Chapter 32

Phosphorus

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The total P concentration in soils is generally in the range from 200 to 5000 mg P kg\(^{-1}\) with an average of 600 mg P kg\(^{-1}\) (Lindsay, 1979). Physicochemical and biological reactions in soils and sediments act in concert to regulate P solubility which in turn affects both agronomic production as well as eutrophication of surface water.

Phosphorus exists in soil as organic and inorganic P forms. Oxidation of organic constituents and acid dissolution of minerals are necessary for total P determination. This is generally accomplished by Na\(_2\)CO\(_3\) (sodium carbonate) fusion, acid digestion, H\(_2\)O\(_2\) (hydrogen peroxide) or NaOBr (sodium hypobromite) oxidation.

The soil organic P fraction may be derived from plant residues and from soil flora and fauna tissue and residues that resist rapid hydrolysis. While a large proportion of soil organic P remains uncharacterized, inositol phosphate, phospholipids, nucleic acids and their derivatives, and polyphosphates have been identified. Chromatographic and nuclear magnetic resonance techniques have been used to quantify various organic P fractions. Quantification of organic P is necessary to better understand the mineralization-immobilization turnover of P under particular environments and cropping systems in soils. Dalal (1977), Anderson (1967, 1980) and Stevenson (1982) have provided detailed discussion of organic P and its transformations in soil.

To understand the inorganic P status and availability in soil, diverse fractionation schemes and soil tests have been developed. The P fractions have been used to study the transformation of applied P fertilizer in soils and interpretation of P soil test values. The fractionation scheme proposed by Chang and Jackson (1957), which is intended to separate Ca-P, Al-P, and Fe-P fractions, has been modified to consider soil type effects.

When the P concentration in soil solution, or P intensity, is diminished by P removal, it is replenished by labile P which in turn is replenished much more slowly by nonlabile P.