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# Understanding Fertilizer Calculations

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Properly calculating fertilizer rate requirements is important to ensure that nutrients are not limiting crop yield and that producers are not spending more on input costs than needed. Highly variable fertilizer costs and crop prices, coupled with consistently changing environmental conditions, can make fertilizer management a challenge.

As the knowledge base of fertilizer management practices increases, the basics of understanding how to calculate fertilizer needs are often overlooked, leaving a knowledge gap between experienced and novice producers regarding proper nutrient management. This article aims to increase understanding of fertilizer calculations and help producers compare available products to meet crop needs without compromising yield or profitability.

This fact sheet builds on the knowledge gained in "*Understanding Fertilizer Nutrient Content and Guaranteed Analysis*" (FSA2222), although the information presented can be used without referencing that article.

Information such as soil analysis, available products and cost will be needed to make fertilizer recommendations. This article provides background information to ensure you receive the most effective and efficient product and application rates.

## Calculating Fertilizer Requirements

The most important question to answer is how much product will be necessary to meet the recommendations. For granular products, divide the recommended weight of nutrients by the whole number percent of the nutrient in the product and multiply by 100. Rounding to the nearest whole number will simplify the calculations.

The following example is calculated to meet the needs of a soil test recommendation of 100 lb N, 80 lb $P_2O_5$ and 120 lb $K_2O$, using Diammonium Phosphate (DAP), fluid 32 percent urea ammonium nitrate (UAN) and Muriate of Potash (MOP). As you begin the calculations, it is always a good idea to start with any multi-nutrient product that supplies a nutrient the other select products do not. In this example, DAP would be the starting point since it is the only fertilizer supplying $P_2O_5$.

**80 lb $P_2O_5$ (recommendation) ÷ 46 (% $P_2O_5$ in DAP) × 100 = 174 lb DAP**

So, 174 lb of DAP would apply 80 lb of $P_2O_5$, satisfying

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the soil test recommended amount. However, DAP is a multi-nutrient fertilizer that also contains 18 percent nitrogen (N). When using a multi-nutrient fertilizer, it is best practice to account for all nutrients contained in the product when planning fertilizer applications of those nutrients as well.

For the previous example, this can be done by calculating the amount of N that would be applied by the DAP and subtracting that from the recommendations of the soil test. For example,

**174 lb DAP × 18 ( % N in DAP) ÷ 100 = 31 lb N**

The soil test recommendation of 100 lb N can be reduced by the 31 lb of N that will be added by the application of DAP fertilizer. The remaining 69 lb N will be needed from another fertilizer source. The following example calculates the amount of fluid 32 percent UAN needed to fulfill the recommendation.

For fluid fertilizers, the nutrient density (pounds per gallon) of the product is needed and used to divide the recommendation by. To determine the nutrient density of the fertilizer, multiply the product density by the concentration and divide by 100.

**11.06 lb per Gallon × 32 (% N in UAN) ÷ 100 = 3.54 lb N per Gallon of 28% UAN**

**69 lb N (recommendation) ÷ 3.54 lb N per Gallon = 19.5 Gallons of 32% UAN**

The application of 19.5 gallons of 32 percent UAN in addition to the 109 lb of DAP applied would satisfy the soil test recommendations for N and P. The MOP rate needed to meet the potassium (K) requirement can be calculated just like P, as in the following example.

**120lb $K_2O$ (recommendation) ÷ 60 (% $K_2O$ in MOP) × 100 = 200 lb MOP.**

## Calculating the Cost

Arguably, the most important part of any fertilizer decision is the cost of application. Fertilizer prices are often volatile, meaning they may change significantly over short periods of time. Therefore, it is important to understand how to determine the cost of the fertilizer and apply that cost to your operation. This can be done easily using the information already calculated. For granular fertilizers, divide the cost by the weight of the unit and multiply that amount by the per-acre application rate previously calculated.

**$720.00 per Ton of DAP÷ 2000 lb per Ton × 174 lb DAP per acre = $62.64 per acre**

For fluid fertilizer, it depends if the price is given by volume or by weight. Typically the cost is by volume, therefore simply multiplying the volume in gallons needed by the price per gallon would suffice. If the product cost is presented by weight, such as dollars per ton, the following example shows how to use density to convert this price to a volume.

**$400.00 per Ton of UAN 28%÷ 2000 lb per Ton × 10.96 lb per Gal.x 23 gal per acre = $50.42 per acre**

More information about calculating and comparing fertilizer prices can be found in "*Comparing Fertilizer Prices by Unit of Nutrient Rather than Unit of Fertilizer*" (FSA2224).

## Summary

Fertilizer calculations can be confusing, but using the information outlined in this fact sheet can help producers successfully calculate fertilizer requirements and ensure fertilizer applications meet nutrient requirements of fertilizer rate recommendations.

The following two pages provide a step-by-step, fill-in-the-blank guide for calculating fertilizer needs. The information presented here is not intended to deter or enforce the use of any one fertilizer type or source, but to help producers better understand what is being used. This information should be used in conjunction with soil tests, nutrient removal and other recommendations for guiding fertilization programs and maintaining proper nutrient stewardship. For more information on fertilizer calculations, soil testing, or nutrient recommendations please contact your local University of Arkansas Division of Agriculture Cooperative Extension Service or visit https://www.uaex.uada.edu/.

# Fertilizer Calculations Work Sheet

This is a work-through sheet to help calculate the amount of fertilizer needed to achieve soil test recommendations on a per-acre basis. Using a pencil for mistake correction is recommended.

## Soil Test Recommendations

_____ lb/ac N  _____ lb/ac $P_2O_5$  _____ lb/ac $K_2O$  _____ lb/ac $SO_4$  _____lb/ac Zn  _____lb/ac B

## Granular Fertilizer

Fertilizer Name: _____

Fertilizer Analysis: _____% N  _____% $P_2O_5$  _____% $K_2O$  _____% $SO_4$  _____% Zn  _____% B

### Step G1. Calculate the amount of product needed per acre.

Calculate the amount of fertilizer needed to meet a nutrient need. Recommend starting with multi-nutrient products first, use the largest nutrient in the product or the smallest soil test need.

_____ (Nutrient Req.) ÷ _____ (% nutrient) x 100 = _____ (Answer G1) **lb/ac** of _____ (Product Name)

### Step G2.1. Calculate the amount of additional nutrients added per acre by the product.

If this product has more than one nutrient do the following to calculate the amount of additional nutrients applied by the granular and repeat as needed for each additional nutrient found in the product. If not, restart Step G1 for other Granular Fertilizers.

_____ (Answer G1) ÷ _____ (% nutrient) ÷ 100 = _____ (Answer G2.1) **lb/ac** of _____ (Nutrient) in _____ (Product Name)

### Step G2.2. Calculate the new fertilizer requirement for the additional nutrients.

Reduce the recommendation for other nutrients found in the fertilizer. Repeat for each nutrient in the product.

_____ (Current Req.) – _____ (Answer G2.1) = _____ (New Rec.) **lb/ac** of _____ (Nutrient) still needed

## Soil Test Recommendations

| _____ lb/ac | _____ lb/ac | _____ lb/ac | _____ lb/ac | _____lb/ac | _____lb/ac |
|---|---|---|---|---|---|
| N | $P_2O_5$ | $K_2O$ | $SO_4$ | Zn | B |

## Fluid Fertilizer

Fertilizer Name: _____ Fertilizer Density _____ **(lb/gal)**

| Fertilizer Analysis: _____% | _____% | _____% | _____% | _____% | _____% |
|---|---|---|---|---|---|
| N | $P_2O_5$ | $K_2O$ | $SO_4$ | Zn | B |

### **Step F1.1.** Calculate the amount of nutrients in pounds per gallon of the product.

Calculate the amount of nutrient applied for each gallon of fertilizer. Recommend starting with multi-nutrient products first, using the nutrient in the largest quantity or the smallest need.

_____ x _____ ÷ 100 = _____ **lb** of _____ **per gallon** of _____

(Density) (% nutrient) (Answer F1.1) (Nutrient) (Product Name)

### **Step F1.2.** Calculate the amount of product needed per acre.

Calculate the amount of fertilizer needed to meet a nutrient need.

_____ ÷ _____ = _____ **gal/ac** of _____

(Nutrient Req.) (Answer F1.1) (Answer F1.2) (Product Name)

### **Step F2.1.** Calculate the amount of additional nutrients in pounds per gallon of the product.

If this product has more than one nutrient do the following to calculate the density of the additional nutrient(s) and repeat as needed for each additional nutrient. If not, restart Step F1.1 for other fluid Fertilizers.

_____ x _____ ÷ 100 = _____ **lb** of _____ **per gallon** of _____

(Density) (% nutrient) (Answer F2.1) (Nutrient) (Product Name)

### **Step F2.2.** Calculate the amount of additional nutrients added per acre by the product.

Calculate the amount of additional nutrients applied by the fluid fertilizer product and repeat as needed for each additional nutrient found in the product.

_____ x _____ = _____ **lb/ac** of _____ **from** _____

(Answer F1.2) (Answer F2.1) (Answer F2.2) (Nutrient) (Product Name)

### **Step F2.3.** Calculate the new fertilizer requirement for the additional nutrients.

Reduce the recommendation for other nutrients found in the fertilizer and repeat as needed for each additional nutrient found in the product.

_____ ÷ _____ = _____ **lb/ac** of _____ still needed

(Current Req.) (Answer F2.2) (New Rec.) (Nutrient)

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