A2304

# Garden fertilization

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The best way to determine how much lime and fertilizer your garden needs is to have your soil tested. Soil tests also help prevent over-fertilization, saving you money and helping to protect the environment.

For instructions on how to sample soils for testing, see *Sampling Garden and Turf Areas for Testing* (A2166).

This publication discusses how to use soil test results and how to apply the recommended fertilizers to your garden for best flower and vegetable production.

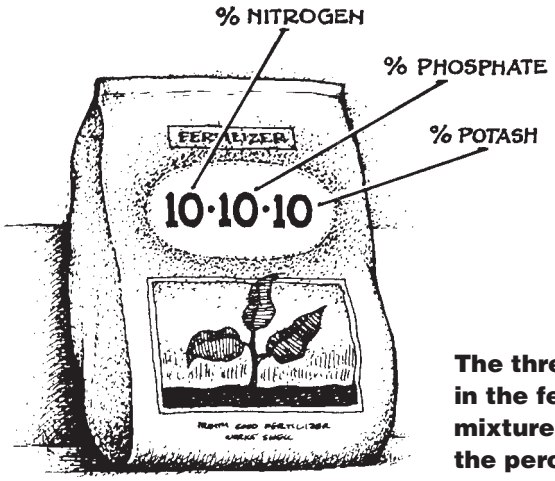
## Using the soil test report

Once your soil has been tested, you will receive a soil test report. The report gives an interpretation of the relative amount of nutrients in the soil sample that are available for plants to use and identifies the amount of nutrients needed for good flower and vegetable production. These recommendations are in pounds (lb) of nitrogen (N), phosphate ($P_2O_5$), and potash ($K_2O$), per unit area, usually 100 $ft^2$. The soil test report also will suggest a type, or grade, of commonly available fertilizer that you could use to meet the nutrient needs of your garden.

**Understanding fertilizer grades.** To understand fertilizer materials, you must know that each fertilizer grade consists of three numbers, such as 10-6-4. These numbers show the percentage of nitrogen, phosphate, and potash, respectively, contained in the mixture. Use the equation in the box below to calculate the actual amount of each nutrient in a bag of fertilizer.

If you do not already have on hand or cannot buy the specific grade of fertilizer recommended on the soil test report, you may substitute fertilizers having a similar ratio of nutrients. For example, 5-10-5 or 5-9-7 can be used in place of 10-20-10. In this example, you will need to apply twice as much of these grades because these materials are only half as concentrated as 10-20-10.

Very high or excessive levels of phosphorus (P) and/or potassium (K) occasionally build up in garden soils, primarily because of past use of commercial fertilizer, manure, or compost with very limited nutrient removal in the form of harvested produce or flowers. When this occurs, the recommendations on the soil test report show that you




**The three numbers in the fertilizer mixture stand for the percentage of each nutrient.**

**Calculating how much of each nutrient is in a bag of fertilizer**

NUTRIENT WEIGHT
= total bag weight X percentage of each nutrient

For example, a 50-lb bag of 10-6-4 fertilizer contains:

| | | |
|---|---|---|
| Nitrogen (N): | 50 lb x 0.10 | = 5 lb |
| Phosphate ($P_2O_5$): | 50 lb x 0.06 | = 3 lb |
| Potash ($K_2O$): | 50 lb x 0.04 | = 2 lb |

won't need one or both of the nutrients. If a mixed grade of fertilizer containing all three nutrients is applied in these cases, the soil test level will continue to increase.

As noted, if the phosphorus test is very high, no phosphate will be recommended, so applying a fertilizer that does not contain phosphate would be preferable. However, fertilizers such as 10-0-10 or 20-0-10 are often not commercially available. Instead, use a complete mixed fertilizer that contains a low percentage of the nutrient that is high in your soil. For example, for soils with high levels of phosphorus, use 10-5-10, 20-5-10, or 25-5-5. For soils with too much potassium, use 10-6-4, 20-10-5, or 25-5-5.

Better still, you can apply nitrogen and phosphorus or nitrogen and potassium separately, omitting the high-testing nutrient. If the phosphorus test is high, apply the recommended amount of nitrogen as ammonium nitrate (33% N) or urea (45% N), and the potash as muriate of potash (60% $K_2O$) or sulfate of potash (50% $K_2O$). If the potassium test is high, apply the nitrogen as above and the phosphate as ordinary superphosphate (20% $P_2O_5$) or triple superphosphate (46% $P_2O_5$).

**How much fertilizer do you need?** To determine how much of a given fertilizer to apply, use the equation provided in the box below.

If you don't have a scale for weighing fertilizer and lime, estimate the amount to apply by using a volume measure instead of weight. Approximate equivalent volume measures are listed in the following table for some common fertilizer materials and lime.

### How much fertilizer do you need?

**AMOUNT FERTILIZER NEEDED**
**= amount nutrient recommended ÷ percent nutrient in fertilizer**

Suppose the soil test report calls for 0.3 lb potash/100 $ft^2$. To figure out how much muriate of potash or sulfate of potash to apply, plug the following numbers into the equation:

Muriate of potash (0-0-60): 0.3 lb ÷ 0.60 = 0.5 lb
Sulfate of potash (0-0-50): 0.3 lb ÷ 0.50 = 0.6 lb

### Converting between fertilizer weights and volumes

| Material | Weight (lb) | Volume[a] (pt) |
|---|---|---|
| Most mixed fertilizers (10-6-4, 10-10-20, 20-10-10, etc.), Ammonium sulfate (21-0-0), Muriate of potash (0-0-60), Superphosphates (0-20-0 and 0-46-0) | 1 | 1 |
| Activated sewage sludge, Processed manure, Urea (45-0-0), Ammonium nitrate (33-0-0) | 1 | 1.33 |
| Sulfate of potash (0-0-50), Ground (dolomitic) limestone | 1 | 0.75 |

*[a]For smaller quantities: 1 pint = 2 level cups = 32 level tablespoons = 96 level teaspoons. (To convert, multiply pints by smaller amounts.)*

### Don't have a scale? Convert fertilizer weight to volume.

You can estimate the amount of fertilizer needed based on the volume using this easy conversion chart. For example, suppose the recommendation calls for 3 lb of ammonium nitrate (33-0-0). From the table we find that 1 lb of ammonium nitrate equals 1.33 pt. So 3 lb (weight) = 1.33 X 3 = 4 pints (volume).

## About organic fertilizers

Many organic materials can be used to supply plant nutrients in home gardens. The nutrient recommendations in pounds of nitrogen, phosphate, and potash per 100 $ft^2$ can be met by organic as well as inorganic sources. An advantage of organic materials is that these materials also improve soil structure (tilth) and the moisture-holding ability of the soil. For a list of organic amendments and their composition, see Extension publication *Organic Soil Conditioners* (A2305).

## About lime

Your soil test report will tell you if and how much lime is needed. In southern Wisconsin, urban soils often do not need lime because the water used for watering contains lime. A soil pH of 6.2–7.0 is ideal for most gardens. High soil pH can be a problem as it reduces the availability of phosphorus, boron, iron, manganese, and zinc.

## Applying commercial fertilizers

**Before planting.** Broadcasting is the most practical way to apply fertilizer and the only effective way to apply limestone. Spread the material uniformly over the soil and work it into the upper 4–6 inches. Incorporation is especially critical when applying lime, as lime is not very soluble and will not dissolve or move readily in the soil without tillage.

When applying large amounts of fertilizer (more than 2 lb/100 $ft^2$), split the application. Apply about two-thirds before spading, rototilling, or plowing and work the remaining one-third into the upper few inches of soil after soil preparation.

When applying smaller amounts of fertilizer (less than 2 lb/100 $ft^2$), broadcast about three-fourths of the fertilizer after the soil has been prepared and work it lightly into the soil. Apply the rest at planting time in a band alongside the row, as discussed in the following paragraph.

**At planting.** Use band placement to get vegetable plants off to a good start. Place fertilizer in a narrow furrow or band 2–3 inches from the seed row and 2–3 inches deep. For widely spaced plants—such as tomatoes, cucumbers, squash, and melons—place a circular band of fertilizer around each plant.

In vegetable gardens needing only small amounts of fertilizer, you can apply all the fertilizer in bands. To fertilize a single row or plant, multiply the length of the row or distance between plants by the width between the rows or plants to obtain area, and then fertilize accordingly. (See example below.)

For transplants such as tomato and cabbage, add an additional small amount of soluble fertilizer to transplant water to help plant recovery and increase yield. Select soluble complete fertilizers that contain a high proportion of phosphate and follow package label directions carefully.

### Fertilizing small gardens

**SQUARE FOOTAGE/ROW = row length (ft) X row width (ft)**
**AMOUNT NEEDED = (square footage/row ÷ 100 $ft^2$) X recommendation**

Say you have a single row that's 10 feet long and 3 feet wide and you need to apply 0.25 lb of ammonium nitrate/100 $ft^2$. To calculate the amount needed for the row:

Square feet per row: 10 ft X 3 ft = 30 $ft^2$

Pounds needed per row: (30 $ft^2$ ÷ 100 $ft^2$) X 0.25 lb = 0.075 lb

To convert the result to smaller units of measure:

Ounces (oz) per row: 0.075 lb X 16 oz/lb = 1.2 oz

Tablespoons (tbsp) per row:

0.075 lb X 1.33 pt/lb X 32 tbsp/pt* = 3.2 tbsp

**If you wish to convert to cups or teaspoons, substitute 2 or 96, respectively, for 32 tbsp/pt.*

Most commercial fertilizers have a high soluble salt content that can damage seeds and plants. This is known as salt injury or "fertilizer burn." To avoid damage, it is important to follow label directions on fertilizer packages and place all fertilizer bands away from seeds and roots.

**During the growing season.** Usually, your garden will need a midseason application of nitrogen for normal growth—especially on sandy soils and/or during rainy years.

## Fertilizing vegetables

Most vegetables need about 0.25 lb (⅔ cup) of ammonium nitrate (33-0-0), 0.20 lb (½ cup) of urea (45-0-0), or 0.38 lb (¾ cup) of ammonium sulfate (21-0-0)/100 $ft^2$. Apply in a relatively wide band at least 3–4 inches from the vegetable row. If nitrogen fertilizers are not readily available, substitute a complete fertilizer high in nitrogen, such as 20-10-10, 25-5-5 or 30-3-3, at 0.38 lb (¾ cup)/100 $ft^2$. In most situations, and especially on sandy soils, it is best to hold back about one-fourth of the fertilizer for later application. This remaining fertilizer should be applied after the plants are half-grown for leafy crops, greens, tomatoes, sweet corn, cucumbers. Too much nitrogen will cause excessive leaf growth but little tuber or fruit production.

## Fertilizing flowers

**Annual flowers.** On annual flower beds, use the fertilizer rate suggested on the soil test report to ensure good growth and many flowers. If the fertilizer material contacts the foliage, spray the plants with a fine mist of water to remove fertilizer from leaves, which can cause foliage burn.

**Perennial flowers.** In established plantings, apply half the rate of recommended fertilizer to most perennial flower beds each spring when growth begins. This application will stimulate plant growth and bloom. Repeat the above treatment in late June or early July. Broadcast the fertilizer over the area, but keep the material away from bulbs, stems, and 2–4 inches from perennial crowns.

Spring-flowering bulbs—such as tulip, hyacinth, daffodil, narcissus, and crocus—should be fertilized in spring when the plants are above ground. If foliage is pale-green and undersized after flowering, apply additional fertilizer at about one-fourth of the original rate.

Special rose fertilizers are available. Many of these are excellent but may cost more than a standard fertilizer grade which will work just as well. Apply one-third of the suggested rate and grade of fertilizer about mid-May, in mid-June before or just at flowering, and again about mid-July. Broadcast the fertilizer in a circular area about 6–8 inches from the plant crown.

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