

Fertilizing Your Garden: Vegetables, Fruits, and Ornamentals

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Plants need an adequate level of nutrients to thrive. This publication will help you ensure that your plants receive ample levels of all nutrients for optimum yield, quality and aesthetic value. It discusses:

- Factors involved in plant growth.
- Types of fertilizer.
- How much fertilizer to apply.

The fertilizer recommendations in this guide are based on soil test results. See EC 628, [A Guide to Collecting Soil Samples for Farms and Gardens \(https://catalog.extension.oregonstate.edu/ec628\)](https://catalog.extension.oregonstate.edu/ec628).

How big is your garden?

To know how much fertilizer to apply, you need to know how big your garden is. To find the square footage of your garden, multiply the width times the length. For example, if your garden is 30 feet long and 10 feet wide, it totals 300 square feet (30 x 10).

The tables in this publication recommend quantities of fertilizer material to apply per 100 square feet. For a 300-square-foot garden, you need three times as much fertilizer as you need for a 100-square-foot garden.

Plant growth

Some factors in plant growth — soil, nutrients, and soil pH — are discussed below. These are only a few of the factors involved in healthy plant growth. Other important practices include plant spacing; insect, weed and disease control; irrigation; and timely harvest.

Soil

In many cases, garden soil suffers from a variety of problems. For example:

- Topsoil often is removed or covered with fill material during construction. Although a 2- to 4-inch layer of topsoil may be placed over fill, this shallow layer may not support vigorous plant growth without improvement.
- Heavy construction equipment may compact soil, this slowing root growth and water movement.

- Construction wastes may be buried near the house. These hidden wastes can lead to sudden death of plants.
- Many soils are naturally "heavy" due to high clay content.

You can't solve these kinds of problems simply by adding fertilizer. In all of these cases, you need to improve the structure of your soil. The most effective way to improve soil structure is by adding organic matter, such as composted plant material or manure. These materials increase soil workability at the same time they provide nutrients. Since organic matter is "used up" over time, you'll need to add it on a regular basis. Gypsum can improve structure in eastern Oregon where sodium (Na) is a problem and soil pH is above 8.5, but it does not appreciably improve clay soils in western Oregon.

Nutrients

The three key nutrients for plant growth are nitrogen (N), phosphorus (P) and potassium (K). These nutrients are contained in most commercial fertilizer mixes. Other materials you may need to add are lime, sulfur, magnesium and boron.

Nitrogen is important for healthy plant growth. It usually needs to be applied each year because rain and irrigation remove most of the nitrogen not used by plants. Phosphorus is essential for vigorous growth of seedlings, especially in cool, wet, spring weather. Potassium is important for disease resistance and starch formation.

Plants use the most nitrogen during or just before the time of rapid growth. For most plants, this is the best time to add nitrogen.

If you apply nitrogen fertilizers late in the growing season, most plants can't efficiently utilize the nitrogen, and the excess is likely to remain in the soil after the growing season. This extra nitrogen is not a groundwater problem in the dry climate of central and eastern Oregon. In western Oregon, however, winter rains will move nitrogen in the form of nitrate below the root zone and possibly deposit it in groundwater. Nitrate in groundwater is a contaminant that poses a health risk.

pH

Soil pH is a measure of how acidic or alkaline a soil is. A soil with low pH (below 7.0) is acidic, while a soil with high pH (above 7.0) is alkaline (basic).

Vegetables gardens produce well in a soil pH of 6.0–7.0, and lawns do well in a pH of 6.0. "Acid-loving" plants such as azaleas, blueberries and rhododendrons require a soil pH below 6.0 and preferably 4.5 to 5.5.

If soil pH is too low, add lime to make the soil less acidic. Use 5 to 10 lb lime per 100 square feet if mixing into the soil before planting. For established lawns or plants, add 5 lb per 100 square feet. Retest soil pH three to six months later to see whether you've achieved the target pH.

You can use various methods to acidify the soil if pH is too high. A soil pH greater than 7.0 is uncommon west of the Cascades, so gardeners in western Oregon typically need to acidify their soil only if they are growing acid-loving plants. Many soils in the east side of the Cascades are very alkaline, and need to be acidified for all crops.

Types of fertilizer

Opinions vary concerning the merits of manures or other organic fertilizers versus "chemical" fertilizers. Excellent gardens may be grown using either method. Plants do not differentiate between nutrients from organic and chemical fertilizers; the form absorbed by plant roots from both sources is identical.

Plants can use chemical fertilizers as soon as they are applied. Soil bacteria and fungi must act on most organic nutrient sources to change them into a usable form. Thus, if you use mostly organic fertilizers, you may need to add a small amount of a source of more readily available nitrogen early in the season to ensure adequate plant nutrition until the organic sources become available to plants. Options include liquid fish, blood meal and chemical fertilizer.

Packages mixes

Both chemical and organic fertilizers are available as package mixes containing N, P, K and sometimes sulfur (S). Package labels tell how much of each nutrient the fertilizer contains.

The nutrients always are listed in this order on the label: nitrogen-phosphorus-potassium. Thus, a fertilizer labeled 5-15-10 contains 5% nitrogen, 15% phosphorus (in the form of phosphate), and 10% potassium (in the form of potash). In other words, every 10 pounds of this fertilizer material contains 0.5 pound nitrogen, 1.5 pounds phosphorus, and 1 pound potassium (10 lb material x 0.05 N = 0.5 lb N).

If a fourth number is listed, it represents sulfur. Thus, a 5-15-10-10 fertilizer also contains a 10% concentration of sulfur (in the form of sulfate).

The remaining components of the fertilizer material include carbon, hydrogen, oxygen and coating materials.

Many fertilizers are labeled for specific uses such as roses, azaleas, or vegetables. These specialty blends generally are an expensive alternative to standard blends applied at an adequate rate.

Unblended organic sources

Wood ash

Wood ash is a good source of potassium. You can use ash as a fertilizer and liming material on vegetable gardens, flower beds, lawns, and most shrubs. It's particularly useful on acid soils low in potassium.

The fertilizer value of wood ash depends on the type of wood burned. Generally, hardwoods weigh more per cord than softwoods and yield more ash per pound of wood. Their ash also contains higher percentages of nutrients.

Ash from a cord of oak meets the potassium needs of a garden 60 feet by 70 feet (4,200 square feet), and ash from a cord of Douglas-fir, a garden 30 feet by 30 feet (900 square feet). Both contain enough calcium and magnesium to reduce soil acidity slightly. See Table 4b for application rates.

Elements in ash are water-soluble. Therefore, always store ash in a dry place until you're ready to use it.

Apply ashes evenly, and if possible mix them into the soil. Never leave ashes on the surface in lumps or piles. If ashes are concentrated in one place, excessive salt leaches into the soil, creating a harmful environment for plants. Spreading wood ashes in a thin layer over your lawn is a safer application than to use them in your garden, where they are more likely to be concentrated in the soil.

Be aware of several precautions if you use wood ashes:

- Don't apply wood ashes to acid-loving plants such as blueberries, rhododendrons and azaleas.
- You may have problems with potato scab, a fungus disease, if you use ashes where you grow potatoes.
- Don't add fertilizer containing nitrogen in the form of ammonium immediately after adding wood ash; the presence of ash can result in the loss of ammonia.
- Don't add fresh ashes to newly germinated seeds.
- Some types of ash are not safe to use on plants, including coal ashes, ashes from lead-painted or chemically treated wood, and ashes from fireplaces or incinerators where trash has been burned.
- Don't use ashes in eastern and southeastern Oregon, where soils are naturally high in potassium and soil pH.
- If the potassium soil test value is above 600 ppm, do not apply wood ashes for 5 years.

Grass clippings

A 6- to 8-inch layer of grass clippings can be added to gardens as a fertilizer material. Grass clippings are a good source of potassium. Do not use fresh clippings from weedy lawns, bentgrass lawns, or turf with rhizomes. These sources may introduce weeds and unwanted grass.

Manure

Manure can modify the soil structure and water-holding capacity of a garden. In fact, these benefits often are greater than the nutrient benefit of manures.

Manures are extremely variable in their nitrogen content. Table 1 shows typical nutrient contents of various types of manure. As little as 20 pounds of poultry droppings or as much as 150 pounds of manure mixed with straw, shavings or sawdust may be required for each 100 square feet.

More than 50% of the nitrogen in manure can be lost during storage or after it is applied to the soil surface. Nitrogen loss is least when fresh manure is spread in the fall and worked into the soil immediately.

Manures often contain weed seeds. Some of these weeds may be very difficult to control. In addition, manure that has been in contact with soil may contain symphylans, insects that can be very damaging to plant roots.

Don't use fresh manure in vegetable gardens. The manure may contain disease-causing organisms that can make people sick when they eat the vegetables.

Table 1. Nutrient content of manures

Kind of manure	Water and nutrient content (%)			
	Water	N	P ₂ O ₅	K ₂ O
Dairy	87	0.50	0.16	0.44
Beef	82	0.65	0.43	0.53
Poultry	73	1.30	1.02	0.50
Swine	84	1.45	0.27	0.40
Sheep	73	1.00	0.36	1.00
Horse	60	0.70	0.25	0.60

Blood meal

Blood meal applied at 1.5 to 2 pounds per 100 square feet is another good source of organic nitrogen.

Methods of applying fertilizer

Three ways to apply fertilizer are described below. Regardless of the method you use, keep the following facts in mind:

- The nitrogen in chemical fertilizers is highly water-soluble and is carried to the roots by irrigation and rain. Thus, you don't need to mix these materials into the soil, but you do need to water your garden if rain doesn't fall within a day after you apply them.
- Organic sources of nitrogen are most accessible to plants if mixed into the top 2–3 inches of soil.
- Phosphate moves slowly in the soil. You'll obtain best results by banding phosphate-containing fertilizer 2 inches below the seed when you plant or by tilling it into the soil during spring preparation.
- Work potassium fertilizers into the soil using the banding or broadcast methods. Do not allow potassium fertilizer to contact plant roots.

Broadcast

Scatter the material uniformly over the surface. If an application method is not mentioned, broadcasting is implied.

Band

Place the fertilizer in a trench about 3 inches deep. The corner of a hoe works well to make the trench. Sow seeds 1 1/2 to 2 inches above and to the side of the fertilizer. The plant roots quickly absorb the nutrients and grow rapidly.

Sidedress

Scatter the fertilizer material close to growing plants. Keep fertilizer granules off leaves to prevent burning. Nitrogen is very soluble and need not be mixed with the soil. A fertilizer blend containing nitrogen, phosphate, and potash should be lightly scratched in, but take care to avoid damaging plant roots. Apply irrigation so the plants can absorb the nutrients.

Vegetable gardens

Before planting

If you use a packaged fertilizer mix (organic or chemical)

Use Table 3 to determine how much fertilizer to apply before planting. The tables are based on soil test results for phosphorus and potassium. If you follow these recommendations, you'll automatically apply sufficient nitrogen for initial growth of newly planted seeds and plants.

If you live in western Oregon, choose a fertilizer mix that also contains sulfur (S). Look for a fourth number on the fertilizer package, e.g., 10-10-10-10. In central Oregon, you may wish to try a sulfur-containing fertilizer on a trial basis.

If you use unblended organic sources

Use Table 4a for manure application rates. If the soil test for phosphorus is low, add P according to Table 4c. Additional potassium usually isn't needed unless the soil test for potassium is less than 300 ppm.

All of the nutrients in manure are not completely available for first year. Approximately 75 percent of the nitrogen from poultry manure is available the first year, while only 25%–50% of the nitrogen from other manures may be available during this time. Thus, during the first 3 years of manure application, add a source of more readily available nitrogen such as liquid fish, blood meal, or chemical fertilizer. Or triple the amount of manure you use (column 1 in Table 4a).

A note about boron

Many soils in western Oregon are deficient in boron (B). Several crops (cabbage, broccoli, cauliflower, caneberries, strawberries, beets, carrots, etc.) can benefit from an application of boron.

If the soil test for boron is less than 1 ppm, apply household or agricultural grade borax (11% B) at the rate of 1 tablespoon 100 square feet where boron-requiring plants will be grown. Apply the borax evenly and mix thoroughly with the soil. It may be easier to dissolve 1 tablespoon of borax in 1 gallon of water and apply the solution evenly with a sprinkling can. Apply 1 fluid ounce of solution per plant. You can find borax in the cleaning supplies section of most grocery stores.

Be careful! Excessive quantities of boron are highly toxic to plants, especially young bean plants. One application should be sufficient for up to three years or until another soil test is made.

During the growing season

Nitrogen is needed for continued healthy growth. If you notice a pale green or yellow color and a slower rate of growth about 4–5 weeks after planting, your vegetable plants may need additional nitrogen.

Sidedress 1/2 cup of ammonium sulfate (21-0-0-24) or equivalent fertilizer per 10 feet of row, and then water the plants. Do not apply this extra nitrogen to peas or tomatoes. If other nutrients have been omitted, you can add them at this time.

Fruit trees

To determine fruit trees need for fertilizer, observe tree growth, as well as the size and color of leaves and fruit. Young trees should grow 18-30 inches each year. You also can have a laboratory do a leaf analysis to determine which nutrients are present in leaf tissue in adequate, deficient, or excessive amounts. To determine the need for lime or sulfur, perform a soil test.

Nitrogen probably is the only nutrient needed in most home orchards. Apply according to Table 2 in the spring around the time the trees finish blooming. Broadcast the fertilizer under the entire canopy of the tree. Be careful! One- and two-year-old trees can be injured if nitrogen is banded around the tree.

Table 2. Fertilization rates for fruit trees *

Tree age (years)	Pounds of fertilizer to apply (per tree)**	
	Apples, pears, prunes	Cherries, peaches
1	0-1.25	0-5
2	2.5	5

Tree age (years)	Pounds of fertilizer to apply (per tree)**	
	Apples, pears, prunes	Cherries, peaches
3-5	2.5-3.25	5-7.5
6-7	3.5-5	7.5-10

* Based on 10%-nitrogen fertilizer. For 5%-nitrogen fertilizer, multiply by 2. For 20%-nitrogen fertilizer, divide by 2.

** 1 pound of fertilizer usually equals about 2 cups.

Phosphorus also is needed in the Hood River area. Add 1/4 pound P_2O_5 when you plant your trees.

Suspect a nutrient deficiency if poor tree performance cannot be explained by lack of pruning, poor pollination, disease, winter injury, deep cultivation, insects, physical injury, limited moisture, rodents, poor weather, and/or poor soil drainage.

Ornamental shrubs

In general, if your ornamental shrubs are growing well, there is no need to fertilize them.

Azaleas, blueberries, and rhododendrons may require special care. These acid-loving plants require a soil pH below 6.0 and preferably below 5.5. They grow best when soil pH is 4.5 to 4.8.

If your soil pH is above 5.0

Fertilize acid-loving shrubs with ammonium sulfate (21-0-0-24) to lower soil pH. For mature bushes, use 2/3 to 3/4 pound (about 1 1/3 to 1 1/2 cups) ammonium sulfate per bush. For younger plants, use one-third to one-half as much, depending on age.

For lower analysis organic materials, increase the application rate proportionally. For example, if the organic material has an analysis of 7-3-2, use three times the amount listed above (4 cups per mature bush or 1 1/2 to 2 cups for younger plants).

If your soil pH is below 5.0

Use any of the fertilizer recommendations in Tables 3-4 for your acid-loving plants. Use Table 3 for packaged mixes, either for packaged mixes, either organic or chemical. For unblended organic sources, use Tables 4a-4c.

For azaleas and rhododendrons, fertilize around the time the plants bloom. For blueberries, which are both shallow rooted and inefficient in using nitrogen fertilizer, it's best to split fertilizer over two or three applications. Apply half before bud break in the spring and half about six weeks later. Or, if using three applications, apply one-third at each of the above times and the last application no later than July 1.

Flowers

In cool, wet spring weather, phosphorus can enhance early growth, so apply phosphorus-containing fertilizer before planting. Use Table 3 for packaged mixes, either organic or chemical. For unblended organic sources, use Tables 4a-4c. Be sure to work phosphorus and potassium into the soil. Do not allow potassium fertilizers to contact plant roots.

An annual flower planting may or may not require additional fertilizer during the growing season. If the soil fertility is low, fertilize at a rate of 1/2 to 1 pound (about 1 to 2 cups) of 5-10-5 per 100 square feet every 4 to 6 weeks. Sprinkle the fertilizer lightly around the plants and scratch it into the soil. Additional fertilizer may be necessary if you use an organic mulch.

Caneberries and roses

You can meet the needs of caneberries and roses for nutrients by following the recommendations in Tables 3-4. Use Table 3 for packaged mixes, either organic or chemical. For unblended organic sources, use Tables 4a-4c. If you use wood ashes, apply no more than 1/2 to 1 cup per plant per application. Spread the ash over a 1-square-foot area around the base of the plant. Apply during the dormant season. If cane growth is excessive, use less fertilizer in following years.

Strawberries

You can meet the needs of strawberries for nutrients by following the recommendations in Tables 3-4. Use Table 3 for packaged mixes, either organic or chemical. For unblended organic sources, use Tables 4a-4c. Fertilize June-bearing strawberries around August 1, and then water the plants to move the fertilizer into the soil.

Table 3. Recommendations for fertilizer mixes — organic and chemical

If soil test for phosphorus is (ppm)	Soil test for potassium is (ppm)	Use this kind of fertilizer*	Apply this much (pounds per 100 square feet)
Western Oregon			
Less than 25	0-300	15-15-15	2
Less than 25	Greater than 300	16-20-0	2
25-60	0-300	15-15-15	1.5
25-60	Greater than 300	16-20-0	1.5
Greater than 60	0-300	15-15-15	1.5
Greater than 60	Greater than 300	21-0-0	1.5
Eastern Oregon			
Less than 10	0-300	15-15-15	2
Less than 10	Greater than 300	16-20-0	2
10-20	0-300	15-15-15	1.5
10-20	Greater than 300	16-20-0	1.5
Greater than 20	0-300	15-15-15	1.5
Greater than 20	Greater than 300	21-0-0	1.5

* A common organic blend is 7-3-2. To use a 7-3-2 fertilizer, double the 15-15-15 rate or triple the 16-20-0 rate. See "Some handy conversions" below for other fertilizer.

Some handy conversions

To convert from:	To:	Do this:
100 square feet	10-foot row	Divide the 100-square-foot rate by 10
100 square feet	1 large plant (e.g., tomato)	Divide the 100-square-foot rate by 20
100 square feet	1 smaller plant (e.g., broccoli)	Divide the 100-square-foot rate by 40.
15-15-15 fertilizer	10-10-10 fertilizer	Multiply the 15-15-15 rate by 1.5
15-15-15 fertilizer	7-3-2 fertilizer	Multiply the 15-15-15 rate by 2.
15-15-15 fertilizer	5-5-5 fertilizer	Multiply by 15-15-15 rate by 3.
21-0-0 fertilizer	10-10-10 fertilizer	Multiply the 21-0-0 rate by 2.
21-0-0 fertilizer	7-3-2 fertilizer	Multiply the 21-0-0 rate by 3.
21-0-0 fertilizer	5-5-5 fertilizer	Multiply the 21-0-0 rate by 4.
pounds of fertilizer	cups of fertilizer	Multiply pounds by 2.

Table 4.—Recommendations for unblended organic sources

Table 4a. - Fertilizer recommendations using manure*

Type of manure	Amount of manure to apply	
	First 3 years	Subsequent years
Manure containing little bedding	1.5 inches	0.5 inch
Manure containing 50 percent bedding	3 inches	1 inch

* It takes about five 5-gallon buckets to spread a 1/2 inch layer of manure over 100 square feet.

Table 4b. - Potassium (K) recommendations using wood ash.

If soil test for potassium is (ppm)	Apply this much wood ash (pounds per 100 square feet)*
less than 300	1-1.5
300-600	0
greater than 600	0**

* Never apply more than 5 - 10 lb of wood ash per 100 square feet.

** If the potassium soil test value is greater than 600, do not use wood ashes for 5 years.

Table 4c. - Phosphorus (P) recommendations using bonemeal or rock phosphate.

Western Oregon: If soil test for phosphorus is (ppm)	Eastern Oregon: If soil test for phosphorus is (ppm)	Apply this much bonemeal (pounds per 100 square feet)	Apply this much rock phosphate (pounds per 100 square feet)
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less than 25	less than 10	4	5
25 - 60	10 - 20	2.5	3
greater than 60	greater than 20	0	0

Commonly asked questions

The fertilizer rates are given for 100 square feet, and my garden is 25 x 8 feet.

What should I do?

Multiply 25 x 8 to find the square footage of your garden (200 square feet). Multiply the 100-square foot rate times 2 to find out how much fertilizer to apply.

I don't want to broadcast fertilizer over my entire garden, but rather along a row.

How much do I use?

Each 10-foot row of a crop such as lettuce or carrots is about 10 square feet (10 feet long x 1 foot wide). Divide the 100-square-foot rate by 10 to find out how much to apply along a 10-foot row.

I just want to apply fertilizer to individual plants. How much do I use?

One large plant (such as a tomato or melon) equals about 5 square feet. Smaller plants (such as broccoli) equal about 2.5 square feet. Divide the 100-square-foot rate by 20 to find out how much to apply to each large plant. Or divide by 40 to find out how much to apply to each smaller plant.

The fertilizer recommendation is for 15-15-15, and I have 10-10-10 fertilizer. What should I do?

Since there's 15% nitrogen in the 15-15-15, but only 10% nitrogen in the 10-10-10, you'll need more fertilizer to get the same amount of nitrogen. Multiply the rate for 15-15-15 fertilizer by 1.5 to get the rate for 10-10-10 fertilizer. Similarly, multiply by 3 to get the rate for 5-5-5 fertilizer.

I don't have a scale to weight fertilizer. Can I measure by cups instead of weight?

Although it's impossible to correlate pounds to cups for all fertilizer mixes, generally speaking 1 pound of packaged fertilizer mix usually equals about 2 cups. So if the recommendation is for 4 pounds of fertilizer, multiply by 2 to find out how many cups to use (8).

An example

Suppose your vegetable garden is 20 x 30 feet. Based on a soil test and Table 1a, you determine that you should apply 2 pounds of 15-15-15 fertilizer per 100 square feet. But you only plan to broadcast fertilizer over a 20 x 15 foot area for corn. You also have three 10-foot rows — one each of carrots, lettuce and spinach. You also have 10 tomato plants, which you prefer to fertilizer individually. Your garden center only sells bags of 10-10-10 fertilizer. What should you do?

- The 20 x 15 foot area for corn equals 300 square feet. Multiply the fertilizer rate given for 100 square feet by 3 to find out how much to apply: $2 \text{ pounds} \times 3 = 6 \text{ pounds}$
 - Since your fertilizer 10-10-10, multiply 6 pounds by 1.5 to get the correct rate: $6 \text{ pounds} \times 1.5 = 9 \text{ pounds}$.

- Each 10- foot row equals about 10 square feet. Divide the fertilizer rate given for 100 square feet by 10 to find out how much to apply to the row crops: $2 \text{ pounds} \div 10 = 0.2 \text{ pound per 10-foot row}$
 - Since your fertilizer is 10-10-10, multiply 0.2 pound by 1.5 to get the correct rate: $0.2 \text{ pound} \times 1.5 = 0.3 \text{ pound per 10-foot row}$.
 - Since this is a small amount, it may be easier to measure it as cups. There are about 2 cups per pound of fertilizer, so multiply the rate by 2: $0.3 \text{ pound} \times 2 = 0.6 \text{ (about 2/3) cup}$.
- Each tomato plant equals about 5 square feet. Divide the fertilizer rate given for 100 square feet by 20 to find out how much fertilizer to apply per plant: $2 \text{ pounds} \div 20 = 0.1 \text{ pound per plant}$
 - Since your fertilizer is 10-10-10, multiply 0.1 pound by 1.5 to get the correct rate: $0.1 \times 1.5 = 0.15 \text{ pound per plant}$
 - Multiply x 2 to find out how many cups to apply: $0.15 \text{ pound} \times 2 = 0.3 \text{ (about 1/3) cup}$.

For more information

- [Fertilizing Shade and Ornamental Trees \(https://catalog.extension.oregonstate.edu/fs103\)](https://catalog.extension.oregonstate.edu/fs103), FS 103
- [A Guide to Collecting Soil Samples for Farms and Gardens \(https://catalog.extension.oregonstate.edu/ec628\)](https://catalog.extension.oregonstate.edu/ec628), EC 628

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