

## Phosphorus as a capital investment

Summary: Phosphorus fertilization can be a long-term investment.

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BOZEMAN – Investing in soil phosphorus may not seem worthwhile in difficult economic times, but building soil phosphorus levels may be economical in the long run if soil tests show low to medium phosphorus levels.

“At very low soil phosphorus levels, a high phosphorus dose prevents phosphorus deficiency, and has longer lasting benefits than smaller annual applications,” says Clain Jones, Extension soil fertility specialist in the Department of Land Resources and Environmental Sciences at Montana State University.

There are different approaches to phosphorus fertilization: Maintenance, sufficiency, and build. “In a maintenance fertilizer program you apply approximately what is removed at harvest. A 40 bushel per acre harvest would need approximately 25 pounds phosphorus (P<sub>2</sub>O<sub>5</sub>) per acre added annually to avoid ‘mining’ the soil of phosphorus,” Jones said.

Maintenance rates are generally the lowest, yet they are not recommended unless soil phosphorus test levels are high, above 16 parts per million (ppm).

In a sufficiency fertilizer approach just enough phosphorus is added annually to optimize that year's yield under average growing conditions. “Neither of these approaches gives the producer large soil phosphorus reserves to use in years of high fertilizer prices or yield potential”, says Jones.

In comparison, the "build approach" supplies a large amount of phosphorus over one or two years to increase available phosphorus levels, and could be considered an investment in your soil, Jones said.

One concern about adding a large amount of phosphorus is that it might get tied up with calcium and not be available to plants. This does happen, but the phosphorus can be released over time.

Ardell Halvorson currently with the USDA-ARS Soil, Plant and Nutrient Research Lab in Fort Collins, Colo., studied wheat grown near Culbertson, Mont., on calcareous soils with less than 6 parts per million phosphorus. He found a single large dose of surface broadcast and then incorporated phosphorus increased available soil phosphorus for over 15 years and satisfied crop needs for several years. A P<sub>2</sub>O<sub>5</sub> dose of 180 pounds per acre increased cumulative yield over six wheat-fallow cycles by 104 bushels per acre when compared to yields from fields without added phosphorus. Halvorson stressed that the crops were better at using residual phosphorus if sufficient nitrogen was available.

A University of Saskatchewan study, reported by John Stewart, showed that yields from single high doses compare favorably to yields from annual applications on a calcareous soil with less than 3 parts per million phosphorus. A single application broadcast on the surface and then incorporated of 81 pounds P<sub>2</sub>O<sub>5</sub> produced yields similar to 41 pounds P<sub>2</sub>O<sub>5</sub> per acre seed-placed annually over 5 years and saved 124 pounds of P<sub>2</sub>O<sub>5</sub>. Adding 20 pounds P<sub>2</sub>O<sub>5</sub> per acre seed-placed annually to the single dose application of 81 pounds P<sub>2</sub>O<sub>5</sub> yielded better than either a single application of 324 pounds or 5 annual applications of 41 pounds P<sub>2</sub>O<sub>5</sub> per acre and required less P<sub>2</sub>O<sub>5</sub>.

Jones says a build approach for phosphorus is possible because, unlike nitrogen, phosphorus applied well above crop needs is not readily lost from a well-managed system. Although excess uptake of phosphorus can occur at high application rates, the benefits may well outweigh this potential disadvantage.

“A one-time big application may not be a bad way to go especially when fertilizer prices are relatively low, or prior to seeding a perennial crop,” Jones said. The phosphorus rate, soil properties, and type of crop will determine how well and for how long crop needs could be satisfied. Also, Jones adds, “build-up is likely only economical if soil tests are low to medium. If they are high, this likely won’t pay.”

Jones acknowledges that annual phosphorus applications may be easier and less costly than applying a single high dose, especially in no-till where the grower cannot work the phosphorus into the root zone. Dry phosphorus sitting on the soil surface will not feed the crop. However, the no-till producer faced with very low soil phosphorus still can increase the annual seed-placed amount to slowly build soil phosphorus. Stewart found that annual seed-placed phosphorus in a low phosphorus soil can build soil phosphorus and become significant in crop production in as few as 5 years.

Assessing the costs of build-up is complicated. They include the lost revenue if yields are limited by phosphorus deficiency and the potential gain on other investments not made because funds were tied up in phosphorus in the soil. Depending on the farm, those alternative opportunities or investments might include paying off loans, replacing equipment, adding new facilities or investing in a non-farm business. Yet, there may be immediate net returns, as Halvorson found the higher uptake of nitrogen due to sufficient phosphorus helped increase grain protein. Higher protein helped offset the cost of the phosphorus.

If producers decide to invest in the phosphorus fertility of their land, they should consider increasing fertility quickly to maximize the yield return on the investment. Rapid buildup can be used on areas of low fertility or to return a whole field with low phosphorus back into full potential production.

A build approach should likely only be considered if you are the landowner or have a long-term lease. If you plan to sell soon, determine if potential buyers are willing to pay for higher soil phosphorus. Investing in soil phosphorus may also offer tax advantages in years with high revenues. In the long-term, if potential phosphorus loss is low, then a single application to build soil phosphorus may optimize yields and only require minimal annual phosphorus additions for many subsequent years. Phosphorus management options should be revisited periodically.