by FFF Review

Where Does Organic Phosphorus Fit In Your Fertility Program?

Phosphorus is a key ingredient in the DNA molecule. Strange as it may seem, up to 50 percent of the soil's organic phosphorus could be in the form of DNA.

Webster's dictionary says the word *organic* pertains to a branch of chemistry that deals with compounds containing carbon. Organic phosphorus, then, pertains to compounds containing both phosphorus and carbon. Unlike simple compounds such as calcium phosphate, sodium phosphate, or ammonium phosphate, organic phosphorus compounds are extremely *complex* compounds that originate from the decomposition of corn stalks or straw by microorganisms in the soil.

How it works

Why should we be interested in organic phosphorus? Because the plant we fertilize has everything to do with ultimately enriching the soil for future crops. The process works something like this. We know the plant absorbs phosphorus by taking in anions — $(H_2PO_4)^{-1}$, $(HPO_4)^{-2}$— in the soil solution. These inorganic phosphates are easily supplied by adding commercial fertilizers to the fields. During the growing process, however, plants convert this inorganic phosphorus into organic phosphorus. In what quantities? Substantial. For example, a 200-bu/A corn crop contains about 30 lbs of organic phosphorus in the grain and the same amount—and this is important—in the residue and roots that will he left. This organic phosphorus in the residue will eventually find its way into the phosphorus reserve in the soil and be available for future crops.

Also in the soil are what we call "fixed" inorganic phosphates, a group of phosphates that are unavailable to the plant. They include iron, calcium, and aluminum phosphates. Soils have different fixing properties, depending on pH and various metallic ions that can tie up phosphorus.

Figure 1 shows the relationship of fixed inorganic phosphates, available phosphates, and organic phosphates. When incorporating inorganic phosphates, the equilibrium can shift toward fixation. On the other hand, as organic matter decomposes (or mineralizes) the equilibrium can shift to the phosphates more available to the plants. It is important to note that the grower can promote decomposition of organic matter and release of phosphates (and nitrogen) during July and August, the two months of maximum uptake by the corn plant.

Three key steps

How does the grower promote decomposition of organic matter?

First, he must manage residue to form the organic matter.

Second, pH of the soil should be

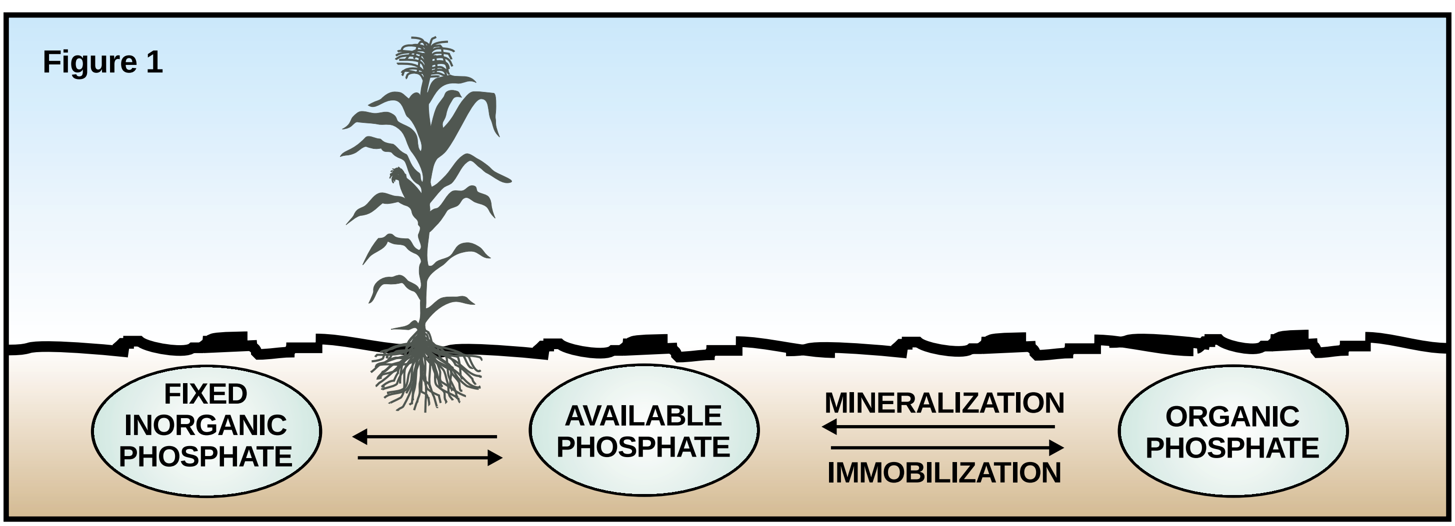

Figure 1. Relationship of fixed inorganic phohphates, available phosphates, and organic phosphates.

adjusted to maximize microbial activity.

Third, and these may or may not be under control of the grower, there must be warmth, moisture and soil tilth to encourage an active microbial environment. Rains or irrigation can supply moisture, but the grower will have to depend on Mother Nature to supply the warmth.

Concerning soil tilth, remember the goal of our Maximizing Soil Productivity (MSP) program is to produce a low density, deep soil that tends to also maximize microbial activity. This “mineralization” kicks loose phosphates that become one of the needed ingredients in raising high-yield crops. The mineralization process is carried out by soil microorganisms that literally feed on the residue, then die. These dead bodies make up a black material we call soil organic matter.

When organic matter is finally produced, it contains a substantial amount of organic phosphorus (Table 1). Notice that in the 0 to 6-inch layer, a soil with 3 percent organic matter could contain about 1,000 lbs of phosphorus (expressed as P_2O_5) per acre. The organic phosphorus in this organic matter is not immediately available to the plant. This phosphate must be converted again to the inorganic form, as we mentioned before, in order to be available.

But don’t dismay, we aren’t sliding backwards. The organic phosphate *is* being stored for the corn grower. It will be released into the soil in available form when the corn needs it most: in the summer months at the peak of the growing season. Through a process of “mineralization:’ organic phosphorus (as well as nitrogen and other nutrients) is made available under conditions of warmth, moisture, proper pH, and good residue management.

Like the rumen

Another interesting way to look at it is to compare organic phosphorus in the cornfield with the rumen of a cow. Cattle feeders know that their livestock can eat tremendous quantities of silage, corn, or milo and still develop serious phosphorus deficiencies. Organic phosphorus in feed (called Phytin phosphorus) is only slightly bioavailable to animals. To make up for this deficiency, supplemental inorganic phosphorus fed to livestock in the form of monocalcium or dicalcium phosphate increases digestion. The result is 1) better feed efficiency, 2) increased weight gains, and 3) improved general health. In livestock, as well as humans, about 20 percent of the phosphorus is in the soft tissue in the form of literally hundreds of complex organic compounds. Phosphorus in soft tissue is required to metabolize carbohyrdrates and fats. It is a component of all living cells. How critical is it? When phosphorus was removed from the diet of young turkeys, they died within 10 days!

A MUST ingredient

In modern farming, when yields are approaching 200 to 300 bu/A, when more and more residue is being added to the soil, organic phosphorus becomes a significant consideration in residue management. Added residue need not be a problem. Instead, *it can be* the solution to nutrient management for high yields.

Let there be no question. Organic phosphorus plays a big role in our quest for building a highly productive soil that can produce high yields.