

Fertilizers can promote vigorous growth of plants and good production. However, fertilizing will not correct problems with pH, salinity, or sodium in soils. Successful gardening begins with soil testing in order to get the most out of your dollar for fertilizer. Soil testing can tell you what to do before fertilizing in order to have a successful garden (such as salinity control or managing sodium). Prescription fertilizer recommendations can be made for your specific conditions if your soil is tested.

Timing fertilizer applications will be important once a recommended fertilizer rate is determined from the soil test. Plants vary in their requirements, and soils can contain different amounts of plant-available nutrients based on their history. Fertilizer packaging is required by law to state clearly the percentage nitrogen (N), phosphorus (P₂O₅), and potash (K₂O) by weight. For example, if a container or package reads “16-4-8”, this means that for every hundred pounds of this fertilizer there would be 16 pounds of nitrogen, 4 pounds of P₂O₅ and 8 pounds of K₂O. The rest of the weight, all 72 pounds worth, is a carrier of the N, P₂O₅, or K₂O. For example, K₂O is often present as potassium chloride (KCl) or potassium sulfate (KSO₄). The chloride or sulfate helps carry the nutrient of interest, in this case, potassium (K).

NMSU soil test interpretations report fertilizer application rates on a per-acre basis, pounds per 1,000 square feet, or the pounds needed for the size of the garden or lawn specified on the form submitted with the sample. Other labs may provide recommendations in pounds of fertilizer per acre. Tables 1 through 6 can help estimate how much material is needed for those managing small areas.

Table 1. Conversion from Pounds Per Acre to Pounds Per 100 or 1,000 Square Feet

Rate per acre lb	Rate per 100 sq. feet		Rate per 1,000
	lb	ounces	sq. feet lb + ounces
100	0.23	4	2, 5
200	0.46	7	4, 9
400	0.92	15	9, 3
500	1.15	18	11, 8
600	1.38	22	13, 12
700	1.61	26	16, 1
800	1.84	29	18, 6
1,000	2.30	37	22, 15
2,000	4.59	73	45, 15

General Formula: Desired pounds = [(pounds per acre) ÷ 43,560] x (square feet to be fertilized)

1 acre = 43,560 square feet, 1 pound = 16 ounces, 454 g = 1 pound.

You can also calculate exactly what you need for your specific space with a little practice.

Example:

Determine the amount of ammonium sulfate needed by a 1,000 square-foot lawn if the soil test fertilizer recommendation suggests 50 pounds of nitrogen per acre.

Lawn: 1,000 square feet

Fertilizer: ammonium sulfate (21-0-0)

Nutrient Rate: 50 pound of nitrogen per acre

Square feet per acre: 43,560

Step 1. Divide pounds N per acre by 43,560.

This is the pounds needed per square foot.

$$(50 \text{ lb N/Acre}) \div (1 \text{ acre}/43,560 \text{ sq feet}) = 0.00115$$

¹ Extension Agronomist, Agricultural Science Center at Artesia, Department of Extension Plant Sciences, New Mexico State University.

Step 2. Multiply by square feet to fertilize. This is the pounds of nitrogen needed.

$$0.00115 \times 1,000 = 1.15 \text{ lb N}$$

Step 3. Divide the percent N in the fertilizer by 100.

$$21\%N \div 100 = 0.21$$

Step 4. Divide the result in Step 2 by the result in Step 3.

$$1.15 \div 0.21 = 5.48 \text{ pounds} = 5 \text{ pounds } 8 \text{ ounces}$$

This is the amount of ammonium sulfate needed over 1,000 square feet to supply an equivalent of 50 lb N per acre. On the other hand, only 2½ pounds of urea would be needed since urea contains 46% nitrogen.

The NMSU fertilizer recommendation would present pounds of ammonium sulfate needed for the specified area of interest. It would state that 239 pounds per acre of ammonium sulfate would be needed, or 5.48 pounds per 1,000 square feet.

From tons to teaspoons

When working with small areas, flower pots, or garden boxes we often switch from using pounds and ounces to units of volume including pints, cups, tablespoons, and teaspoons. Though it is easy to over-apply fertilizers in this manner the following tables should help when trying to use fertilizer recommendations based on soil testing. The fertilizer can be mixed with the soil to be put in the pot, or the fertilizer can be dissolved in water and then poured into the pot containing the soil. It is important, however, not to put all the nitrogen or potash material into the pot at one time, especially in liquid form. This can lead to excess salinity in the pot or loss of nitrogen and potash by leaching. Slow-release fertilizers should be added in the granular form. Many potting soils are sold with nutrients already mixed into the media, and additional fertilization is often not needed.

Soil test-based fertilizer recommendations are given as weight per unit area. Converting to

volume measures means that the fertilizer density needs to be known. Fertilizers do not all have the same density. One cup of urea does not weigh the same as one cup of ammonium sulfate. Blended fertilizers vary in density based on what is used to arrive at the “grade” or percent N, P₂O₅, and K₂O. Density refers to weight per unit volume. Table 2 lists the approximate weight per level cup of different fertilizers. Worksheet 1 shows how to calculate teaspoons of fertilizer for a given square footage, for any fertilizer.

Table 2. Fertilizer Densities (ounces per cup) Used to Make Volume Calculations for Fertilizer Rates (densities are for dry, loose, not packed or tamped, unless otherwise noted; blended fertilizers vary in density based on what products are used to make the blend)

Nitrogen Sources			
46-0-0 (Urea)		Ammonium Sulfate (21-0-0-24S)	
Granular			
Prilled	(tamped)	Loose	Tamped
6.0	6.8	7.6	7.9
Phosphorus Sources			
18-46-0 (DAP†)	11-52-0 (MAP‡)	0-46-0 (TSP¶)	16-20-0-13S§
7.5	8.3	9.1	8.1
Potassium Sources			
0-0-60 (Muriate of Potash)		(Langbeinite) Potassium Magnesium Sulfate	
Loose	Tamped	Loose	Tamped
10.0	11.0	11.1	12.6
Elemental Sulfur Sources			
90% Soil Acidifier	Granular (loose)	Granular (tamped)	Flake (tamped)
9.4	10.2	11.8	11.4

† Di-ammonium Phosphate

‡ Mono-ammonium phosphate

¶ Triple superphosphate

§ Ammonium phosphate sulfate

If you are using a blended fertilizer it is best to tare, or zero out, a 1-cup measure on a scale, fill the cup with the fertilizer level with the top, and weigh.

Keep in mind that Tables 3 and 4 are for conversion purposes only and are not to be used as recommendations. Recommendations come from actual soil testing.

Table 3. Conversions for Flower Pots or Flower Boxes†

Volumes of average blended fertilizer (with a bulk density of 16 ounces per pint) to meet pound-per-acre recommendation from soil test interpretation.					
Pounds per acre	Flowerpots*			Flower boxes	
	4-inch Teaspoons	6-inch Tablespoons	8-inch Teaspoons	1 square foot Tablespoons	4 square feet Teaspoons
250	2½	1¼	1½	½	2
500	5	2⅓	3	1	4½
750	7	3½	4⅔	1⅓	6⅔

† Volume relationships: One pint = 2 cups = 32 tablespoons = 96 teaspoons

*If the volume of fertilizer to add seems impossible to mix with the soil, consider dissolving a portion of the fertilizer (1 teaspoon, for example) in a pint of water and then adding this liquid mixture to the pot. Do this in increments during the growing season to reach the recommended rate given in the soil test and meet the plants' demand for nutrients. Remember, too much fertilizer at one time can cause damage to plants.

Table 4. Conversion for Fertilizer Products of Given Density for Small Areas

Weight per pint†	Rate per acre	Equivalent weight to apply to:		Volume per 3 feet row spacing	
	From soil test Pounds	100 sq ft Ounces	1,000 sq ft Pounds	10 feet of row Tablespoons	100 feet of row Pints
13 oz/pint	100	3.7	2.3	2.7	⅞
	300	11.0	6.9	8.1	2½
	500	18.4	11.5	13.6	4¼
16 oz/pint	100	3.7	2.3	2.2	⅔
	300	11.0	6.9	6.6	2
	500	18.4	11.5	11	3½
18 oz/pint	100	3.7	2.3	2.0	⅔
	300	11.0	6.9	5.9	1¾
	500	18.4	11.5	9.8	3
22 oz/pint	100	3.7	2.3	1.6	½
	300	11.0	6.9	4.8	1½
	500	18.4	11.5	8.0	2½

Conversions are approximate. Fertilizers vary in density. Weigh one pint of your fertilizer to determine which density is closest to your product.

†Determined from product specification sheets or Material Safety Data Sheets. Blends depend on what products are used to make grades (percent N, P₂O₅, K₂O).

To do your own volume calculation: Pints per unit area = [(lb/ of a product) x (1 acre ÷ 43,560 sq ft) x (16 oz/lb) x (linear feet x row spacing)] ÷ product density. Convert to cups by multiplying by 2.

Sometimes only one, two, or three rows in a garden need to be fertilized. Table 5 helps estimate how many ounces of fertilizer would be needed for differently spaced rows when given pounds per acre, pounds per 1,000 square feet, or pounds per 100 square feet.

Table 5. Conversion From Pounds Per Acre of Average Mixed Fertilizers to Ounces Per 10 Feet of Row at Three Different Row Spacings

acre	Rate per		Distance between rows		
	1,000 sq ft	100 sq ft	One Foot	Two Feet	Three Feet
	Pounds		oz/10 feet	oz/10 feet	oz/10 feet
100	2.3	0.23	1/3	3/4	1 1/8
200	4.6	0.46	3/4	1 1/2	2 1/4
400	6.9	0.69	1 1/2	3	4 1/2
500	11.5	1.15	1 3/4	3 3/4	5 1/2

Some gardeners are familiar with the quantity of soil needed to fill a raised bed or practice container gardening. Table 6 converts fertilizer products of various densities when rates are given in pounds per acre to volumes of fertilizer for a given volume of soil. Worksheet 2 shows you how to make volume calculations specific to your needs.

Table 6. Approximate Volume of Fertilizer for Specified Volume of Soil for an 8-inch Rooting Depth (values in parentheses are nearest tenth of a teaspoon, tablespoon, or cup)

Fertilizer	Fertilizer volume for specified volumes of soil				
	Pounds per acre	Per cubic yard	Per cubic foot	5 gallons	
		Tbsp	Cups	tsp	tsp
13 oz/pint	100	3 2/3 (3.7)	1/4 (0.2)	1/2 (0.4)	1/4 (0.3)
	300	11 (11.0)	2/3 (0.7)	1 1/4 (1.2)	3/4 (0.8)
	500	18 1/3 (18.3)	1 1/8 (1.1)	2 (2.0)	1 1/3 (1.4)
16 oz/pint	100	3 (3.0)	1/8 (0.2)	1/3 (0.3)	1/4 (0.2)
	300	9 (8.9)	1/2 (0.6)	1 (1.0)	2/3 (0.7)
	500	14 7/8 (14.9)	1 (0.9)	1 2/3 (1.7)	1 (1.1)
18 oz/pint	100	2 2/3 (2.6)	1/8 (0.2)	1/4 (0.3)	1/4 (0.2)
	300	8 (7.9)	1/2 (0.5)	7/8 (0.9)	5/8 (0.6)
	500	13 1/4 (13.2)	7/8 (0.8)	1 1/2 (1.5)	1 (1.0)
22 oz/pint	100	2 1/8 (2.2)	1/3 (0.1)	1/4 (0.2)	1/5 (0.2)
	300	6 1/2 (6.5)	2/5 (0.4)	3/4 (0.7)	1/2 (0.5)
	500	10 3/4 (10.8)	5/8 (0.7)	1 1/4 (1.2)	3/4 (0.8)

Worksheet 1

Don't see your fertilizer? Here's how to determine teaspoons of fertilizer for a given square footage:

- A) Determine fertilizer rate (lb/acre) from soil test interpretation _____ (1)
- B) Divide by square feet per acre (43560) $(1) \div 43560 =$ _____ (2)
- C) Determine area to treat (area = length x width or πr^2) _____ (3)
- D) Multiply (2) by (3) to get pounds needed for area _____ (4)
- E) Multiply (4) by 16 (there are 16 oz per lb) _____ (5)
- F) Determine bulk density of fertilizer (ounces/pint) _____ (6)
- G) Divide (6) by (5) _____ (7)
- H) Multiply (7) by 96 for teaspoons, or 32 for tablespoons _____ (8)

Worksheet 2

How to make your own volume calculations specific to your needs:

- A) **Determine effective rooting depth (8 inches for most plants) or pot depth.** 1a) _____ (in)
To convert to feet divide by 12 To convert to yards divide by 36
feet _____ (1b) yards _____ (1c)
- B) **Determine the surface area (sq inches) of the pot or planter box.**
square / rectangle _____ (2a) circle _____ (2a)
length x width $3.14 \times r^2 = \pi \times r \times r$

To convert to square ft divide (2a) To convert to square yards divide (2a)
by 144 by 1,296
_____ (2b) _____ (2c)
- C) Multiply (1a) by (2a) to get cubic inches of potting volume. (3a) _____ (in³)
Multiply (1b) by (2b) to get cubic feet of potting volume. (3b) _____ (ft³)
Multiply (1c) by (2c) to get cubic yards of potting volume. (3c) _____ (yd³)
- D) **Convert to gallons, if needed:**
Divide (3a) by 231 Multiply (3b) by 7.48 Divide (3c) by 0.00495
_____ (4a) _____ (4b) _____ (4c)
- E) **Obtain fertilizer rate from Table 5 or the soil test report.**
Pounds per acre Pounds per 1,000 sq feet Pounds per 100 sq feet
_____ (5a) _____ (5b) _____ (5c)
- F) **Determine fertilizer weight needed for area specified.**
Pounds for square inches: Pounds for square feet: Pounds for square feet:
Divide (5a) by 6,272,640 Divide (5b) by 43.56 Divide (5c) by 4.356

then multiply by 2a then multiply by 2b then multiply by 2b
_____ (6a) _____ (6b) _____ (6c)
- G) **Convert to ounces**
Multiply 6a by 16 (ounces per pound) (7a) _____ ounces
Multiply 6b, or 6c, by 16 (ounces per pound) (7b) _____ ounces
- H) **Obtain fertilizer density (refer to Table 2).** oz/cup _____ (8a) oz/pint _____ (8b)
Multiply 8a by 2 to get oz per pint
- I) **Determine cups of fertilizer needed:** Divide 7a by 8a Divide 7b by 8a
_____ (9a) _____ (9b)
- J) **Tablespoons of fertilizer** Multiply 9a by 16 Multiply 9b by 16
_____ T (10a) _____ T (10b)
- K) **Teaspoons of fertilizer** Multiply 10a or 10b by 3

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Worksheet 1 (COPY)

Don't see your fertilizer? Here's how to determine teaspoons of fertilizer for a given square footage:

- A) Determine fertilizer rate (lb/acre) from soil test interpretation _____(1)
 - B) Divide by square feet per acre (43560) $(1) \div 43560 =$ _____(2)
 - C) Determine area to treat (area = length x width or πr^2) _____(3)
 - D) Multiply (2) by (3) to get pounds needed for area _____(4)
 - E) Multiply (4) by 16 (there are 16 oz per lb) _____(5)
 - F) Determine bulk density of fertilizer (ounces/pint) _____(6)
 - G) Divide (6) by (5) _____(7)
 - H) Multiply (7) by 96 for teaspoons, or 32 for tablespoons _____(8)
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Worksheet 2

How to make your own volume calculations specific to your needs:

- A) **Determine effective rooting depth (8 inches for most plants) or pot depth.** 1a) _____ (in)
To convert to feet divide by 12 To convert to yards divide by 36
feet _____ (1b) yards _____ (1c)
- B) **Determine the surface area (sq inches) of the pot or planter box.**
square / rectangle _____ (2a) circle _____ (2a)
length x width $3.14 \times r^2 = \pi \times r \times r$

To convert to square ft divide (2a) To convert to square yards divide (2a)
by 144 by 1,296
_____ (2b) _____ (2c)
- C) Multiply (1a) by (2a) to get cubic inches of potting volume. (3a) _____ (in³)
Multiply (1b) by (2b) to get cubic feet of potting volume. (3b) _____ (ft³)
Multiply (1c) by (2c) to get cubic yards of potting volume. (3c) _____ (yd³)
- D) **Convert to gallons, if needed:**
Divide (3a) by 231 Multiply (3b) by 7.48 Divide (3c) by 0.00495
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Pounds per acre Pounds per 1,000 sq feet Pounds per 100 sq feet
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Pounds for square inches: Pounds for square feet: Pounds for square feet:
Divide (5a) by 6,272,640 Divide (5b) by 43.56 Divide (5c) by 4.356

then multiply by 2a then multiply by 2b then multiply by 2b
_____ (6a) _____ (6b) _____ (6c)
- G) **Convert to ounces**
Multiply 6a by 16 (ounces per pound) (7a) _____ ounces
Multiply 6b, or 6c, by 16 (ounces per pound) (7b) _____ ounces
- H) **Obtain fertilizer density (refer to Table 2).** oz/cup _____ (8a) oz/pint _____ (8b)
Multiply 8a by 2 to get oz per pint
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_____ (9a) _____ (9b)
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