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Fertilizing gardens

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Plants are complete biochemical factories requiring only raw materials — sunshine, air, water, and nutrients. To meet the nutrient needs of a plant, you should try to keep a balance of nutrients in the soil.

Most Idaho soils require annual applications of nitrogen (N). Some soils require phosphorus (P), and soils in a few areas of the state may need potassium (K), sulfur (S), zinc (Zn), and iron (Fe).

A soil test that measures N, P, K, organic matter, and pH in soil from a 0- to 12-inch depth provides important information about available plant nutrients in your garden soil. Soil tests need not be run every year. One test should give you the baseline data you need to correct nutrient imbalances. Follow-up tests may be needed every 3 to 5 years to monitor your fertilization practices.

Take the money you would have spent for an annual soil analysis and purchase a "complete" fertilizer (one containing N, P, K, and S). Phosphorus and K remain in the root zone until plants use them. N, on the other hand, can be harmful if applied in excess as it can burn plants and encourage weak, fast plant growth. Because N is depleted by growing plants and precipitation, you may need to add it every year in moderate amounts.

The type of fertilizer you choose — organic or commercial inorganic — is strictly a matter of personal preference. Both organic and inorganic fertilizers have distinct advantages and disadvantages. Cost of the product or material and ease of handling are two considerations. Others will be addressed later.

Organic fertilizers

A wide variety of plant and animal organic materials is available. Organic gardeners may wish to use the most economical materials and ones readily available from local sources.

Organic materials such as manures and composts are highly desirable for gardens. They supply necessary plant nutrients and improve soil structure, tilth, aeration, and water-holding capacity. They do not change soil texture, however. For clay soils, use long-fibered materials such as straw. For sands, consider a material with more humus such as peat or rotted sawdust.

Nutrients derived from decaying organic materials have the same chemical composition as nutrients from inorganic commercial fertilizers. However, the nutrients in organic materials may not be immediately available to plants because soil microbes must first break them down (decompose them). The nutrients become available over a period of time, sometimes over more than one growing season. Unlike commercial inorganic fertilizers, organic materials offer a valuable source of humus to improve soils.

Organic materials vary widely in their nutrient contents (Table 1). Because their nutrient contents often are low, it can take large amounts of material to supply the needed nutrients.

Table 1. Average N, P, and K contents of organic nutrient sources.

Material	N	P	K
	(%)	(%)	(%)
Alfalfa hay	2.5	0.5	2.0
Blood meal	15.0	1.3	0.7
Bone meal	4.0	21.0	0.2
Coffee grounds (dried)	2.0	36.0	0.7
Cornstalks	0.7	0.4	0.9
Cottonseed meal	7.0	2.5	1.5
Dried blood	12.0	3.0	0
Peat	2.0	0.3	0.6
Sawdust	0.2	0.1	0.2
Wood ashes	0	1.5	3.5

The nutrient content of livestock manure varies with the amount and type of animal waste and with the amount of straw, sawdust, or other bedding material mixed with it. As a general rule, each ton of livestock manure contains

8 to 30 pounds of N (0.4 to 1.0 percent N),

3 to 14 pounds of P_2O_5 (0.5 to 0.6 percent P_2O_5), and

8 to 22 pounds of K_2O (0.5 to 1.0 percent K_2O).

S
83
322
922

Because of this wide variability in nutrient content, it is difficult to know the exact amount of nutrients you are applying.

To apply 2 pounds N on 100 square feet (ft^2) of garden, you would apply about 120 pounds of dry steer manure (Table 2). The amount you apply will vary depending on the amount of bedding material in the manure. If the manure contains no bedding material, you would apply an amount at the low end of the range given in Table 2. If it contains a great deal of bedding, you would apply an amount at the high end.

Table 2. Nitrogen, P, and K contents of dry manures and amounts providing 0.5 pounds of N per 100 square feet.

Manure (dry)	N	P	K	Amount to supply 0.5 lb N per 100 ft^2
	(%)	(%)	(%)	(lb)
Chicken	2 to 4.5	2.0 to 6.0	1.2 to 2.4	11 to 25
Steer	1 to 2.5	0.9 to 1.6	2.4 to 3.6	20 to 50
Dairy	0.6 to 2.1	0.7 to 1.1	2.4 to 3.6	23 to 83
Horse	0.3 to 0.6	0.1 to 0.2	0.3 to 1.0	83 to 166
Pig	0.5 to 1.0	0.3 to 0.7	0.1 to 2.0	50 to 100

To avoid contaminating produce or burning plants, do not apply fresh manure to actively growing plants. Instead, apply composted manure or apply fresh manure the previous fall. Make sure it is mixed well with the soil. Continued heavy applications of manure may increase soil salinity to harmful levels.

It is a good idea to alternate organic with commercial inorganic fertilizers. Some organic materials such as sawdust and straw may require composting before use in the garden.

Commercial inorganic fertilizers

Research has shown that plants produced with commercial inorganic fertilizers are identical in appearance, taste, and food value to plants produced with organic materials and are as safe. Commercial inorganic fertilizers are easy to apply because you need only a relatively small amount. Also, because commercial fertilizers have a guaranteed content analysis, you can measure exact amounts of a nutrient. The many different commercial fertilizers come in a variety of formulations for convenience of handling, and they are readily available (Table 3).

If you have a fertilizer with an analysis not listed in Table 3, look in the table for the fertilizer with the closest analysis and apply its rate or follow package directions. To convert the rates in Table 3 to smaller areas, first divide the area to be fertilized in square feet by 100 square feet. Then multiply by the rate, in cups, given for 100 square feet.

Table 3. Amounts of common inorganic fertilizers providing 0.2 pounds of N per 100 square feet.

Fertilizer analysis (N-P_2O_5-K_2O)	Amount to supply 0.2 lb N per 100 ft^2	
(%)	(lb)	(cups)
2-3-2	10.0	20
4-10-4	5.0	10
6-10-4	3.4	6.5
8-10-8	2.4	5
10-10-5	2.0	4
12-12-5	1.6	3.5
15-10-0	1.2	2.5
16-20-0[1]	1.1	2.5
20-16-0	1.0	2
21-0-0[2]	1.0	2
33-0-0	0.6	1.25
45-0-0	0.4	1

Note: The fertilizer analysis is shown on all containers. The first number gives percentage total nitrogen (N); the second, percentage available P_2O_5; the third, percentage water-soluble K_2O. A fertilizer with a 2-3-2 analysis contains 2 lb N, 3 lb P_2O_5, and 2 lb K_2O per 100 lb of fertilizer. A fertilizer with a 16-20-0 analysis contains 16 lb N, 20 lb P_2O_5, and no K_2O per 100 lb of fertilizer. A fertilizer with a 45-0-0 analysis contains 45 lb of N and no P or K per 100 lb of fertilizer. Other mixes may contain Zn and other micronutrients. Check the label. All nutrients in the fertilizer will be listed.

[1]16-20-0 contains 15 percent S.

[2]Ammonium sulfate (21-0-0) contains 24 percent S.

For example:

1. Area 8 ft by 10 ft, fertilizer analysis 4-10-4, and rate of application 10 cups per 100 ft^2 block (from Table 3):

   8 ft × 10 ft = 80 ft^2

   80 ft^2/100 ft^2 = 0.8

   0.8 × 10 cups (rate of application) = 8 cups

   Apply 8 cups of a 4-10-4 fertilizer to a 8 ft by 10 ft block.

2. Row 2 ft by 20 ft, fertilizer analysis 6-10-4, and rate of application 6.5 cups per 100 ft^2 (from Table 3):

   2 ft × 20 ft = 40 ft^2

   40 ft^2/100 ft^2 = 0.4

   0.4 × 6.5 cups (rate of application) = 2.6 cups

   Apply 2.6 cups of a 6-10-4 fertilizer to a 2 ft by 20 ft row.

Application methods

Gardens

You can apply the fertilizer on the surface and mix it into the soil. This is called broadcasting. Another method is to band the fertilizer 2 inches to one side of the row and 3 inches deep. This is called banding (Fig. 1). You can also apply fertilizer to the soil surface after plant emergence. This is called side-dressing (Fig. 2).

Nitrogen fertilizer can be applied to the surface and incorporated into the soil with irrigation water or rainwater. Phosphorus and K do not move as readily with

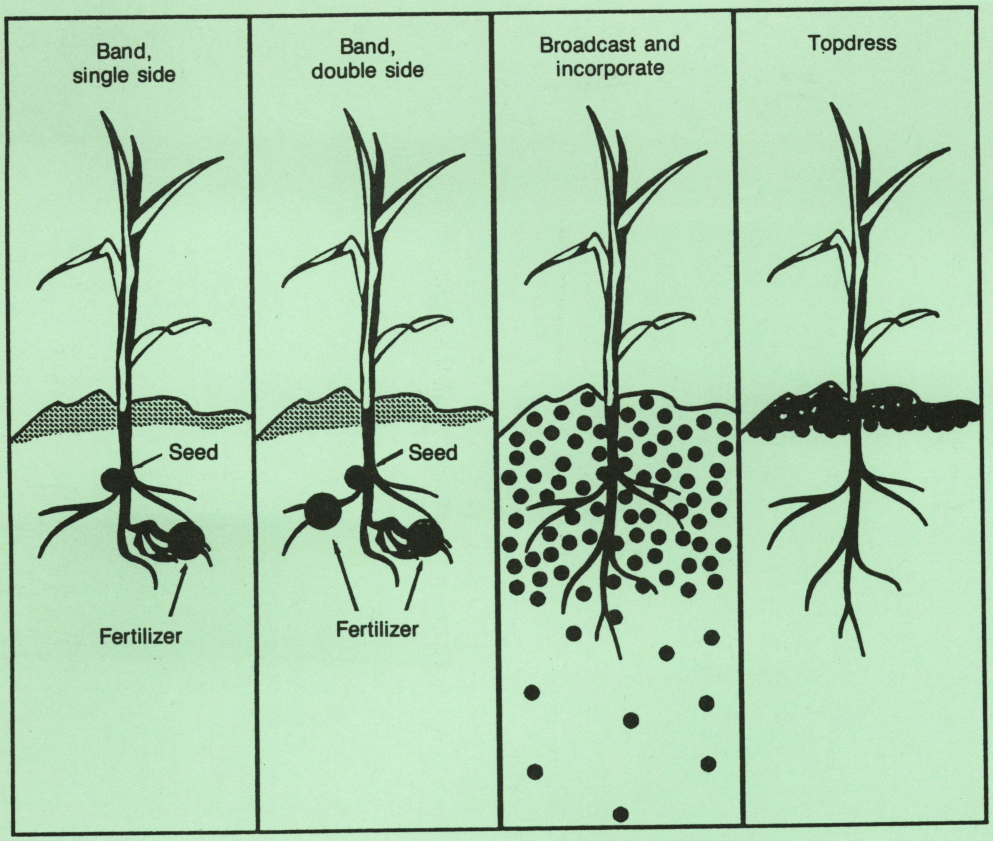

Fig. 1. Fertilizer placement. Banded fertilizer concentrates in a small zone. Broadcast and incorporated fertilizer distributes evenly to the depth of mixing.

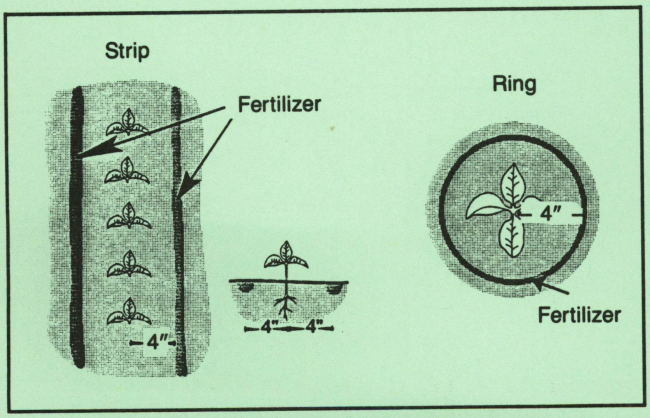

Fig. 2. Side-dressing individual plants and garden rows. When rainwater or irrigation water moves a side-dressing into the soil, its distribution resembles that of banded fertilizer.

water and therefore should be mixed into the soil whenever possible.

Shrubs and trees

Spread fertilizer around the base of the plant inside the perimeter of the top growth. This perimeter is called the dripline. The amount of fertilizer to apply depends on the size of the plant. One-half pound of N per 1 inch trunk diameter (caliper) at chest height is a good rule of thumb for trees. For small shrubs, apply 1 cup of 21-0-0 fertilizer at the dripline. Divide fertilizer applications in two, applying one-half in early spring and one-half in late fall.

Lawns

Keep in mind that established lawns require 0.5 to 1.0 pound of N per 1,000 square feet per month of active growth. Lawn fertilizers should contain N, P, and K in a 3:1:2 ratio. For established grass lawns, N is the principle fertilizer nutrient needed.

Divide the total fertilizer amount into three or four applications. Make the first two applications in fall (September through November), the next one in early spring, and the final one in late May or early June. Avoid fertilizing turf during the heat of summer when cool-season grasses are semidormant.

To avoid severe foliage burns, do not apply fertilizer to wet lawns unless large amounts of irrigation water or rain will immediately follow the application.

Iron

Iron (Fe) may be needed on shrubs, lawns, fruit trees, and ornamental trees and shrubs grown on alkaline soils in southern Idaho. Iron deficiencies — shown by chlorosis or yellowing of the foliage, especially on new growth — are quite common. You can correct Fe deficiency with either soil or foliar applications of Fe.

For soil applications, apply a chelated Fe at rates shown on the label. For best results, poke 12-inch holes into the soil around the plant's dripline with a soil probe, hollow metal tube, or shovel. Mix the Fe product in

water and fill up the holes. Follow package label directions and apply in spring or fall to avoid burning plants.

To apply Fe as a foliar spray, use a solution containing 0.5 percent ferrous sulfate or a chelate at rates shown on the package label. Keep in mind that foliar applications of Fe are only a temporary solution and do not last as long as soil-applied materials. Soil pH may need to be altered for a long-term solution.

Zinc

Zinc deficiencies are rare in garden soils with at least 2 percent organic matter. Zinc (Zn) deficiency shows up on ornamentals and fruit trees as very small leaves and "rosetting" of new growth. Rosetting means that leaves grow around the tips of branches and twigs, but foliage is sparse below branch tips. Zinc can be applied in the same ways as Fe. Make soil applications during the late-dormant season, usually in February or early March. Foliar sprays are best for fruit trees, but for most plants, soil applications are best. Zinc is often available in mixtures with N, P, and K.

Sulfur

Sulfur (S) is needed on lawns in most areas of Idaho. If S is not in the fertilizer mix, apply it separately as gypsum or its equivalent at 1 cup per 100 square feet of area.

Soil pH

Most plants grow best in garden soils with pH values between 5.5 and 7.0. If the garden soil is too acidic (pH less than 5.5), lime ($CaCO_3$) may be added to raise the soil pH (Table 4).

Table 4. Amounts of lime ($CaCO_3$) to raise soil pH.

Initial soil pH	Desired soil pH	$CaCO_3$ per 100 ft²	
		(lb)	(cups)
5.5 to 6.0	6.5	15	30
5.0 to 5.5	6.5	20	40
4.5 to 5.0	6.5	25	50

In garden soils that are too alkaline (pH greater than 7.5), elemental S can be applied to lower the soil pH (Table 5). Before attempting to alter soil pH, obtain an accurate pH test.

Table 5. Amounts of elemental S to decrease soil pH.

Initial soil pH	Desired soil pH	S per 100 ft²	
		(lb)	(cups)
7.5	6.5	1.5	3
8.0	6.5	3.5	7
8.5	6.5	4.0	8
9.0	6.5	6.0	12

Points to remember

1. Check the fertilizer analysis on the bag or container.
2. Apply the fertilizer at the rates given in this publication or on the fertilizer container.
3. Work fertilizer well into the soil.
4. Don't guess at rates; measure or weigh the fertilizer product.

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