CHAPTER - VII

SUMMARY:

A variety of edaphic factors are known to condition the rapidity of soil urease activity. Many of the soil enzymes including urease remain in a stable state, being immolilized by the soil organic matter. There are also other conditions that tend to inhibit the soil enzymes through the process of destabilization or denaturation. The unequivocal stability of urease in soil, especially from the action of proteolytic enzymes is well recognised.

Present study that compared urease activity with soil physico-chemical characteristics suggest that maximum variability (61.47%) is due to soil organic matter. Organic matter in turn is either positively or both positively and significantly correlated with a number of other soil properties. With nitrogen the correlation is maximum ($r = 0.953$). Cation exchange capacity, another regulatory factor for urease activity also has a significant correlation with organic matter percentage ($r = 0.693$). The clay percentage too has a positive relationship with a r value of 0.577. This suggests an intimate association of organic matter content with soil biological processes.

The soil nitrogen content has a relationship with urease which is surpassed only by organic carbon. Its relationship with C.E.C. is also keen, i.e., 0.638. The nitrogen fraction has a similar mobilizing effect on the cation exchange capacity in influencing the urease activity as the organic matter.

The surface area of soil particles is a function of the proportion of different textural constituents and other particles of colloidal diamension. The correlation of soil surface area and clay percentage with urea activity are lower, 0.447 and 0.438 respectively though they were found to have more intimate association with organic carbon content with r values of 0.665 and 0.577 respectively. The observation suggests that these two factors have an intimate and direct effect on organic carbon level. The influence on urease is indirect, mediated through organic carbon molecules.

The soil pH seemingly bears no relationship with urease activity through finding in some earlier reports indicate both positive as well as negative relationship. Our data, compared to such two contradictory findings suggest that pH has a differential influence, i.e., in the acid range it has a promotive effect on urease activity and in the alkaline range it has an inhibitory effect. The correlation value (0.132) therefore is in keeping with soil reaction status of different samples studied by us.

The electrical conductance value of soil also has a differential influence on urease activity. When the salinity is low the conductance value is low, it tends to promote the activity of this enzyme, and when high, it tends to gradually inhibit the process. This finding will be of importance in controlling soil biological activities.

Soil sugar content was found to have a positive and significant relationship ($r = 0.701$) with urease activity available phosphorus has a similar correlation value ($r = 0.705$) and total amino acid has none ($r = 0.085$).

When all the above properties were combinedly considered as independent variables for their influence on urease activity they were found to account for 90.24% of variability, but none of the regression coefficients were significant. Available phosphorus, amino acid, sugar, organic carbon and nitrogen were found to control 90.24% of this variability.

Different soil elements, such as silicon, aluminium, titanium, iron, calcium, magnesium, sodium and potassium were also compared against the level of urease activity. The individual elements were analysed after igniting the soil at a temperature of 1000°C. The substances that were lost during ignition were found to have a positive correlation (0.481). Of the soil elements, calcium and magnesium were found to be positively and significantly correlated with urease having r values 0.729 and 0.795

respectively. The relationship of this enzyme with potassium was positive (0.478) and with aluminium, the relationship though positive, was weak (0.417), with sodium the relationship was still weaker (0.384), with iron, the relationship was insignificant (0.171) and so also with titanium (0.779×10^{-2}) with silicon the relationship was negative (-0.525).

When the percentage of elemental constituents in their oxide form together with loss in weight due to ignition were put to multiple regression analysis, as independent variables they were found to account for 76.69% of variability in urease activity (it may be noted that the substances lost during ignition also included the soil organic matter). None of the regression coefficients however, were found to be significant.

Dehydrogenase, β-glucosidase, cellulase, amylase and invertase were compared with urease activity for their possible significance as independent variables. Except dehydrogenase, rest of the four named enzymes like urease also are immobilized by soil organic matter and responsible for breaking down the long chain-carbon molecules into short chain residues. The level of dehydrogenase activity is an indication of the total activity due to microbial population.

The enzyme cellulase was found to have a maximum correlation with urease, the r value being 0.719 followed by dehydrogenase (0.685), invertase (0.665) and amylase (0.587). The correlation with β-glucosidase was not significant (0.371).

When these enzymes, alongwith soil, pH nitrogen organic carbon content and C.E.C. were tested for their combined effect on urease activity, they were found to account for 87.33% of variability. From multiple regression it was noted that the dehydrogenase activity and the level of carbon were having significant effects.

The variability in soil urease level in different rhizospheric soil suggests differential behaviour which is due mostly to the free urease, not bound to organic matter fraction. The factor that obviously acts upon the level of free urease activity is the root exudates which may either premote or inhibit the ureolytic population. It may be noted that in a total microbial population the percentage of ureolytic organisms do not vary significantly.

For this purpose, the rhizospheric soils associated with different plants, such as, Zizyphus jujuba, Amaranthus spinosus, Tridax procumbens, Boerhaavia diffusa, Euphorbia hirta and Phyllanthus niruri were compared with a control sample. Here the urease activity was more intimately associated with ureolytic population than with organic carbon content. Obviously the total urease activity was mostly due to the fraction that was not immobilized by the organic matter molecules. This again suggested the organic matter transfermation to be a slower process in the rhizosphere.

In order to ascertain the possible mechanism of soil urease stability the soil samples were subjected to irradiation doses up to 0.5 Mrad, were compared against a control sample that had received no irradiation.

It was noted that the soil urease activity tended to decline following irradiation with γ-ray. The sugar and amino acid contents were found to undergo no quantitative variation. There was no change in organic matter content but the possibility of its degradation into shorter polymeric units was obvious, for, the loss in viscosity of soil extract was noticeable following irradiation. The process of shortening was effected by release of metallic ions as indicated by electrical conductance values. There was also a loss in active unsaturation following irradiations. The terminal ends had the choice of uniting with the monovalent homolysis products of water.

The findings led us to suggest that urease molecules enter into copolymeric association with organic matter molecules that had a protective influence. When the association is intercepted, the stability of this enzyme is gradually lost.

The present findings suggest that without exception, the level of activity of immobilized soil enzymes could be predicted with a fair degree of accuracy from the organic matter percentage eventhough the content is comparatively low in the samples studied in this thesis.

The organic carbon content taken together with urease activity will provide important guide line for successful application of urea as a nitrogenous fertilizer. The investigation provides a good deal of data concerning different soil properties and their mutual relationship that are related to cycling of nutrients through soil enzymes.