Horticulture

EXTENSION
UtahStateUniversity

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August 2016 Horticulture/Fertilizers/2016-01

Calculating Fertilizer for Small Areas

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Introduction

Soil nutrients in the home landscape and garden may become depleted over time. Replacing these nutrients with fertilizers is often necessary. For some nutrients (phosphorus or potassium), a single yearly application is sufficient while with other nutrients (nitrogen) more frequent applications are warranted. Knowing exactly how much fertilizer to apply in your garden plot can be challenging as fertilizer recommendations are typically given for large areas (i.e., pounds per acre or per 1000 square feet). Gardeners and urban farmers often must convert these recommendations to much smaller areas, sometimes just a few square feet or even for a single container or pot. Guessing at amounts to apply often results in over or under fertilizing. Over fertilizing can lead to ground water contamination, negatively impact plant growth, and wastes money. Under fertilization results in decreased plant health and reduced yields. This fact sheet is meant to help gardeners convert fertilizer recommendations to fit their individual garden plot size.

Four Steps for Successful Fertilizer Application

1. **Soil test.** Start with having a soil test done on the area you will be growing in. This is particularly important when cultivating a new location, but should also be done once every few years in an established garden or if you are noticing decreased productivity. Utah State University Analytical Labs is open to the public and offers a wide variety of soil tests. Visit http://usual.usu.edu/ for a complete list of tests offered, pricing information and directions for collecting a soil sample. Once you get your soil test results, correct interpretation is important. If you are having difficulty interpreting your results, the fact sheet Understanding Your Soil Test Report provides a helpful explanation.

Table 1 shows a sample soil test report for the most basic test offered from the USU Analytical Lab, reporting soil texture, pH, salinity, phosphorous, and potassium. Soil nitrogen is not reported but a general recommendation is still given.

2. Deciding how much to apply. You will need to know the square footage of the area to be fertilized. Table 2 shows various formulas that can be used to calculate the square footage of your garden.

Once you know your garden's square footage and have the fertilizer recommendations from your soil test, calculate the number of pounds of each nutrient needed using the following equation.

Pounds recommended per 1000 sq ft X Square Footage/1000 sq ft = Pounds to apply in garden

Based on your soil test results, determine which nutrients you need to apply. Usually, in vegetable gardens and lawns, nitrogen needs to be applied every year. If you do not have a soil test, a general recommendation for a vegetable garden is to apply 2 to 4 pounds of nitrogen per 1000 square feet.

3. Deciding which fertilizer to apply. There are many different fertilizer options that provide nutrients to the soil. All the different choices can be very overwhelming and leave homeowners confused about what they should actually apply. There are two main groups of fertilizers: organic and inorganic (sometimes referred to as chemical) fertilizers. Both types, if properly used, are a good option for homeowners. The fact sheets, Selecting and Using Organic Fertilizers and Selecting and Using Inorganic Fertilizers provide useful information on both types of fertilizer as well as lists of fertilizer nutrient content in each type.

Example: 10 by 20 foot garden and 2 pounds per 1000 square feet nitrogen recommendation

10 x 20 =200 square feet

2 lbs N x (200 sq ft/1000) = 0.4 pounds nitrogen applied over total garden area

All fertilizers sold commercially must be labeled with a standardized label. The label will have 3 numbers, separated by dashes, indicating the percentage of three major nutrients: nitrogen (N), phosphate (P_2O_5), and potash (K_20). As an example, a common starter fertilizer is 20-27-5. That means it contains 20% nitrogen, 27% phosphate, and 5% potash. To calculate how many pounds of each nutrient in your fertilizer bag, multiple the weight of the bag by the percentage of each nutrient.

Example: 5 pound bag of 20-27-5 fertilizer

Nitrogen: 5 lbs fertilizer x 20% (0.20) = 1 pound N

Phosphate: 5 lbs fertilizer x 27% (0.27) = 1.35 pounds Phosphate

Potash: 5 lbs fertilizer x 5% (0.05) = 0.25 pound Potash

Other nutrients, such as zinc, magnesium, iron or copper can also be purchased in a fertilizer but will be specified elsewhere on the label. Table 3 lists single nutrient fertilizers.

From our example above, the garden requires 0.4 lbs of nitrogen. If you are using the 20-27-5 fertilizer sources, you would apply 2 lbs (0.4 lbs. N / 0.20 (20% N) = 2) of that fertilizer over the 200 sq. ft. garden. Since the soil test (Table 1) indicated low P and high K applying a 20-27-5 fertilizer is an acceptable option. However, one without any K would be better.

When choosing a fertilizer material, application of only those nutrients needed (as dictated by soil test results) is advised to protect against unnecessary accumulation of excess nutrients in the soil. Excess amounts of P and K are not toxic to plants, but can have secondary environmental effects on surface water quality (e.g., P in runoff) and soil and water salinity (e.g., high K accumulation). Over-application of N is a serious issue that can have a detrimental effect on plant growth, and also presents potential undesirable environmental effects such as nitrate contamination of ground water. Additionally, N in surface water contributes to algal blooms that deplete oxygen for fish and other aquatic organisms. Furthermore, excess P in soils can present competitive uptake restriction over minor, but often limiting nutrients such as iron (Fe) and zinc (Zn). Finding one fertilizer that perfectly meets your soil test recommendation is not always possible; combining different single-nutrient fertilizers (Table 3) may be the best option for your situation.

4. Measuring the correct amount. When working with backyard gardens, flower beds or patio boxes the amount of fertilizer needed is typically fairly small. Conversions to smaller measurements are often needed. Table 4 and 5 have useful conversions for various measurements. To take some of the guesswork out of measuring, consider investing in some simple tools that will improve accuracy. A small kitchen scale and a set of measuring cups and spoons that can be dedicated to fertilizer applications will prove useful.

Case Study

Table 1 is a sample garden report for the most basic test offered from the USU Analytical Lab. It recommends the gardener apply 2 to 4 pounds N per 1000 square feet, 1 to 2 pounds P_2O_5 per 1000 square feet, and 0 pounds K_2O per 1000 square feet and. The area to be fertilized is 200 square feet.

Calculations for each of the three nutrients follow.

Pounds recommended per 1000 sq ft X Square Footage/1000 sq ft = Pounds to apply in area

Nitrogen:

2 lbs N X (200 sq ft/1000 sq ft) = **0.4 lbs N**

to

4 lbs N X (200 sq ft/1000 sq ft) = **0.8 lbs N**

Phosphate:

1 lbs P_2O_5 X (200 sq ft/1000 sq ft) = **0.2 lbs P_2O_5**

to

2 lbs P_2O_5 X (200 sq ft/1000 sq ft) = **0.4 lbs P_2O_5**

Potash:

0 lbs K_2O X (200 sq ft/1000 sq ft) = **0 lbs K_2O**

See companion Excel workbook at

http://digitalcommons.usu.edu/extension_curall/1582/

to enter in your exact specifications and get nutrient recommendations that fit your needs. The workbook will walk you through calculating fertilizer amounts.

Table 1. Sample soil test report from USUAL.

Soil Test Report

and

Fertilizer Recommendations

USU Analytical Labs
Utah State University
Logan, Utah 84322-9400
(435) 797-2217
(435) 797-2117 (FAX)
www.usual.usu.edu

Date Received: 3/31/2015
Date 4/9/2015
Name: Ima Gardener
Address: 120 Flower Lane
LOGAN UT 84321
Phone: .
County: CACHE
Lab Number: 1501-0784
Grower's Comments:
Acres in Field:
Identification: 1
Crop to be Grown: Garden

Soil Test		Interpretations	Recommendations
Texture	Loam		
pH	7.6	Normal	
Salinity - ECe	0.7	Normal	
Phosphorus - P	12.1	Low	1-2 lbs P2O5/1000 sq ft
Potassium - K	580	High	0 lbs K2O/1000 sq ft
Nitrate-Nitrogen - N mg/kg			2-4 lbs N/1000 sq ft*
Zinc - Zn			
Iron - Fe mg/kg			
Copper - Cu			
Manganese - Mn			
Sulfate-Sulfur - S			
Organic Matter			
SAR			

Note
*SEE GARDEN GUIDE

Table 2. Formulas for calculating square footage of variously shaped areas.

Shape	**Formula**
Square or rectangle	Area = Length x Width
Triangle	Area = 1/2 x Base x Height
Circle	Area = 3.14 x radius2
Ovals (5% accuracy)	Area= Length x Width at midpoint x 0.8
Irregular shapes (5% accuracy)	Measure longest axis of area (length) At every 10 ft on the length line measure the width Total all widths and multiply by 10 Area = (A + B + C + D + E) x 10

Table3. Single source fertilizers.

Fertilizer	N-P-K
Urea	46-0-0
Ammonium nitrate	34-0-0
Ammonium sulfate	21-0-0
Triple superphosphate	0-45-0
Potassium chloride	0-0-60

Table 4. Equivalents for volume measurements

Gallons	Quarts	Pints	Fluid Ounces	Cups	Tablespoons	Teaspoon	Milliliters	Liters
1	4	8	128	16	256	768	3785	3.785
-	1	2	32	4	64	192	946	0.946
-	-	1	16	2	32	96	473	0.473
-	-	-	1	1/8	2	6	30	0.03
-	-	-	-	1	16	48	236	0.236
-	-	-	-	-	1	3	15	0.015
-	-	-	-	-	-	1	5	0.005
-	-	-	-	-	-	-	1	0.001

Table 5. Rate of application equivalent table (dry materials)

Per Acre	Per 1,000 sq ft	Per 100 sq ft	Per 10 sq ft
1 lb	2.5 tsp	0.25 tsp	0.025 tsp
3 lbs	2.25 tbs	0.75 tsp	0.075 tsp
4 lbs	3 tbs	1 tsp	0.10 tsp
5lbs	4 tbs	1.25 tsp	0.13 tsp
10 lbs	0.4 cup	2 tsp	0.2 tsp
100 lbs	2.25 lbs	0.25 lb	2.4 tsp
200 lbs	4.66 lbs	0.5 lb	1.6 tbs
300 lbs	7 lbs	0.75 lb	2.4 tbs
400 lbs	9.25 lbs	1 lb	3.2 tbs
500 lbs	11.5 lbs	1.15 lbs	4 tbs

This project is funded in part by USDA-Risk Management Agency under a cooperative agreement. The information reflects the views of the author(s) and not USDA-RMA.