SOIL

Fertilizer Cost Calculations no. 0.548

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Quick Facts...

A guaranteed analysis must be given for every fertilizer material sold in Colorado.

The analysis includes the percentages of nitrogen, phosphorus, potassium and other plant nutrients present in quantities large enough to conform to state law.

The cost per pound of nutrient is a major criterion in selecting a fertilizer.

The Colorado fertilizer law requires that the guaranteed analysis of every fertilizer material sold in the state be given on the face or display side of the container. The guaranteed analysis provides the percentage of nitrogen (N), available phosphorus (expressed as percent P_2O_5), water soluble potassium (expressed as percent K_2O) and other nutrients present in quantities that conform to state law.

The Commercial Fertilizer, Soil Conditioner, Plant Amendment and Agricultural Liming Materials Act of 1977 sets minimum nutrient content levels for the guaranteed analysis. Any commercial fertilizer for agricultural use primarily for nitrogen, phosphorus and potassium must contain a minimum total of 20 units of N-P_2O_5-K_2O. For other nutrients, the fertilizer must guarantee the minimum amounts shown in Table 1 in order to be registered for sale in Colorado.

Even though the guaranteed analysis expresses phosphorus and potassium on the oxide basis, these plant nutrients occur in the fertilizer as mixtures of different chemicals. For example, the chemical formula for diammonium phosphate is $(NH_4)_2HPO_4$. It has a guaranteed analysis of 18-46-0 expressed as 18 percent N, 46 percent P_2O_5 and 0 percent K_2O, but actually contains no P_2O_5. The use of the oxide expression for plant nutrient content is a carry-over from early practices when chemists ignited fertilizer samples and weighed the oxides.

If the cost per pound of elemental P or K is desired, then the guarantee must be changed from P_2O_5 to P and/or K_2O to K. To find the conversion factor, use the ratio of the molecular weight of (2 x P) and divide by the molecular weight of P_2O_5. A similar approach is used for K. No conversion is needed for N since it is already expressed on an elemental basis. These conversions are:

Equation (1): $P = P_2O_5/2.29$
Equation (2): $P_2O_5 = 2.29 \times P$
Equation (3): $K = K_2O/1.21$
Equation (4): $K_2O = 1.21 \times K$

Single-Nutrient Fertilizers

The calculation of the cost of a pound of a nutrient in a fertilizer that contains a single element fertilizer is relatively simple. The costs in the following examples are for illustration only and do not reflect what the cost should be.

Urea, $CO(NH_2)_2$, has a guaranteed analysis of 45-0-0 and costs $300 per ton. What is the cost per pound of N?

- First, calculate the pounds of N in the fertilizer:
  2,000 lbs fertilizer x 0.45 = 900 lbs N.
- Next, calculate the cost per pound of N:
  $300 / 900 lbs N = $.33/lb N.

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Table 1: Minimum nutrient concentration standard for fertilizer sold in Colorado.

Element	Percent
Calcium (Ca)	1.00
Magnesium (Mg)	0.50
Sulfur (S)	1.00
Boron (B)	0.02
Copper (Cu)	0.05
Iron (Fe)	0.10
Manganese (Mn)	0.50
Molybdenum (Mo)	0.0005
Zinc (Zn)	0.05

Superphosphate (0-46-0) costs $280 per ton. What is the cost per pound of P_2O_5?

- First, calculate the pounds of P_2O_5 in the fertilizer:
  2,000 lbs fertilizer x 0.46 = 920 lbs.
- Next, calculate the cost per pound of P_2O_5:
  $280 / 920 lbs = $.30/lb P_2O_5.

What is the cost per pound of P in the superphosphate example above? There were 920 pounds of P_2O_5 in one ton of superphosphate. If equation 1 is used, the cost per pound of P can be found.

- First, correct pounds of P_2O_5 to pounds of P:
  Lbs P = 920 / 2.29 = 402 lbs P.
- Next, calculate the cost per pound of P:
  $280 / 402 lbs P = $0.70/lb P.

Use similar procedures for any fertilizer that contains one plant nutrient.

Mixed Fertilizers

Mixed fertilizers contain more than one nutrient. An example is granulated diammonium phosphate (18-46-0) (DAP).

Assume DAP costs $320/ton. Calculate the cost of the P_2O_5 in this fertilizer. Assume a cost per pound of N and the cost of the P_2O_5 can be calculated. Assume the cost of the N is the same as 45-0-0 in the first example, or $.33/lb N. What is the cost of the P_2O_5 in 18-46-0?

- First, calculate the pounds of N and P_2O_5 in a ton of fertilizer:
  2,000 lbs fertilizer x 0.18 N = 360 lbs N.
  2,000 lbs fertilizer x 0.46 P = 920 lbs P_2O_5.
- Next, calculate the cost of the fertilizer that can be attributed to the N:
  $.33/lb N x 360 lbs N = $118.80
- Therefore, the total cost of the P_2O_5 in the fertilizer is:
  $320 - $118.80 = $201.20.
- Finally, the cost of the P_2O_5 is:
  $201.20 / 920 lbs = $.22/lb P_2O_5.

Compare the cost for P_2O_5 to other P_2O_5 sources. Notice that the cost of the P_2O_5 in 18-46-0 is substantially less than the cost of P_2O_5 in 0-46-0 in the second example.

Solution or Suspension Fertilizers

When determining the cost per pound of the nutrients in liquid based fertilizers that are priced by the gallon, the density of the material must be known.

A hypothetical zinc (Zn) chelate costs $6/gallon. It has a density of 11.2 pounds/gallon and contains 6 percent Zn. What is the cost per pound of Zn?

- First, find the pounds of Zn/gallon of solution:
  11.2 lbs Zn chelate/gallon x 0.06 Zn = 0.67 lbs Zn/gallon.
- Next, calculate the cost of Zn:
  $6/gallon x 1 gallon / 0.67 lbs Zn = $8.96/lb Zn.

Urea-ammonium nitrate (UAN) solution (32-0-0) costs $160/ton. What is the cost per pound of N?

- Calculate the pounds of N in the fertilizer:
  2,000 lbs fertilizer x 0.32 lbs N = 640 lbs N.
- Next, calculate the cost per pound of N:
  $160 / 640 lbs N = $.25/lb N.

Summary

Every fertilizer material sold in Colorado must contain a guaranteed analysis. This analysis consists of three numbers that provide the percent N, percent P_2O_5 and percent K_2O. Any other nutrients that are guaranteed also must be listed on the label. The cost per pound of N, P_2O_5 and K_2O in a fertilizer with only N, P or K can be calculated using the cost per ton of fertilizer and the percent N, P_2O_5 and/or K_2O in the material. To calculate the cost per pound of elemental P or K, a factor must be used to convert percent P_2O_5 to percent P and percent K_2O to percent K.

For mixed fertilizer (those with more than one plant nutrient), assume the cost per pound of one or more nutrients. Subtract the cost of these nutrients from the total fertilizer cost. Use the residual cost to determine the cost per pound of the nutrient in question.

For liquid-based fertilizers (solutions or suspensions) that are priced by the gallon, cost calculations require the price per gallon of material, the density of the liquid and the percent of the nutrient present. When the liquid fertilizer is priced on a weight basis (cost/pound or cost/ton), the calculations are similar to those used for dry fertilizer materials. Most liquids are priced on this basis.

The cost per pound of nutrient should be the major criterion to determine which fertilizer material to use. Most N-P_2O_5-K_2O fertilizers perform equally well when applied properly. Handling, safety considerations and the fertilizer's ability to integrate into a grower's production program will determine which fertilizer material is best.

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