Material Contributed by the Potash & Phosphate Institute

Effective Phosphate Management

Understanding behavior of phosphorus relative to environment and recent technology is critical in tapping this elusive nutrient so essential to plant growth.

It is difficult to keep phosphorus (P) available to plants. It is virtually immobile and wants to link up chemically with such elements as Ca and Fe to form compounds that do not move readily to roots. How little does P actually move? If the P in a loamy soil is more than one-fourth of an inch from a root, it will never move close enough to be taken up by the root. It has been estimated that roots of a growing crop contact only one to three percent of the soil in the surface six to seven inches.

Thus, it should not be surprising that P deficiency in crops may be more limiting to world crop production than other deficiencies, toxicities and diseases. A recent summary of soil test information indicates that many areas have a significant percentage of soils testing medium or less in P (Table 1).

In this discussion, we will explore the principles of managing phosphate to produce maximum efficiency in plant uptake. Included in the review will be cultural/environmental factors, nutrient interactions, and nutrient placement.

Variables

P availability is tied to a number of variables which are listed below. Most crops recover only 10 to 30 percent of phosphate during the first year following application. Recovery percentage varies widely, depending on phosphate source, soil type, crop grown, application method, and weather. But much of the residual P will be available to succeeding crops.

Amount of clay. Soils high in clay content will fix more P than those containing less clay.

Type of clay. Soils high in kaolinitic clay (common to high rainfall and temperature regions such as the southern U.S.) retain or "fix" more added P than other soils.

Timing. The longer soil and added phosphate are in contact, the greater the chances of fixation. The critical period— how long after application can plant effectively use P?—determines fertilization scheduling.

Aeration. Oxygen is necessary for plant growth, nutrient absorption, and microbiological breakdown of soil organic matter, an important P source.

Compaction. Soil compaction reduces aeration and pore space in the root zone, which reduces P uptake and plant growth.

Soil moisture. Delicate balance here. Right amount makes P more available. Too much slows P uptake.

P status. It is important to maintain high soil P levels to support optimum crop production.

Temperature. When temperatures are too high or too low, they can affect plant P uptake.

Crop. Crops differ greatly in their ability to extract available P from the soil. Time and method of phosphate fertilization should be matched to cropping system to ensure most efficient uptake.

Interaction

Nitrogen. When applied with N, phosphate is more available to plants than when applied without N. Figure 1 shows the improvement 20 lbs/A of N makes in P uptake by the plant. This influence of N on P uptake is very clear during early growth, in some cases as much as 65 percent of P in the plant comes from fertilizer early in the season.

Other nutrients. Calcium on acid soils and sulfur on alkaline soils seem to increase P availability. But zinc fertilization with borderline P deficiency tends to restrict P uptake. Potash applications have little or no effect.

pH

Figure 2 illustrates how P availability varies with soil pH. In acid soils, P reacts with Fe, Mn, and Al to form insoluble products, making P less available. In alkaline soils, Ca reacts with P to lessen P availability. The more soluble or available P forms exist

Table 1. Phosphorus soil test summary as reported by U.S. states and two Canadian provinces, PPI.

State or province	% testing medium or less in P
Iowa	44
Alabama	65
Pennsylvania	56
Oklahoma	52
Nebraska	69
Ohio	32
Saskatchewan	85
Ontario	52

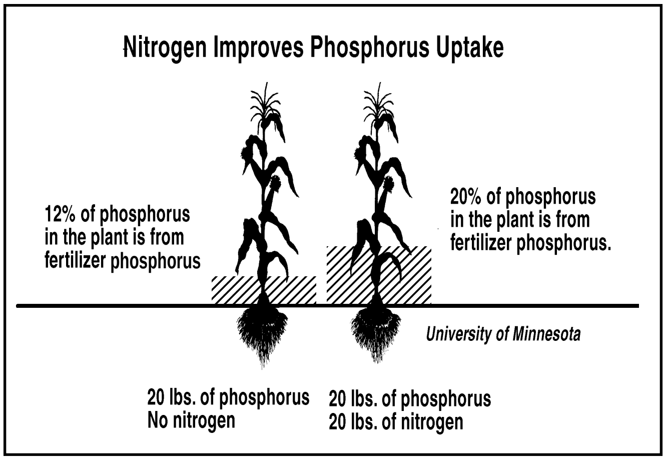

Figure 1. Effect of N application on P uptake by corn plant.

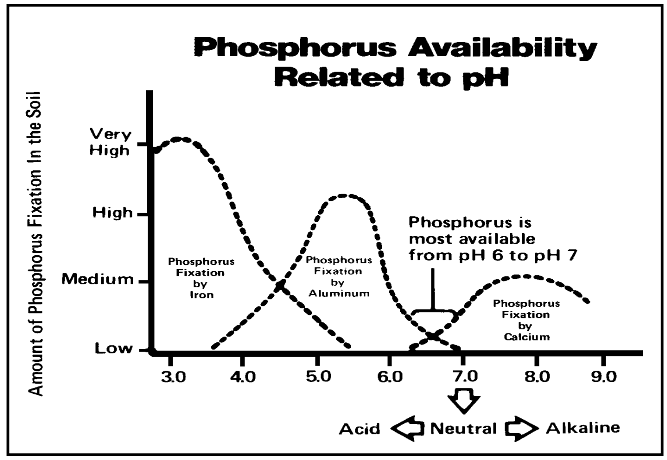

Figure 2. Effect of pH on P solubility in the soil.

in the 5.5 to 7.0 pH range. This makes a sound liming program essential on very acid soils.

Banding favored

There is no set method of applying phosphate fertilizer. If a grower is looking for maximum return from phosphate investment, band application is the best bet. Crops usually respond more to banded than to broadcast phosphate on low fertility soils. Banding puts a readily accessible P source in the root zone, making it positionally more available. Fixation is greater when phosphate is broadcast. However, as fertility levels increase, the banding advantage disappears. And potential yields go up.

Fluids choice

In addition to precision placement, water solubility of phosphate and inclusion of primary and secondary nutrients are advantages universally recognized as inherent in fluid fertilizers. Mixes are homogeneous and fluids lend themselves to banding or subsurface injection technology. Thus, fluids can play a key role in reducing phosphate fixation via precision placement where the phosphate is positionally available to plant roots. Efficiency is maximized and profits improved.

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