Understanding Common Fertilizer and Plant Nutrition Units

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Fertilizer Labels

Fertilizer products are always labeled with three numbers denoting the percentage (%) by weight of nitrogen (N), phosphoric acid (P_2O_5), and potash (K_2O). It's important to note that N is expressed on an elemental basis but P and K are denoted by their oxide forms (P_2O_5 contains 44% P and K_2O contains 83% K). For example, a 15-10-15 fertilizer product contains 15% N, 10% P_2O_5, and 15% K_2O. If you have a 100 lb bag of that 15-10-15 product, it would contain 15 pounds of N, 10 pounds of P_2O_5, and 15 pounds of K_2O. To calculate the amount of elemental P, multiply the amount of P_2O_5 by 44% (0.44 x 10 = 4.4 lb P). Likewise, to calculate the amount of elemental K, multiply the amount of K_2O by 83% (0.83 x 15 = 12.5 lb K).

The analysis on a liquid fertilizer means the same as that on a granular fertilizer (that is, the three numbers represent the percentage of N - P_2O_5 - K_2O by weight). There can be some confusion, however, because liquid fertilizers are often applied by volume rather than by weight. Most liquid fertilizers provide the number of pounds of N and other elements on a per gallon (or liter) basis that can then be used for calculating application rates.

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Percentage - This unit of measure is the easiest for plant practitioners to understand. It is used most often for plant or soil macronutrients (N, P, K, Ca, and Mg) because they are present in relatively large amounts and are therefore usually expressed as a percentage of the whole.

Parts per million (ppm)- This is an expression of concentration often used to describe very small amounts, such as the amount of micronutrients in plant tissue or soil. It refers to how many parts of a solute that are in a million parts of the whole solution. This is usually expressed on a mass basis.

Some simple conversions:
ppm = mg/kg = mg/L = (% * 10,000)

Milliequivalent per liter (meq/L) - This is a chemistry term that is determined by the concentration of a nutrient and its molecular weight and charge. The formula for meq/L is to divide a given ppm by the equivalent weight. Equivalent weight of an element or compound is simply its atomic weight (found in the periodic table) divided by its valence (electrical charge). For example, the equivalent weight for Ca^{++} would be 40/2 = 20. Similarly, the equivalent weight for K+= 39/1 = 39. If the ppm of Ca^{++} is 100, then the meq/L would be 100/20 = 5 meq/L Ca.

To convert to meq/100 g, divide meq/L by 10. So, 5 meq/L/10 = 0.5 meq/100 g.

Nutrient Concentration Versus Nutrient Content

The traditional approach for determining plant nutrients is to send a tissue sample to a laboratory; results come back reporting the concentrations of selected elements using units of % and ppm. However, looking solely at concentration data can lead to inaccurate conclusions because concentration is related to the plant's biomass. For instance, when the plant is actively growing (that is, increasing in biomass), concentrations of nutrients can be diluted even though their total amount (content) may be increasing within the plant. Examining the nutrient proportion (concentration) and amount (content) can give a more accurate look at the plant's nutrient status than evaluating concentration and/or biomass individually.

Nutrient content can be calculated from the biomass and concentration (that is, concentration x biomass = content). The portion of biomass must be clearly defined in order to interpret the results. Common portions of biomass are a specific subsample of needles or leaves, the entire shoot (including the stem and buds), the entire root, or the entire plant. This can be based on an individual plant or on a composite of several plants. For example, a sample of 50 pine needles weighing 680 mg with a nitrogen concentration of 1.7% would have a nitrogen content of 680 mg x 0.017 = 11.56 mg.

These data can be further examined in an easy-to-use integrated graphic format, which is a useful tool for comparing samples, determining treatment effects, or evaluating plant responses over time (Figure 1).

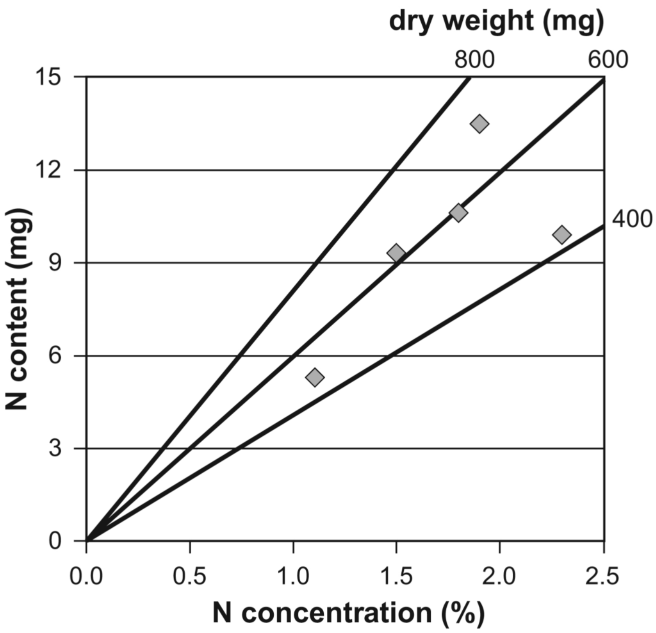

Figure 1 - Example of integrated graphic format that allows for simultaneous comparison of nutrient concentration, nutrient content, and biomass. See Haase and Rose (1995) for additional information on how to use this technique to evaluate plant nutrient data.

Useful Metric Conversions For Use In Nutrient Calculations

1 pound (lb)	=	454 g
1 square meter (m^2)	=	10.76 ft^2
1 hectare (ha)	=	10,000 m^2
		2.47 ac
1 kilogram (kg)	=	1000 g
		2.2 lb
1 lb/acre (ac)	=	1.12 kg/ha
1 kg/ha	=	0.89 lb/ac
1 lb/1000 ft^2	≈	0.5 kg/100 m^2
1 liter (L)	=	1000 ml
		0.264 gal
1 gallon (gal)	=	3785 ml

References

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