Fertilizers

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Fertilizers are regulated by law. All products sold as fertilizers require uniform labeling guaranteeing the minimum percentages of nutrients contained in the product, with a listing of the nutrient sources.

The three-number combination on the product identifies percentages, by weight, of nitrogen (N), phosphorus in the form of phosphate (P_2O_5), and potassium in the form of potash (K_2O) contained in the product. The product may also contain other nutrients such as sulfur, iron, or zinc, and the amounts of these extra nutrients also must be listed as percentage by weight.

Examples of single nutrient products:

Ammonium sulfate (21-0-0) contains 21% N, but no P_2O_5 or K_2O

Blood meal (12-0-0) contains 12% N, but no P_2O_5 or K_2O. *This is an organic fertilizer*.

Triple super phosphate (0-45-0) contains 45% P_2O_5, but no N or K_2O

Bone meal (0-10-0) contains 10% P_2O_5, but no N or K_2O. *This is an organic fertilizer.*

Potassium sulfate (0-0-50) contains 50% K_2O, but no N or P_2O_5

Examples of multi-nutrient products:

Mono-ammonium phosphate (11-52-0) contains 11% N, 52% P_2O_5 , but no K_2O

Potassium nitrate (13-0-44) contains 13% N, no P_2O_5 , and 44% K_2O

Complete fertilizers contain nitrogen, phosphorus and potassium. These are the most common fertilizers available for home gardens. However, phosphorus and potassium are not usually deficient in Colorado gardens, so these nutrients are often being applied when they are not needed. Application of fertilizer nutrients when they are not needed can result in a buildup of unnecessary nutrient in the soil. High levels of nutrients in the soil beyond plant and microbial needs can negatively affect plant growth, and can be a source of pollution to the environment.

Inorganic fertilizers are manufactured by industrial processes. The nutrients in these fertilizers are quickly released for plant use. Time-release or slow release fertilizers have been coated or otherwise formulated to release the nutrients slowly over a period of time.

Organic fertilizers are derived from natural sources. Organic products require microbial activity before nutrients are available for plant uptake. Examples include animal and plant byproducts such as bone meal, blood meal, alfalfa meal, kelp, seaweed, etc. Organic substances approved for use with the USDA National Organic Program have a “USDA Organic” label, which allows for the use of only certain substances (for details refer to www.ams.usda.gov/nop).

CSU Extension has a number of good publications on the use of fertilizers and composts which can be downloaded at www.cmg.colostate.edu. See *GardenNotes* #232 “Understanding Fertilizers”, #234 “Organic Fertilizers”, #241 “Organic Soil Amendments, #243 “Using Compost”, #244 “Cover Crops and Green Manures”, and #245 “Mulching with Wood/Bark Chips, Grass Clippings and Rock”.

Example Calculations of Fertilizer Application Rates

The formula for calculating fertilizer application rates is:

$$\frac{\textbf{Lab recommendation}}{\textbf{Nutrient content of fertilizer}} = \frac{\textbf{lb. nutrient to apply}}{\textbf{lb. nutrient per lb. fertilizer}} = \textbf{lb. of fertilizer to use}$$

Look for the fertilizer analysis on the fertilizer bag. The first number is the nitrogen number. This is the percent by weight of nitrogen contained in the fertilizer. The second number is percent phosphate, and the third number is percent potash.

Example #1: ***Soil analysis of a vegetable garden soil indicates that plant-available nitrogen and phosphorus are low, but all other nutrients are adequate.***

The report recommends adding 0.2 lb. of N and 0.1 lb. of P2O5 per 100 sq.ft.

1. Calculate **nitrogen** application rate for 0.2 lb. N per 100 sq.ft.

   a. Calculation using ammonium sulfate (21-0-0) *(i.e. 21% N, or 0.21 lb. N per 1 lb. fertilizer)*

   $$\frac{\textbf{0.2 lb. N}}{\textbf{0.21}} = \text{0.95 lb. ammonium sulfate per 100 sq.ft}$$
   (about 1 lb. ammonium sulfate per 100 sq.ft.)

   b. Calculation using blood meal (12-0-0) *(i.e. 12% N, or 0.12 lb. N per 1 lb. fertilizer)*

   $$\frac{\textbf{0.2 lb. N}}{\textbf{0.12}} = \text{1.67 lb. blood meal per 100 sq.ft.}$$
   (1 and 2/3 lb. blood meal per 100 sq.ft)

2. Calculate **phosphorus** application rate for 0.1 lb. P_2O_5 per 100 sq.ft.
   a. Calculation using triple super phosphate (0-45-0)

   $$\frac{0.1 \text{ lb. } P_2O_5}{0.45} = \text{0.22 lb. triple super phosphate per 100 sq.ft}$$
   (about ¼ lb. triple super phosphate per 100 sq.ft)

   b. Calculation using bone meal (0-10-0)

   $$\frac{0.1 \text{ lb. } P_2O_5}{0.10} = \text{1.0 lb. bone meal per 100 sq.ft.}$$

3. If using a complete fertilizer that contains N, P and K, e.g. (12-16-4) Vegetable Fertilizer:

   a. Calculation of N addition

   $$\frac{0.2 \text{ lb. N}}{0.12} = \text{1.67 lb. of (12-16-4) Veg. Fertilizer per 100 sq.ft.}$$
   (about 1 and 2/3 lb. of fertilizer per 100 sq.ft.)

b. Calculation of P_2O_5

The (12-16-4) fertilizer adds phosphate as well as N. If you add 1.67 lb. of this fertilizer to fix the nitrogen deficiency, how much phosphate are you adding as well? It contains 16% P_2O_5.

1.67 lb. of (12-16-4) fertilizer X 0.16 = 0.26 lb. of P_2O_5 is added per 100 sq. ft.

But the lab recommended adding 0.1 lb. of P_2O_5 per 100 sq. ft. You have added 0.26 lb. of P_2O_5 instead—this is over 2 ½ times **more** P2O5 than is needed.

Example #2: Soil analysis of a lawn recommends adding 2 lb. N and 1 lb. P_2O_5 per 1000 sq.ft. to the lawn

1. Calculate nitrogen addition using **(27-3-4)** lawn fertilizer (contains 27% N)
   (note: this example is dated; now lawn fertilizers generally contain no P (27-0-4)

   $\frac{2 \text{ lb. N}}{0.27}$ = 7.4 lb. of (27-3-4) lawn fertilizer per 1000 sq. ft.
   (about 7 ½ lb. of fertilizer per 1000 sq.ft.)

2. Calculation phosphate addition from the added (27-3-4) lawn fertilizer (contains 3% phosphate)

   7.4 lb. of (27-3-4) X 0.03 = 0.22 lb. phosphate is being added per 1000 sq.ft.

   But the lab recommended adding 1 lb. of phosphate per 1000 sq.ft.

   You need to add more phosphate to fix the P deficiency in the soil:
   1.0 lb. recommended – 0.22 lb. added = 0.78 lb. phosphate needed per 1000 sq.ft

   Supply the extra phosphate needed with a P-only fertilizer
   e.g. triple super phosphate (0-45-0):

   $\frac{0.78 \text{ lb. P2O5}}{0.45}$ = 1.73 lb. (0-45-0) per 1000 sq.ft.
   (add about 1 ¾ lb (0-45-0) per 1000 sq.ft.)

Converting fertilizer rates to actual square footage:

Example: vegetable garden of 25 x 25 ft. = 625 sq.ft.

1. 1 lb. ammonium sulfate per 100 sq.ft.:(from Example 1)

   $\frac{1 \text{ lb. ammonium sulfate} \times 625 \text{ sq.ft.}}{100 \text{ sq.ft.}}$ = 6.25 lb. ammonium sulfate for the 625 sq.ft. garden

2. 1 .67 lb. blood meal per 100 sq.ft.:(from Example 1)

   $\frac{1.66 \text{ lb. blood meal} \times 625 \text{ sq.ft.}}{100 \text{ sq.ft.}}$ = 10.4 lb. blood meal for the 625 sq.ft. garden

Example: small raised bed vegetable garden of 4 x 8 ft. = 32 sq.ft.

1. 1 lb. ammonium sulfate per 100 sq.ft.:

$$\frac{\text{1 lb. ammonium sulfate}}{\text{100 sq.ft.}} \times \text{32 sq.ft.} = \text{0.32 lb. ammonium sulfate for the 32 sq.ft.}$$

(about 1/3 lb. ammonium sulfate for the raised bed)

2. 1 .66 lb. blood meal per 100 sq.ft.:

$$\frac{\text{1.66 lb. blood meal}}{\text{100 sq.ft.}} \times \text{32 sq.ft.} = \text{0.53 lb. blood meal for the 32 sq.ft. raised bed}$$

(about ½ lb. blood meal for the raised bed)

Example: front lawn of 50 X 70 ft. = 3500 sq.ft.

1. 7.4 lb. of lawn fertilizer (27-3-4) per 1000 sq.ft. takes care of the nitrogen deficiency

$$\frac{\text{7.4 lb. of (27-3-4)}}{\text{1000 sq.ft.}} \times \text{3500 sq.ft.} = \text{25.9 lb. of (27-3-4) for the 3500 sq.ft. lawn}$$

(26 lb. of fertilizer per 3500 sq.ft. lawn)

Some Tips and Suggestions:

1. Consider using mono-nutrient fertilizers (N-only, P-only, etc.) instead of the blends. With a blended fertilizer containing N, P and K, only the N requirement can be calculated accurately and the proper amount of fertilizer added to fix a soil N deficiency. The other nutrients are added at a rate depending on the nitrogen calculation. Nutrients are added when they are not needed, and if a nutrient e.g. P is needed, it is not added at the correct rate.

2. Converting weight to volume:
   a. 2 cups of dry inorganic fertilizer weighs about 1 pound

      1 pound of ammonium sulfate = 2 cups

      ¼ pound of triple super phosphate = ½ cup

      0.32 lb. of ammonium sulfate = 0.64 cups (about 2/3 cup)

   b. Organic fertilizers need to be weighed to determine the cups-to-weight ratio.
      Bone meal: 2 cups of bone meal weighs about 1 pound (same as for inorganic fertilizers)

      Blood meal: 2 cups of blood meal weighs 0.625 pound (it's lighter than bone meal)

$$\text{Pounds blood meal} \times \frac{\text{2 cups blood meal}}{\text{0.625 lb. blood meal}} = \text{Cups blood meal}$$

Pounds of bloodmeal X 3.2 = Cups of bloodmeal