Determining Amounts of Fertilizer for Small Areas

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The College of Agricultural, Consumer and Environmental Sciences is an engine for economic and community development in New Mexico, improving the lives of New Mexicans through academic, research, and Extension programs.

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 nutrient 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 (P_2O_5), and potash (K_2O) 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 P_2O_5, and 8 pounds of K_2O. The rest of the weight, all 72 pounds worth, is a carrier of the N, P_2O_5, or K_2O. For example, K_2O is often present as potassium chloride (KCl) or potassium sulfate (K_2SO_4). The chloride or sulfate helps carry the nutrient of interest, in this case potassium (K).

Soil test interpretations may report fertilizer application rates on a per-acre basis, pounds per 1,000 square feet (sq ft), 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. See NMSU Extension Guide A-146, *Appropriate Analyses for New Mexico Soils* (https://aces.nmsu.edu/pubs/_a/A146.

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This is the amount of ammonium sulfate needed over 1,000 sq ft to supply an equivalent of 50 lb N per acre. On the other hand, only 2.5 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 sq ft.

pdf), for appropriate analyses and a list of soil testing labs to consider for evaluating New Mexico soils. Tables 1 through 6 can help estimate how much material is needed for those managing small areas. Several universities provide online tools to help with calculating fertilizer application rates; links are listed at the end of this document.

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 sq ft lawn if the soil test fertilizer recommendation suggests 50 pounds of nitrogen per acre.
Lawn: 1,000 sq ft
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 sq ft.

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

Step 2. Multiply fertilizer by sq ft. 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.

$$21\% \text{ N} \div 100 = 0.21$$

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

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

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 must 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, P_2O_5, and K_2O. 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 sq ft, for any fertilizer.

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.

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 sq ft, or pounds per 100 sq ft.

Some gardeners are familiar with the quantity of soil needed to fill a raised bed, or they 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.

ONLINE TOOLS TO DETERMINE AMOUNT OF FERTILIZER

- **University of Missouri Extension:** http://agebb.missouri.edu/fertcalc/
- **University of Kentucky Cooperative Extension Service:** http://soils.rs.uky.edu/calculators/mult_fert.asp
- **University of Georgia Extension:** http://aesl.ces.uga.edu/soil/fertcalc/
- **Texas A&M Agrilife Extension:** http://soiltesting.tamu.edu/calc/UNCalclist.htm
- **Purdue University:** https://turf.purdue.edu/fertilizer-calculator/

Table 1. Conversion from Pounds Per Acre to Pounds Per 100 or 1,000 sq ft

Rate per acre (lb)	Rate per 100 sq ft		Rate per 1,000 sq ft	
	lb	ounces	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] × (sq ft to be fertilized)
1 acre = 43,560 sq ft, 1 pound = 16 ounces or 454 g

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)	
Prilled	Granular (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)		Potassium Magnesium Sulfate (Langbeinite)	
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.

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				
	Flower Pots*			Flower boxes	
Pounds per acre	4-inch teaspoons	6-inch tablespoons	8-inch teaspoons	1 sq ft tablespoons	4 sq ft teaspoons
250	2 1/2	1 1/4	1 1/2	1/2	2
500	5	2 1/3	3	1	4 1/2
750	7	3 1/2	4 2/3	1 2/3	6 2/3

† 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					
		Equivalent weight to apply to		Volume per 3-foot row spacing	
Weight per pint†	Rate per acre from soil test (lb)	100 sq ft (ounces)	1,000 sq ft (lb)	10 feet of row (tablespoons)	100 feet of row (pints)
13 oz/pint	100	3.7	2.3	2.7	7/8
	300	11.0	6.9	8.1	2 1/2
	500	18.4	11.5	13.6	4 1/4
16 oz/pint	100	3.7	2.3	2.2	3/5
	300	11.0	6.9	6.6	2
	500	18.4	11.5	11	3 1/2
18 oz/pint	100	3.7	2.3	2.0	3/5
	300	11.0	6.9	5.9	1 3/4
	500	18.4	11.5	9.8	3
22 oz/pint	100	3.7	2.3	1.6	1/2
	300	11.0	6.9	4.8	1 1/2
	500	18.4	11.5	8.0	2 1/2

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, P_2O_5, and K_2O).

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

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

Rate per			Distance between rows		
Acre	1,000 sq ft	100 sq ft	One foot	Two feet	Three feet
lb			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 2/3	5 1/2

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 volume for specified volumes of soil			
		Per cubic yard		Per cubic foot	5 gallons
Fertilizer	lb/acre	tablespoon	cups	teaspoon	teaspoon
13 oz/pint	100	3 1/3 (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 sq ft:

1. Determine fertilizer rate (lb/acre) from soil test interpretation	(1)
2. Divide by sq ft per acre (43,560)	(2)
3. Determine area to treat (area = length × width or πr^2)	(3)
4. Multiply (2) by (3) to get pounds needed for area	(4)
5. Multiply (4) by 16 (there are 16 oz per lb)	(5)
6. Determine bulk density of fertilizer (oz/pint)	(6)
7. Divide (6) by (5)	(7)
8. Multiply (7) by 96 for teaspoons, or 32 for tablespoons	(8)

WORKSHEET 2 How to make your own volume calculations specific to your needs:		
1. Determine effective rooting depth (8 inches for most plants) or pot depth	**(1a)**	inches
To convert to feet, divide (1a) by 12	**(1b)**	feet
To convert to yards, divide (1a) by 36	**(1c)**	yards
2. Determine the surface area (sq inches) of the pot or planter box		
Square/rectangle: length × width	**(2a)**	$inches^2$
Circle: $3.14 \times r^2 = \pi \times r \times r$	**(2a)**	$inches^2$
To convert to sq ft, divide (2a) by 144	**(2b)**	$feet^2$
To convert to square yards, divide (2a) by 1,296	**(2c)**	$yards^2$
3. Multiply (1a) by (2a) to get cubic inches of potting volume	**(3a)**	$inches^3$
Multiply (1b) by (2b) to get cubic feet of potting volume.	**(3b)**	$feet^3$
Multiply (1c) by (2c) to get cubic yards of potting volume.	**(3c)**	$yards^3$
4. Convert to gallons, if needed		
Divide (3a) by 231	**(4a)**	gallons
Multiply (3b) by 7.48	**(4b)**	gallons
Divide (3c) by 0.00495	**(4c)**	gallons
5. Obtain fertilizer rate from Table 5 or the soil test report		
Pounds per acre	**(5a)**	
Pounds per 1,000 sq ft	**(5b)**	
Pounds per 100 sq ft	**(5c)**	
6. Determine fertilizer weight needed for area specified		
Pounds for square inches: Divide (5a) by 6,272,640, then multiply by (2a)	**(6a)**	pounds
Pounds for sq ft: Divide (5b) by 43.56, then multiply by (2b)	**(6b)**	pounds
Pounds for sq ft: Divide (5c) by 4.356, then multiply by (2b)	**(6c)**	pounds

WORKSHEET 2 (CONTINUED)		
7. Convert to ounces		
Multiply (6a) by 16 (ounces per pound)	**(7a)**	ounces
Multiply (6b) or (6c) by 16 (ounces per pound)	**(7b)**	ounces
8. Obtain fertilizer density (refer to Table 2)	**(8a)**	ounces/cup
Multiply (8a) by 2 to get oz per pint	**(8b)**	ounces/pint
9. Determine cups of fertilizer needed		
Divide (7a) by (8a)	**(9a)**	cups
Divide (7b) by (8a)	**(9b)**	cups
10. Convert to tablespoons of fertilizer		
Multiply (9a) by 16	**(10a)**	tablespoons
Multiply (9b) by 16	**(10b)**	tablespoons
11. Convert to teaspoons of fertilizer		
Multiply (10a) or (10b) by 3		teaspoons

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