Proper phosphorus management is key to optimizing Montana crop yield

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Proper management of phosphorus fertilizer applications is key to optimizing crop yield, says a Montana State University Extension specialist.

Phosphorus is second only to nitrogen in the amount of fertilizer applied to cropland in Montana. Unlike nitrogen, phosphorus is very difficult for plants to access. Phosphate is the only form of phosphorus that plants can absorb, but, in most Montana agricultural soils, less than 0.01 percent of phosphorus is phosphate.

Montana has some of the lowest phosphorus soil test results in the United States. "Unfortunately, because Montana's calcareous, high pH soils quickly convert phosphorus from plant available to unavailable forms, phosphorus fertilization does not always substantially increase phosphorus soil test levels," said Clain Jones, MSU Extension soil fertility specialist in the Department of Land Resources and Environmental Sciences.

"Phosphorus banding below the soil surface is recommended over broadcast applications because banding saturates the soil with phosphorus in a relatively small area within the root zone, increasing phosphorus availability," Jones said.

Applying phosphorus with or near the seed is very effective at increasing yields. Other practices that increase phosphorus availability include increasing organic matter through conservation tillage and manure applications. When conservation tillage is used, Jones recommends using a subsurface band of phosphorus either with, or as much as two inches below the seed, to avoid stranding the phosphorus at the surface. Minimizing soil erosion and avoiding practices that cause high levels of phosphorus at the soil surface, are the best ways to decrease phosphorus losses from fields.

Of the phosphorus fertilizers sold in Montana, generally the form of phosphorus fertilizer is less important than the actual application rate. Jones said that the main exception to this is that "MAP" or monoammonium phosphate may be slightly more available than "DAP" or diammonium phosphate in Montana soils, because MAP temporarily lowers soil pH in a small region around the granule. Banding elemental sulfur with phosphorus fertilizer can increase available phosphorus, because elemental sulfur acidifies the soil.

Some soil bacteria and fungi can access otherwise unavailable phosphorus, and some are commercially available. In a study on barley, one of these bacteria increased phosphorus availability by about 10 percent. In another study, a phosphate-solubilizing fungus was found to increase spring wheat grain yield by nine percent. "For both studies, the economics need to be considered to determine if these increases are worthwhile, and additional research is needed to determine the effectiveness of these products for different crops and soils," Jones said.

Though commercial humic acid is sometimes applied to improve phosphorus availability, a Montana study showed no increases in phosphorus availability or spring wheat yield when two different humic acid sources were applied at label rates. "Consultants and producers should use caution when purchasing humic acid products that claim to increase small grain yields when applied at low rates," said Jones.
"Seeding crops that acidify the root zone may be a good approach to increase phosphorus availability. These crops include buckwheat, most legumes including pea, lentil, alfalfa and sainfoin and crops within the mustard family such as canola and yellow mustard," Jones said. He added that less phosphorus fertilizer should be necessary if crops can acidify their root zone, because more of the phosphorus fertilizer remains available. It is likely that increases in phosphorus availability only occur for the acidifying crop and not subsequent crops due to Montana's well buffered soils, and because the acidification happens in only a small region near the root.
Although phosphorus is not very available in Montana soils, the management techniques listed above provide some means to increase phosphorus availability in order to optimize crop yield.
Contact your local MSU Extension agent or crop adviser for help with phosphorus fertilizer decisions, or for additional information on phosphorus fertilizer calculations and placement, see Nutrient Management Modules 4 and 11 on the Web at http://landresources.montana.edu/nm.