Phosphorus

In native ecosystems, plant growth is in balance with soil,water and nutrient content. Native plants have adaptations (primarily mycorrhizal fungi infected roots) that allow them to acquire needed phosphorus without using fertilizers. These plants should not be fertilized with anything as this could compromise these desirable mycorrhizal associations. Conversely, in cultivated systems such as those used for fruits and vegetables, we usually need to manage soil fertility by adding nutrients. Crop production greatly increases the nutrient demand on the soil – some crops have greater needs than others. Soil phosphorus is particularly important for annual crop plants to be productive.

Plant roots absorb phosphorus as phosphate ions. Phosphate ions are negatively charged and contain one or two hydrogen atoms and four oxygen atoms that surround a central atom of phosphorus. When a plant root hair encounters a phosphate ion it is taken up by the plant. This should happen often enough to satisfy plant growth and reproductive requirements. Once inside the plant, phosphorus is very mobile and easily transported from one location to another (i.e., from root to leaf). Phosphorus is critically important to plant energy transfer processes. Among other things, phosphorus is a part of the cellular currency (adenosine triphosphate otherwise known as ATP) that fuels chemical reactions within the plant.

As we are often reminded, Mother Nature rarely provides optimum conditions for anything. Rather, organisms are constantly being challenged by nature. Maintaining a pool of plant-available soil phosphorus for crop plants can be a considerable challenge. For example, soils high in calcium (as are many Yavapai County soils) react with phosphorus to form insoluble and plant-unavailable calcium phosphate. Certain clay types, iron, and aluminum also have this affect in soil. This process is called phosphorus fixation and it removes excess phosphorus from the available pool.

To supply adequate amounts of phosphorus to crop plants, it should be applied where it will be most available: in the root zone. The quantity should be great enough to overcome any tendency for the soil to “fix” the phosphorus. The most effective strategy for supplying phosphorus to row crops is called "banding". The fertilizer is simply concentrated in a band six to eight inches below the soil surface of the row prior to planting. This is done with specialized equipment on large farms, but can be done in the backyard garden by digging a narrow ditch below the row and applying the fertilizer.

Fertilizer labels list the percentage of nitrogen, phosphorus, and potassium in each product. All products marketed as fertilizer must provide this guaranteed analysis information. A common fertilizer, ammonium phosphate, is labeled 16-20-0. Ammonium phosphate is 20% phosphate (the second number in the series). Several other products are available, both chemical and organic, that contain phosphorus. Bone meal and rock phosphate are the most common organic phosphorus fertilizers. Unfortunately, much of the phosphorus in these products may take several years to become plant available. Chicken manure can contain 4 to 6% phosphorus.

Though a plant root will not discriminate between organically and chemically produced phosphate ions, some consumers want to know where it came from. Native phosphorus comes from the mineral apatite. This is the source of rock phosphate, an organic fertilizer. Apatite is mined in the southeastern United States and various other fertilizers are produced from it also. Various acids are reacted with treated apatite to produce ammonium phosphate (16-20-0), superphosphate (0-20-0), and triple super phosphate (0-45-0).

The symptoms of phosphorus deficiency are reduced growth, dark green (darker than normal) or purplish foliage, thin stems, reduced lateral bud growth, loss of lower leaves, and reduced flowering and fruiting. Phosphorus toxicity is rare but possible if phosphorus fertilizer has been over applied.

Vegetable crops, annual flowers, bulbs, and newly planted lawns respond well to applications of phosphorus fertilizer. Given yearly phosphorus applications in a vegetable garden area, the need for added fertilizer will decrease over time. This can be monitored through periodic soil analysis. In these cases, a bank account of phosphorus is maintained in the soil. Excess phosphorus is not easily leached out of soil by irrigation or rainfall. In closing, try using phosphorus fertilizer and see if it invigorates your garden and increases yields.

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