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Consider All Factors When Determining Potato Fertilization Needs

William H. Bohl

Higher energy costs have been in the news on an almost daily basis. Increased fuel costs affect everyone, and no one is likely more aware of this than potato producers because higher energy prices have translated into escalating fertilizer costs. With this in mind, now is a good time to review the role plant nutrition plays in potato crop growth and development so producers are aware of all factors that should be considered in determining fertilizer needs.[1]

Considering all the known chemical elements, relatively few, only 16, are needed for plant growth. To be considered essential for plant growth, an element must meet three requirements: 1) it is needed for a plant to complete its life cycle; 2) no other element can be used in its place as a substitute; and 3) it is directly involved in some plant metabolic process. The elements that meet these requirements are carbon, hydrogen, oxygen, nitrogen, phosphorus, potassium, sulfur, calcium, magnesium, zinc, manganese, iron, copper, boron, molybdenum, and chloride.

Nitrogen is contained in all living cells in the form of protein, so it's obvious why this element is so essential for plants. Nitrogen is also part of other necessary plant compounds such as chlorophyll used in photosynthesis. Initially, plants suffering from nitrogen deficiency will be light green in color followed by the older leaves turning yellow to light brown. Later as deficiency symptoms continue to develop, growth will be slowed.

Like nitrogen, phosphorus is contained in all living cells and is used in the process to make RNA and DNA. These two compounds contain the genetic information of plants. Another important role of phosphorus is its involvement in energy storage and transfer. You could almost think of phosphorus as the "gasoline" of plants. Phosphorus-deficient plants are stunted with a dark green color. Potato plants with severe deficiency symptoms may have curled leaves with a purplish color.

Potassium is used by the plant to transport sugars and for starch formation. It is also used in the opening and closing of stomata—openings in the leaves through which plants take in carbon dioxide and give off oxygen during photosynthesis. Plants suffering from potassium deficiency will initially have young leaves that have a glossy appearance with surface crinkling. Severe deficiency will cause leaf margins to turn brown.

By far, the largest part of a producer's fertilizer cost is associated with the major nutrients, nitrogen, phosphorus, and potassium, although some of the micronutrients may need to be applied to some fields. The quantity of nitrogen, phosphorus, or sium needed by a field of potatoes will vary depending on several factors including, for example, potential yield, local growing conditions and variety. Generally, each acre of potatoes yielding 300 to 400 cwt. per acre will take up about 200 to 240 lbs. nitrogen (N), 25 to 35 lbs. phosphorus (P), and 280 to 320 lbs. potassium (K).

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The variety of potato grown in combination with growing season greatly influences how much of a nutrient, particularly nitrogen, is needed by a potato crop. For a variety like Russet Burbank with indeterminate growth—plants continue to produce new foliage all season—as the length of the growing season increases, crop nutrient requirements will need to be increased in proportion to reach the higher yield potential. Some newer varieties, regardless of growth habits, may require less nitrogen than Russet Burbank.

As stated above, especially for indeterminate varieties, longer growing seasons will increase the need for fertilizer. The reason is that photosynthesis needs to be maintained, and if the nutrient supply is not sufficient, the rate of tuber growth will be compromised resulting in less than maximum production.

Both physical and chemical soil characteristics affect nutrient availability. Sandy soils have a lower water-holding capacity, which results in a greater potential for nutrients to leach below the potato root zone. The effective rooting depth of potatoes is 18 to 24 inches. The ability of sandy soils to hold nutrients is likely more important than their water-holding capacity. Coarse-textured soils have a lower cation exchange capacity (CEC). The CEC is a measure of the ability of a soil to hold and exchange positively charged ions. Potassium is a positively charged ion, so soils with a low CEC will not hold and exchange with plants as much potassium compared with clay soils that have a higher CEC.

For phosphorus, another soil chemical property that greatly influences fertilizer rates is soil pH and free lime content. In many areas of Idaho, soils have a high pH and excess lime that substantially reduces phosphorus availability. For each one percent free lime, the amount of fertilizer phosphorus will need to be increased by 40 pounds per acre.

As might be expected, soil temperature will affect nutrient availability. This past spring the temperatures were quite cool all through May and into early June. This likely reduced root growth and root physiological activity, which in turn reduced nutrient

uptake. Phosphorus is particularly affected by low soil temperature because it moves slowly and minimally in the soil, and is absorbed only when roots actively take it up.

Soil nitrogen can also be limited by cool soil temperatures because the rate of nitrogen mineralization is lower. Mineralization is the chemical process converting soil organic matter into a usable nitrogen source for plants. However, with high soil temperatures in the spring, plant growth is accelerated resulting in a higher nutrient demand.

Typically, to produce a 400 cwt. per acre Russet Burbank potato crop will require 240 lbs. fertilizer nitrogen per acre when the soil nitrate-nitrogen test for the 0 to 12-inch soil depth is zero, and will require 320 pounds fertilizer phosphorus with a zero ppm soil P test and no free lime. The amount of fertilizer potassium required will be 600 pounds with a 25 ppm soil K test.

Although producers have little influence on how much fertilizer will cost for the 2009 crop, they must use all available information to determine the amount of each nutrient to apply. In calculating fertilizer application rates, it is essential to set realistic yield goals based on field history and previous crops. A second key factor in estimating fertilizer needs is to obtain a good soil sample. Each soil sample should represent no more than approximately 20 acres. Fertilizer applications can also be fine-tuned by sampling a field by soil type within a field or by grid sampling. Now, more than ever before, it is essential to use your fertilizer dollars wisely.

[1] Information Sources:

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About the Author: See pub box.

Did You Know?

One gram of soil (0.035 oz) may tain up to approximately 4 billion bacteria, which are needed for various soil activities such as decomposing organic materials.

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Editor
William H. Bohl, Ph.D.
UI Extension Educator
wbohl@uidaho.edu

Associate Editor
Phil Nolte, Ph.D.
UI Potato Seed Specialist
pnolte@uidaho.edu