Best Management Practices for Profitable Fertilization of Potatoes

By Rob Mikkelsen

Because of the intensive nature of potato production, considerable work has been done to determine the optimum techniques to manage the crop and nutrients. This article looks at fertilizer best management practices (BMPs) for potatoes.

Potatoes managed for maximum productivity have a high demand on soil nutrients. Significant quantities of nutrients are accumulated in the tops and are removed from the field in the harvested tubers (**Table 1**). Since potatoes are commonly grown on sandy-textured soils, additional challenges for nutrient management are present.

Potatoes grown for processing are valued for yield, size, and also for dry matter content (measured by specific gravity). As the specific gravity increases, the water content of the potato decreases, improving the frying properties and flavor. Management factors, including fertility decisions, will influence potato yield, quality, and storage properties. Potato growth is classified into four distinct growth phases (**Figure 1**). The exact timing of these growth phases depends on many environmental and management factors that vary between locations and cultivars. However, these distinct stages of growth need to be considered when managing the crop.

Table 1. Typical nutrient accumulation and removal in Russet potatoes in a 500 cwt/A crop (lb/A).

Nutrient	Potato vines	Removed in tubers	Total accumulation
Nitrogen (N)	139	214	353
Phosphorus (P)[1]	11	29	40
Potassium (K)[2]	275	240	515
Calcium (Ca)	43	7	51
Magnesium (Mg)	25	15	40
Sulfur (S)	12	22	34

Source: Oregon State Univ. Potato Information Exchange, 2004. Also personal communication, Dr. Don Horneck, Oregon State Univ.
[1]To convert P to P_2O_5, multiply by 2.29
[2]To convert K to K_2O, multiply by 1.2

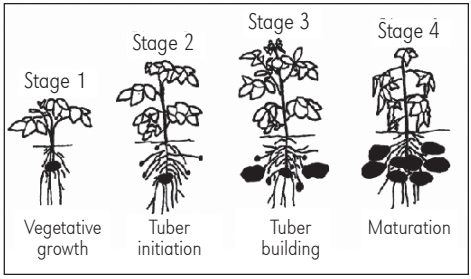

Figure 1. Major stages of growth and development of potatoes. The nutrient requirement of the developing potato changes during the growing season.

The maturity class and growing season length are two primary factors determining potato nutrient requirements. Short-season, early maturing (determinate) potatoes generally have a high and intense nutrient demand during the vegetative and tuber initiation stages. Long-season potatoes (indeterminate) have a longer period of nutrient uptake. The specific fertilization strategy must be adjusted for the different varieties and maturity classes or poor results will occur.

Nutrient Management

For potatoes, either deficient or excessive plant nutrition can reduce tuber bulking and quality. Nutrient deficiencies may limit the leaf canopy growth and its duration, resulting in reduced carbohydrate production and tuber

growth. Maintaining healthy leaves is a key to producing high yields. However, excessive nutrient applications may cause nutrient imbalances or over-stimulate vegetative growth at the expense of tuber production. Some nutrients, such as S, may also have indirect yield benefits by reducing tuber disease.

Proper N management is one of the most important factors required to obtain high yields of excellent quality potatoes. An adequate early season N supply is important to support vegetative growth, but excessive soil N later in the season will suppress tuber initiation, reduce yields, and decrease the specific gravity in some cultivars. Excess soil N late in the season can delay maturity of the tubers and result in poor skin set, which harms the tuber quality and storage properties.

Potatoes are a shallow-rooted crop, generally growing on sandy, well-drained soils. These soil conditions frequently make water and N management difficult since nitrate is susceptible to leaching losses. On these sandy soils, it is recommended that potatoes receive split applications of N during the growing season. This involves applying some of the total N requirement prior to planting and applying the remainder during the season with side-dress applications or through the irrigation system. The period of highest N demand varies by potato variety and is related to cultivar characteristics such as root density and time to maturity. Use of petiole analysis during the growing season allows producers to determine the N status of the crop and respond in a timely manner with appropriate nutrients.

Roots absorb phosphate ions only when they are dissolved in the soil water. Phosphorus deficiencies can occur even in soils with abundant available P if drought, low temperatures, or disease interfere with P diffusion to the root through the soil solution or otherwise stunt normal root development and function. Proper irrigation management and scheduling is critical for potato development and utilization of applied nutrients.

Commonly available P fertilizer sources are equally useful for potato nutrition. The selection of a particular P fertilizer is generally based on grower preference, price, and compatibility with application equipment. Recent research suggests that modifications to P fertilizer, such as polymer additives, humic substances, and coatings may be beneficial in improving P uptake and potato production.

Potatoes require large amounts of soil K, since this nutrient is crucial to metabolic functions such as the movement of sugars from the leaves to the tubers and the transformation of sugar into potato starch. Potassium deficiencies reduce the yield, size, and quality of the potato crop. A lack of adequate soil K is also associated with low specific gravity in potatoes.

Potassium deficiencies impair the crop's resistance to diseases and its ability to tolerate stresses such as drought and frost. Applying K fertilizer with a broadcast application prior to planting is most commonly recommended. If the K is band-applied, the rates should be kept below 50 lb K_2O/A to avoid any salt injury to the developing sprouts.

Pre-season soil sampling and analysis can provide essential information on the starting point and residual fertility related to the growing conditions for the potato crop. In-season soil analysis can also provide information useful for monitoring nutrient availability along with plant tissue testing.

Potato petioles are frequently sampled during the growing season to monitor the plant nutrient status. Petiole analysis can be done for all of the essential nutrients, but nitrate determination is the most common test. Petiole P concentrations are also used to measure the P status during the growing season. BC

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To view a chart listing fertilizer BMPs for the Northwest U.S., plus additional information and references, visit the PPI website: ***>www.ppi-ppic.org<***.