

FACT SHEET

Apatite –Rock Phosphate



Rock phosphate applications to agricultural soils are increasing in response to the growth in organic food production. This demand will increase beyond the organic sector as ornamental chemical fertilizer use is restricted, environmental legislation affecting agriculture becomes more stringent and continued research is able to demonstrate the agronomical benefits over soluble fertilizers.

The phosphate ion is extremely reactive combining with at least 30 elements and under every conceivable geological setting resulting in approximately 300 phosphate minerals. Minute changes in impurities, pH, and crystal defects, to list of few, result in significant changes in solubility-reactivity behavior. For this reason wide discrepancies exist for solubility rates for many phosphate minerals and sources. Different phosphate phases maybe stabilized or destabilized by the presence of various cations and anions, which do not have to be incorporated into the crystal lattice.

Microorganisms play a very important role in the distribution of phosphorous on the earth's surface. Microorganisms are closely involved in the cycling of phosphorous and current biogeochemistry and geomicrobiology research is providing greater insight into influences on phosphorous dissolution and mineralization within the soil system. The impact of this work undoubtedly will change current thinking on solubility characteristics of phosphate minerals, particularly in the soil system where phosphorous is supplied to plants by microbial mediated interactions. A 21-year study comparing conventional, biodynamic and organic agroecosystems recognized that the solubility fraction of phosphorous and potassium was lower and calcium and magnesium was higher in organic soils versus conventional. However, phosphatase activities were higher in organic soils than in conventional. Phosphorous movement through the microbial biomass was faster with more phosphorous being bound (Mader, 2002). Organically bound P accounts for approximately 30 to 50% of phosphorous in soil. The maintenance of soil organic matter ensures high levels of organically bound phosphate and large populations of symbiotic microorganisms, which acquire and supply plants with phosphorous.

1. All soils have undergone at least one sedimentary cycle, resulting in most of the iron and transition metals occurring in a higher oxidation state. It is for this reason that plants will likely utilize only 10% of applied acidulated phosphate fertilizer in a growing season. The PO_4 radical will rapidly combine with almost any soil element to form stable secondary soil phosphate minerals, particularly iron, aluminum, calcium and manganese. This process is far more exaggerated in acid soils where aluminum, iron and manganese hydroxides are prevalent. The mineral apatite does not react in this manner. Apatite mineral weathering by microorganisms is primarily accomplished by their acid production. Banfield (1999) was able to detect pH values of 3 to 4 in proximity of cells attached to mineral grains within a local microenvironment. The bulk soil solution was pH 7. A lowering of pH between 3-4 will result in 10 to 1000-time increase in the mineral dissolution rate.

Phosphate minerals are a favored host for radioactive ions and heavy metals, particularly cadmium. The phosphate fertilizer refining process removes radioactive ions but cadmium is incorporated into the fertilizer. Recent research is showing plant and animal cadmium uptake exceeding tolerable level intake guidelines established by the World Health Organization. Cadmium containing phosphate fertilizers were confirmed to have increased the Cd status both in soil and plants. In response New Zealand, Australia, Austria, Sweden and Finland have established guidelines and worked with the fertilizer industry to reduce Cd soil contamination. Austria, Sweden and Finland have enacted legislation to ban high cadmium fertilizers.

Rock phosphate applications to agricultural soils in North America, for the most part, have gone unregulated. This has possibly resulted in U, Th and Cd soil contamination. To address this problem the North American organic agriculture industry has adopted Canadian waste management guidelines. Recognized as one of the most stringent these regulations are based on the philosophy that in order to insure the long-term fertility of the soil, the levels of selected contaminants should not be increased over background soil levels. Under these regulations there are no threshold levels set for radioactive elements.

The New Zealand and Australian experience suggests that utilizing waste management guidelines could be ineffective in reducing Cd soil and plant levels. The plant availability of heavy metals is very dependant on soil conditions, farming practices and climate. Generally, metal uptake is high in acid soils, guidelines in

New Zealand and Australia recommend maintaining soil fertility to reduce weed pressure and using lime to prevent soil acidification. Calcium within the soil system also stimulates microbial activity, provided there is adequate carbon and nitrogen. Increased microbial activity will result in increased phosphate mineral dissolution and higher levels within the soils biomass.

Spanish River Carbonatite™ – Apatite (Rock Phosphate)

Current opinion amongst soil scientists is in the industrialized world soil phosphorous levels are sufficient and phosphorous use is declining as a result. Nutrient management legislation in effect across North America is curtailing phosphorous use.

The utilization of existing soil phosphate minerals can be accomplished by microbial enhancement through adequate levels of organic matter, reactive calcium and catalytic minerals. Not only is the apatite in SRC more efficient than soluble phosphate fertilizers but SRC also contains a variety of minerals, which will stimulate soil microbial-mineralogical interactions enhancing dissolution of existing secondary soil phosphate minerals. Generally, the application of SRC has resulted in increased phosphorous plant uptake. Within an organic system SRC enhances sourcing of existing phosphorous in the soils and its more reactive apatite component is utilized as required.