# Calculating Fertilizer Costs

Guide A-133

**Revised by Robert Flynn**[1]

Cooperative Extension Service • College of Agricultural, Consumer and Environmental Sciences

## QUICK FACTS

The guaranteed analysis of a fertilizer includes the percentages of nitrogen, phosphorus, potassium, and other plant nutrients present in quantities large enough to conform to state law. Guaranteed analysis must be given for every fertilizer material sold in New Mexico.

The cost per pound of nitrogen (N), phosphorus (as $P_2O_5$), or potassium (as $K_2O$) is calculated using the total cost and the nutrient percentage in the fertilizer. Cost per pound of nutrient should be the major criterion in determining which fertilizer source to use.

If more than one plant nutrient is contained in a fertilizer, the cost of one or more nutrients must be assumed. This cost is subtracted from the total fertilizer cost, and the residual cost is used for determining the cost per pound of the nutrient in question.

When liquid fertilizers (solutions or suspensions) are priced by the gallon, the cost and the density of the material as well as the percent of the nutrient in the fertilizer must be known to complete the cost calculation. If the liquid fertilizer is priced by the ton, the calculations are similar to dry fertilizer materials.

Always use soil testing to determine what fertilizer(s) are needed for your particular soil and crop.

The 1978 New Mexico Fertilizer Act requires that the guaranteed analysis of every fertilizer material sold in the state be given in a clearly legible and conspicuous form. The guaranteed analysis provides the percentages of nitrogen (N), available phosphorus (expressed as percentage $P_2O_5$), water-soluble potassium (expressed as percentage $K_2O$), and other nutrients in quantities that conform to state law.

The Fertilizer Act defines a *commercial fertilizer* as any substance that contains one or more recognized plant nutrients, is used for its plant nutrient content, and is designed for use or claimed to have value in promoting plant growth (except unmanipulated animal and vegetable manures, marl limes, limestone, wood ashes, gypsum, and other exempt products). A *fertilizer material* means a commercial fertilizer that either 1) contains important quantities of no more than one of the primary plant nutrients—nitrogen, phosphoric acid, and potash; or 2) has approximately 85% of either nitrogen, phosphoric acid, or potash in the form of a single compound; or 3) is derived from a natural source and processed in such a way as to purify and concentrate the plant nutrient.

Although the guaranteed analysis expresses phosphorus and potassium on the oxide basis ($P_2O_5$ and $K_2O$) these plant nutrients occur in the fertilizer as mixtures of different chemicals. For example, the chemical formula for diammonium phosphate (DAP) is $(NH_4)_2HPO_4$. DAP has a guaranteed analysis of 18-46-0 expressed as 18% N, 46% $P_2O_5$, and 0% $K_2O$—but it 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. Soil test recommendations for P and K additions to soil have been corrected for this oxide expression.

To calculate the cost per pound of elemental P or K, the guarantee must be changed from $P_2O_5$ to P and $K_2O$ to K. (No conversion is necessary for N because it is already expressed on an elemental basis.) These conversions are provided in Table 1. Use Table 2 to convert between English and metric units.

## FERTILIZER CONTAINING A SINGLE NUTRIENT

Calculating the cost per pound of a nutrient in a fertilizer containing a single element is relatively simple, and the following calculations are provided as examples[2]. Similar procedures can be used for any fertilizer containing one plant nutrient.

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[2] The costs provided for all of the following examples are used for illustrative purposes and do not necessarily reflect what the cost per pound of the fertilizer should be.

| Table 1. Conversion Factors for P and $P_2O_5$ and K and $K_2O$ | | | |
|---|---|---|---|
| **To convert column 1 to column 2, multiply by** | **Column 1** | **Column 2** | **To convert column 2 to column 1, multiply by** |
| 2.29 | P | $P_2O_5$ | 0.437 |
| 1.21 | K | $K_2O$ | 0.836 |

**Example A.** Urea, $CO(NH_2)_2$, has a guaranteed analysis of 46-0-0, and since 2010 has cost an average of $567 per ton (2,000 lb) in the Mountain Region, which includes New Mexico. What is the cost per pound of N?

First, calculate the pounds of N in the fertilizer:
2,000 lb fertilizer × 0.46 = 920 lb of N

Next, calculate the cost per pound of N:
$567 ÷ 920 lb N = $0.62/lb N

**Example B.** Superphosphate (0-46-0) has cost an average of $996 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 lb fertilizer × 0.46 = 920 lb $P_2O_5$

Next, calculate the cost per pound of $P_2O_5$:
$996 ÷ 920 lb = $1.08/lb $P_2O_5$

**Example C.** What is the cost per pound of P in the superphosphate from example B? Notice in example B that there were 920 lb of $P_2O_5$ in one ton of superphosphate. Converting $P_2O_5$ to P allows for the cost per pound of P to be found.

First, convert pounds of $P_2O_5$ to units of P (refer to Table 1 for conversion factor):
920 lb $P_2O_5$ × 0.437 = 402 lb P

Next, calculate the cost per pound of P:
$996 ÷ 402 lb P = $2.45/lb P

## MIXED FERTILIZERS

Mixed fertilizers contain more than one nutrient. An example is granulated diammonium phosphate (18-46-0). Although mixed fertilizers supply more than one nutrient, fertilizers should be mixed to meet the specific needs of the crop in question based on sound soil sampling and analysis. Always test your soil using good techniques prior to fertilization (see NMSU Extension Guide A-114, *Test Your Soil* [http://aces.nmsu.edu/pubs/_a/A114.pdf]).

| Table 2. English–Metric Conversions | | | |
|---|---|---|---|
| **To convert column 1 to column 2, multiply by** | **Column 1** | **Column 2** | **To convert column 2 to column 1, multiply by** |
| 0.454 | pound (lb) | kilogram (kg) | 2.205 |
| 0.907 | ton | metric ton (Mg) | 1.102 |
| 3.78 | gallon (gal) | liter (L) | 0.265 |

**Example D.** Diammonium phosphate (18-46-0) has cost an average of $675 per ton in the Mountain Region. Calculate the cost of the $P_2O_5$ in this fertilizer.

For this calculation, the cost per pound of N from example A ($0.62/lb) can be used; then the cost of the $P_2O_5$ (the one that is of interest) can be calculated.

What is the cost of the $P_2O_5$ in 18-46-0 using the value of N from urea (see example A)?

First, calculate the pounds of N and $P_2O_5$ in a ton of fertilizer:
2,000 lb fertilizer × 0.18 = 360 lb N
2,000 lb fertilizer × 0.46 = 920 lb $P_2O_5$

Next, calculate the portion of the total fertilizer cost that can be attributed to N:
$0.62/lb N × 360 lb N = $223

To calculate the total cost of $P_2O_5$ in the fertilizer, subtract the cost of N from the total cost of the fertilizer:
$675 – $223 = $452

Finally, calculate the cost per pound of the $P_2O_5$:
$452 ÷ 920 lb = $0.49/lb $P_2O_5$

The cost for $P_2O_5$ can then be compared to other $P_2O_5$ sources. Notice that the cost of $P_2O_5$ in 18-46-0 was substantially less than the cost of $P_2O_5$ in 0-46-0 from example B.

**Example E.** Calculate the cost of elemental P from 18-46-0 based on example D.

First, convert pounds of $P_2O_5$ to pounds of P (from example D; refer to Table 1 for conversion factor):
920 lb $P_2O_5$ × 0.437 = 402 lb P

Then calculate the cost per pound of P:
$452 ÷ 402 lb P = $1.12/lb P

| Table 3. Fertilizer Prices as Reported by the USDA for the Mountain States of CO, NM, WY, and MT† | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Analysis | Year | | | | | |
| | | 2010 | 2011 | 2012 | 2013 | 2014 | Avg. |
| Fertilizer | $N$-$P_2O_5$-$K_2O$ | Dollars per ton | | | | | |
| Ammonium nitrate | 33.5-0-0 | 418‡ | 509 | 529 | 523 | 535 | 503 |
| Ammonium phosphate | 10-34-0 | 430 | 720 | 735 | 685 | 679 | 650 |
| Ammonium sulfate | 21-0-0 | 353 | 436 | 464 | 523 | 504 | 456 |
| Ammonium phosphate sulfate | 16-20-0 | 372 | 537 | 626 | 540 | 560 | 527 |
| Anhydrous ammonia | 82-0-0 | 517 | 730 | 780 | 766 | 690 | 697 |
| Diammonium phosphate | 18-46-0 | 516 | 734 | 753 | 682 | 688 | 675 |
| Monoammonium phosphate | 11-52-0 | 504 | 712 | 727 | 683 | 632 | 652 |
| Muriate of potash | 0-0-60 | 555 | 629 | 669 | 645 | 653 | 630 |
| Triple superphosphate ‡ | 0-46-0 | 775 | 1130 | 1180 | 910 | 986 | 996 |
| Urea | 46-0-0 | 473 | 556 | 594 | 608 | 604 | 567 |
| Urea ammonium nitrate‡ | 32-0-0 | 370 | 692 | 499 | 480 | 445 | 497 |

† Agricultural Prices, USDA, National Agricultural Statistics Service.

‡ Fertilizer cost reported from Southwestern states (AZ, CA, NV, UT).

**Example F.** Calculations based on a "plant food approach" lump N and P together for making value calculations that spread the cost of both elements over each other. Care must be taken when approaching fertilizer value this way. Each element must be expressed on an elemental basis before its value can be calculated. What is the cost of total plant food in 18-46-0?

First, because 18-46-0 supplies two nutrients, both must be expressed on an elemental basis so their "plant food" totals can be summed. In one ton of 18-46-0, there are 360 lb of elemental N (2,000 × 0.18) and 402 lb of elemental P (2,000 × 0.46) for a total of 762 lb of "plant food." From Table 3, we see that 18-46-0 has cost an average of $675 per ton. The cost of "plant food" (both N and P) in 18-46-0 is then $0.89/lb ($675 ÷ 762 lb).

## SOLUTION OR SUSPENSION FERTILIZERS

When determining the cost per pound of nutrients in liquid-based fertilizers that are priced by the gallon, the density of the material must be known. When the liquid fertilizer is priced on a weight basis (cost/pound or cost/ton), the calculations are similar to those used to determine the nutrient cost of dry fertilizer materials. Most liquids are priced on a cost per pound basis.

**Example G.** A hypothetical zinc (Zn) chelate costs $6/gal. It has a density of 11.2 lb/gal and contains 6% Zn. What is the cost per pound of Zn?

First, find pounds of Zn per gallon of solution:

11.2 lb/gal × 0.06 = 0.67 lb Zn/gal

Next, calculate the cost of Zn:

$6/gal ÷ 0.67 lb/gal = $8.96/lb Zn

**Example H.** Urea ammonium nitrate (UAN) solution (32-0-0) has cost an average $497 per ton in the Southwestern states (Table 3). What is the cost per pound of N?

The steps to solving this problem are exactly like those given in example A. First, calculate the pounds of N in the fertilizer:

2,000 lb fertilizer × 0.32 = 640 lb N

Next, calculate the cost per pound of N:

$497 ÷ 640 lb N = $0.78/lb N

UAN has a density of 11.06 lb per gallon at 68°F. The number of gallons that equates to 1 ton is approximately 181 gallons.

## SUMMARY

Every fertilizer material sold in New Mexico must contain a guaranteed analysis that consists of at least three numbers that indicate the percentage of N, $P_2O_5$, and $K_2O$ in the fertilizer. Any other nutrients that are guaranteed must also 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 percentage N, $P_2O_5$, or $K_2O$ in the material. To calculate the cost per pound of elemental P or K, a factor must be used to convert percentage $P_2O_5$ to percentage P, and percentage $K_2O$ to percentage K (Table 1). For mixed fertilizers (those with more than one plant nutrient), the cost per pound of one or more nutrients that could replace the nutrient found in the mix must be used. The contribution of these nutrients to the cost of the mix is subtracted from the total mixed fertilizer cost. The residual cost is then used 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.

The cost per pound of nutrient should be the major criterion in determining which fertilizer material to use. Most N-$P_2O_5$-$K_2O$-bearing fertilizers perform equally well when applied properly. Other factors, such as ease of handling, safety considerations, and ease of integration into a grower's production program, also influence which fertilizer material is the best to use.

Always test your soil prior to fertilization to know better what fertilizers may be needed.

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**Revised December 2014** **Las Cruces, NM**