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JOHN'S CORNER:

MINERALS - The Elements and What They Do (Part 8)

by John Ferguson

15) Phosphorous (P) - The name of this element is derived from the Greek phosphoros, meaning bringer of light. Phosphorous is found in igneous rocks at 1,050 ppm, shale at 700 ppm, limestone at 400 ppm, sand at 170 ppm, and soil at 650 ppm, seawater at 0.07 ppm. It can be found in marine plants at 3,500 ppm, land plants at 2,300 ppm, marine animals at 4,000-18,000 ppm, and land animals at 17,000 to 44,000 ppm.

When four oxygen (O) atoms surround an atom of phosphorus (P), it is known as phosphate (PO4-3) a key component of life and the most common way this element is found and used in nature.

When in a pure form, it is known as white phosphorus, which is very dangerously flammable and a deadly poison. It was used to burn Hamburg, Germany to the ground during WW-II. Also in war, it is used in tracer bullets, flares, incendiary bombs, smoke grenades, and firebombs. Phosphorous is also used to make common kitchen matches due to its flammability.

If phosphorus is combined with chlorine (PCl3) we get phosphorus trichloride which is used to make the extremely dangerous chemical called glyphosate used in many herbicides (Round-Up). Phosphoric acid (H3PO4), is also added to soft drinks.

Phosphorous is used in many things in nature; it is part of the energy molecule ATP (adenosine triphosphate), it is a major structural element in bones and teeth, and is used in more functions in the human body than any other mineral. It is second only to calcium in the human body, composing 22% of body's mineral content. Deficiencies in animals lead to pica, cribbing, and fractures.

Soil archeologists have found that a lack of phosphorous in the soil throughout history has caused mass starvations.

Phosphorous is known to combine with more than 30 other elements to form many types of minerals. Over 350 different minerals containing phosphorous have been identified. In the soil, most phosphate minerals occur in microscopic forms and in low concentrations. If the phosphate ion (PO4-3) combines with aluminum (Al) to form the mineral Wavellite, it can cement the soil creating hardpan, particularly in sandy soil. If iron (Fe) is present, the cementation can be even stronger. This is common in soils where artificial fertilizers have been used.

Depending on the soil, it may contain a lot of phosphorous but very little is available for plants as it is chemically bound up. Microbes living on the organic matter do the conversion of phosphorous from mineral forms to available forms in healthy soils.

In many areas, excess phosphorous (P) is becoming a major source of pollution. Excess phosphorous from water soluble artificial fertilizers often runs off into our streams and lakes. This allows for a tremendous growth of algae and aquatic plants that consume all the oxygen in the water. As a result animal life, from minnows to crawfish dies. Without the predators there are no animal life to eat mosquito larva hence we now have a greatly increased mosquito problem.

Most mined phosphate deposits are often found with arsenic, lead, cadmium, mercury, and other toxic elements. Hence, when one uses artificial fertilizers one is adding these toxic materials to their soil. Fungi in nature are very good at extracting phosphorous from rocks and minerals and making it available to plants. However when one uses a toxic chemical fungicide they lose this benefit. Roots with mycorrhizal fungi can double or even triple the amount of phosphorous available to plants per unit of root length.
If one looks at the periodic table, we see that arsenic (As) is directly below phosphorous (P) hence they have similar chemical properties and can be substituted for each other in molecules. A lack of phosphorus in our diets would accelerate our absorption of arsenic, which would then block normal functioning of many enzymes and other systems.

Gardening and Landscaping Problems Associated with Phosphorous (P)

Phosphorus plays a role in the molecules used for energy storage and transfer hence it is important part of the genetic material in plants (part of the molecules that make up genes associated with DNA and RNA). Sometimes phosphorous is called the soil's catalyst, as many processes cannot work without it. For example, without sufficient phosphorous, plants cannot use nitrogen effectively.

In soils phosphorous is often deficient or chemically locked up and unavailable to plants, hence plants concentrates this element in its seeds and fruits. It is involved with stimulating many plant activities (called a "Go" food for plants). All plant tissues contain this element, it is directly related to root and fruit development, required for sugar development and it aids in disease resistance.

Rock phosphate has low solubility along with many other mineral forms found in nature so it is often not readily available to plants. This is why plants store phosphate in their seeds, so new seedlings do not have to depend on finding it in the soil. This is why foods like nuts are a good source of this element.

Many of our area soils have sufficient phosphorous for plant growth, however it is not in an available form. At a pH below five, phosphorous is chemically locked up by aluminum (Al) and iron (Fe). At a high pH (above 7.0) calcium (Ca) and magnesium (Mg) will precipitate the phosphorous into rock phosphate and it becomes unavailable.

One needs to be careful in that high levels of phosphorous can create a zinc (Zn) deficiency. This often occurs when one uses super phosphate or other artificially created forms of this element. Interestingly, a low level of zinc reduces the absorbability of phosphorous by plants. Mineral forms of phosphorous quickly become insoluble and not available to plants while organic forms are readily absorbed, and used by plants (another value of good compost).

For plants to utilize phosphorous efficiently, it requires soils with high organic matter content to provide food and a home for the microorganisms, which then make phosphorus available to plants. Microorganisms excrete acids that release phosphorus from mineral forms. The humic and fulmic acids found in good quality compost, helps release phosphorus.

A phosphorous deficiency shows up in plants as reddish or purplish cast to leaves, tips die off, seeds, tubers, and grains suffer or fail to develop. Other deficiency issues may show up as stunting, slow growth, delayed maturity, short internodes, purple or dark green foliage, old leaves will die back. Problems are more severe in cold weather (lower microbial activity).

Researchers at Pennsylvania State University have found that excess phosphorus is very detrimental to plants, decreasing drought tolerance and stress resistance in general.

For gardeners that grow their own vegetables, most vegetable plants absorb all the phosphate it needs in the first few weeks of growth. This is why small amounts of rock phosphate directly under the seed or a transplant work's so effectively.

For years, bone meal was the best source of this element. Today, most modern bone meal is nutrient deficient, as it has been leached to remove the nutrients for use in other manufacturing processes. However, it is easy to make your own. Save your bones and then dry them in the sun or your oven. When dry place on a concrete surface and use a hammer to break them into tiny pieces.

Sources: compost, native mulches, rock phosphate, phosphoric acid (soft drinks), manures, sewage sludge (Biosolids), bat or bird guano, bone meal, some fish and seaweed by products.