Chapter 37

Soil Enzymes

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Nutrient cycling in soils involves biochemical, chemical, and physiochemical reactions, with the biochemical processes being mediated by microorganisms, plant roots, and soil animals. It is well known that all biochemical reactions are catalyzed by enzymes, which are proteins with catalytic properties owing to their power of specific activation. Enzymes are catalysts, that is, they are substances that without undergoing permanent alteration cause chemical reactions to proceed at faster rates. In addition, they are specific for the types of chemical reactions in which they participate. Enzyme specificity is often dictated by the nature of the groups attached to the susceptible bonds. For example, both \( \alpha \)-chymotrypsin and trypsin are proteolytic enzymes capable of hydrolyzing certain peptide bonds in protein. \( \alpha \)-Chymotrypsin will hydrolyze peptide bonds in which the carbonyl group of that bond is supplied by L-tryosin, L-phenylalanine, or L-tryptophan. Trypsin will hydrolyze peptide bonds in which the carbonyl group of the peptide bond is supplied by L-arginine or L-lysine. Peptide bonds containing D-amino acids are not hydrolyzed. As another example of the specificity of enzymes, maltase hydrolyzes maltose to glucose, whereas cellubiase hydrolyzes cellubiose to glucose but not vice versa. Differences between the two substrates seem slight in that maltose is an \( \alpha \)-glucoside and cellubiose is a \( \beta \)-glucoside.

Enzymes are specific activators in that they combine with their substrates in such a stereospecific fashion that they cause changes in the electronic configuration around certain susceptible bonds. These bonds then are more easily changed. Physiochemical measurements indicate that enzyme-catalyzed reactions have lower activation energy than the uncatalyzed counterparts and, therefore, have faster rates of reactions (Browman & Tabatabai, 1978; Tabatabai & Singh, 1979).

Enzymes are denatured by elevated temperature and extreme pH. Their physiochemical state and their influence on chemical reactions are markedly dependent on pH, ionic strength, temperature, and the presence or absence of inhibitors or activators.