Crop Nutrient News

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Phosphate Expectations

I have counted at least 22 factors which influence the effectiveness of phosphatic fertilizers for increasing plant growth, yields and quality. These factors include soil pH, type and amount of clay, organic matter, soil moisture, soil temperature, soil aeration, fertilizer reaction products and the interaction of phosphorus with other nutrients like copper, zinc, iron or manganese.

There are also a number of factors which the grower can control to a greater or lesser degree by various management and cultural practices. Disease, cultivator "blight," soil compaction and insect damage can reduce phosphorus uptake. Let me focus on three phosphate response factors: (1) soil reaction (pH), (2) soil temperature and (3) phosphate fertilizer properties.

Soil Reaction (pH)

Soil reaction plays a dominant role in the availability and efficiency of both fertilizer phosphorus and soil phosphorus. As a general rule, the pH range for maximum availability of phosphates in the soil is about 5.5 to 7.0–moderately acid to neutral. Availability generally decreases rapidly both above and below these pH values.

In acid reaction zones, phosphorus becomes "fixed" with iron and aluminum compounds to form products which are insoluble and thus less available to plants. The exception is highly organic peat soils. In alkaline or high-calcium soils, where pH values are greater than 7.0, water-insoluble compounds such as dicalcium phosphate are formed.

The use of ammonium nitrogen in combination with phosphorus (P) decreases the root zone pH and this helps to slow the formation of water insoluble phosphates in the fertilizer zone. Banding phosphate fertilizers under early spring seeded crops or fall planted small grains has significantly increased the availability of P. The high concentration of P and the low pH produced by the contained ammonia strongly favors extended availability and increased uptake of fertilizer P.

Soil Temperature

Soil temperature exerts considerable influence on the response by plants to added phosphate. Cool soils, often associated with early spring or late fall and winter, can significantly reduce P availability. This can occur even in soils apparently well supplied with phosphorus. The slowing of soil chemical and biological reactions, reduced nutrient absorption by the roots and a further slowing of root growth contribute to a reduction in P availability and uptake.

Banding of phosphate starter fertilizers, as noted earlier, tends to overcome the effect of low temperatures. Studies show that 50 percent of the total P requirement of a plant is absorbed when only 20 percent of the total plant growth has occurred. The limited root system of seedling plants and competition for available P by the soil explains the need for adequate amounts of readily available P close to roots in the early stages of plant growth.

For example, P shortages are often more pronounced on earlier planted tomatoes. Tomatoes were found to respond more to P at 55 degrees Fahrenheit than at 70 to 85 degrees F, even though growth is sharply reduced at soil temperatures below 58 degrees F, regardless of P availability. Nevertheless, from the agronomic standpoint, the amount of P needed for maximum growth at the lower temperatures is greater than at higher temperatures. The key management point is that it is important for adequate P to be available when tomatoes, small grains, or similar crops are seeded in cold soils.

Even though increasing available P can not completely offset the growth-depressing effect of low temperature, it is one of the few management practices available to help offset low soil temperatures.

Fertilizer Properties

Probably the two most important properties of pelleted phosphatic fertilizers are the form of the contained nitrogen and the presence of sulfate ion (SO4). It is thought that the presence of the sulfate ion may have a significant effect on P uptake by plants.

Purdue University found that when ammonium nitrogen and sulfate sulfur are mixed with water-soluble phosphate fertilizers and applied in a band, there is a great increase in root growth in the band and a greatly increased uptake of P by the plant. This response does not occur with the same magnitude when the nitrogen is in the nitrate form nor does it occur if the sulfate ion is absent. Similar results have been reported under field conditions in California.

For direct seeded crops planted when soil moisture is high and soil temperatures are low, fertilizer phosphate availability can be significantly increased by banding. The use of dry fertilizers containing ammonium (NH4) ion or ammonium based liquid fertilizers enhance P uptake.

Remember, for most crops one of the keys to unlocking "champion-sized" yields may well be found in phosphate management. □