

STUDIES ON SOIL ENZYMES OF ORISSA WITH SPECIAL REFERENCE TO UREASE.

Introduction:

Plant physiologists of the twentieth century envisaged the presence of enzymes of soil in appreciation of the degradative activities noted by them during the cycling of nutrients. A number of reports were subsequently published confirming the existence of various soil enzymes beginning with peroxidase. It has become a major field of research since 1950. The significance of these enzymes in transformations of organic matter and mechanism involved during the process is gradually unfolding.

Most of these enzymes owe their origin to micro-organisms. These microbial enzymes are cytoplasmic, periplasmic or secreted through their wall into the environment of soil. Other possible locations are their association with the membrane or freely diffusible within the periplasm or they may be partially attached to the outermost layer of the cell wall and project into the ambient environment. Enzymes also may be contained within the polysaccharide coatings or may diffuse into the surrounding aqueous phase. Besides, the same enzyme may exist in more than one site.

Extra-cellular enzymes are those which lie outer to the cell wall and have a greater scope to be in contact with the surrounding medium. Hence, to be termed as extra-cellular an enzyme has to be actively secreted by the viable micro-organism. Production of this group of enzymes is at its peak during the post exponential phase of growth when a significant population is undergoing lysis.

Some enzymes can only function outside the cell wall since they catalyse the insoluble substrate or the active configuration only after export. The truly extra-cellular enzymes usually require a simultaneous monitoring of a known cytoplasmic enzyme. But often such controls are omitted. These extra-cellular enzymes may be cell wall bound or be located at a distance from the parent micro-organism. These enzymes are often suggested to be a biological catalysts, i.e., a pertinent system of extra-cellular biological catalysts. Thus, they may be regarded as clever extentions of the biological system into their environment that helps in providing them with soluble nutrients from an unfavourable environment. The soil in turn also has a mechanism to arrest the activity of these enzymes the mechanism being, (i) adsorption to clay minerals, (ii) denaturation by physical and chemical factors, or, (iii) turning them over to serve as food for micro-organisms (proteolysis). The mission of these enzymes is to escape destruction long enough till it reaches food and makes the same suitable for the producer cell. The enzyme should not be accessible to proteolysis or other

destructive forces which is achieved by entrapment during the humic matter genesis. It is apparent that the exoenzymes are distributed between most of the humic fraction of the soil and that their overall stabilization may involve polysaccharides as well as the aromatic polymers.

Several factors are known to effect the activity (and stability) of different enzymes. The same factor may promote one enzyme whereas it may have deleterious effect on another. Many of the soil characteristics, such as organic carbon, clay percentage and (hence) soil surface area are known to have a direct bearing on enzyme activity. Salinity when low is known to promote enzyme activity whereas higher degree of it retards the process. The soil pH value is always has a curve-linear effect. The cation exchange capacity is one of the important characteristics as it determines the exchange of ionic nutrients.

The low molecular weight compounds present in soil such as sugar and amino acids serve as immediate sources of nutrition for both micro-organism and plants. The macro-molecular substances such as polymeric organic compounds which contribute to the structural component of the living cells require extra-cellular transformation prior to the uptake and transformation.

Presence of soil water is crucial to microbial activity. The volume of water in soil and the capacity of the soil to retain the same affects the amount of dissolved oxygen.

Soil constituents are the elements that make up the soil particle. The clay mineral may contain oxides and hydroxide of silicon, aluminium, iron, manganese and titanium. The crystalline aluminosilicates represent aluminium hydroxide and silicon oxide associated in 1:1 or 1:2 ratio. The 2:1 clays expand on wetting during weathering, are replaced by those of lower valency elements the charge deficit being compensated by adsorption of cations such as Ca^{2+} , Mg^{2+} , K^+ , Na^+ , NH_4^+ and H^+ . These cation species located on soil particles constitute sources of nutrients. Anions are negatively adsorbed, i.e., repulsed in the vicinity of clay surface. Soil elemental analysis gives a broad idea about the inorganic nutrients like calcium, magnesium and potassium etc. whereas a more sensitive picture is obtained from the cation exchange capacity studies.

The study of soil urease activity under the complex environment is especially helpful in view of the large scale use of urea as a fertilizer. At the same time the assessment of other enzymes like β -glucosidase, cellulase, invertase and dehydrogenase may prove useful in explaining urease activity in a complex habitat.

The incalculable interplay of biological, chemical and physical factors that accompany the cycling of carbon, nitrogen, phosphorus and other essential elements are intimately associated with the activity as well as the stability of soil urease and other enzymes.