INTERNATIONAL JOURNAL OF AGRICULTURE & BIOLOGY
1560–8530/99/01–3–133–135

# Comparative Enzymatic Studies on Soils Under Cultivation of Wheat and Sugarcane

K.M. KHAN, KHALIL-UR-REHMAN, M. KANWAL, U. RAFIQ AND H.S. GHANI
*Department of Chemistry, University of Agriculture, Faisalabad-38040, Pakistan*

## ABSTRACT

The activities of phosphatase, urease and dehydrogenase; pH and electrical conductivity; carbon and nitrogen %; and bacterial count from the soil samples under cultivation of wheat and sugarcane have been reported. Enzymatic activities were found positively correlated with carbon, nitrogen and bacterial count. There was no significant correlation between enzyme activities and pH of the soil. The activity of phosphatase and dehydrogenase was higher in wheat soil than sugarcane cultivated soil, while urease activity was similar in both types of soil.

**Key Words:** Enzymes; Activity; Soils; Wheat; Sugarcane

## INTRODUCTION

It is well recognized that many reactions involving organic matter transformation are catalyzed by enzymes existing outside the microorganisms and plant root system (Alvi *et al.,* 1989). The chemical changes brought about by microorganisms in the soil are important for fertility and plant growth. When an organic residue is incorporated into the earth and environmental conditions are favorable, the soil organisms immediately start utilizing them as a source of carbon and energy. The soil-enzyme complex represents a completely separate system consisting of soil enzymes associated with dead soil components and extracellular enzymes of living cell soil population (Burns, 1978). Type of crop affect the environment of the soil and influence the activity of soil enzymes (Alvi *et al.,* 1989). This paper presents the correlation of enzyme activities and some physico-chemical characteristics of soil under cultivation of wheat and sugarcane.

## MATERIALS AND METHODS

Sixty samples (0-30 cm depth) each from soil under cultivation of wheat and sugarcane crops were collected from different areas of Faisalabad division. The samples were air dried and sieved. Total nitrogen and organic matter contents were determined by the methods given by Jackson (1958). The pH and electrical conductivity (EC) were measured with the help of pH meter and conductivity meter. Bacterial count was determined by Wollum (1982) method using plate count technique.

Phosphatase activity was determined by using purified phenyl phosphate (Bessey *et al.,* 1946), Urease by Bergmeyer (1965) method and dehydrogenase by Casida *et al.* (1964) method. The data were statistically analyzed (Steel & Torrie, 1984) to establish the correlation of enzymatic activities with pH, EC, nitrogen and carbon contents and total bacterial count.

## RESULTS AND DISCUSSION

Phosphatase, urease and dehydrogenase were the enzymes of choice in soil under wheat and sugarcane cultivation (Table I).

The pH of wheat and sugarcane cultivated soil was found to be 7.2-8.4 and 7.3-8.7, respectively, indicating the alkalinity of the soil (Table II). In samples of both wheat and sugarcane soil, correlation of pH with phosphatase and dehydrogenase activity was negative; whereas it was positive with urease activity (Table III & IV). Owing to change in H-ion concentration in soil, the pH is affected which ultimately affect the activity of the enzymes. This correlation was non significant in all the cases. The findings of Frankenberg and Johnson (1982), and Tarafdar and Roy (1981) supported these results.

**Table I. Mean ± S.D. activities of enzymes in soil under wheat and sugarcane cultivation**

| Crop | Enzyme activity | | |
|---|---|---|---|
| | Phosphatase | Urease | Dehydrogenase |
| Wheat | 0.089±0.032 | 2.318±0.789 | 0.865±0.511 |
| Sugarcane | 0.133±0.020 | 2.033±0.480 | 1.904±0.789 |

**Table II. Mean ± SD of physico-chemical characteristics of soil under wheat and sugarcane cultivation**

| Characteristics | Wheat | Sugarcane |
|---|---|---|
| pH | 7.98 ± 0.268 | 8.02 ± 0.325 |
| EC | 2.94 ± 1.589 | 1.29 ± 0.795 |
| C% | 1.50 ± 0.762 | 1.46 ± 0.804 |
| N% | 0.15 ± 0.276 | 0.13 ± 0.188 |
| Bacterial count | 101.37 ± 53.87 | 168.5 ± 166.48 |

**Table III. Correlation between the activity of different enzymes with physico-chemical characteristics of soils under wheat cultivation**

| Characteristics | Phosphatase | Urease | Dehydrogenase |
|---|---|---|---|
| pH | $-0.00349^{NS}$ | $0.262^{NS}$ | $-0.194^{NS}$ |
| EC | $-0.4530^{*}$ | $-0.603^{*}$ | $-0.24^{NS}$ |
| Organic matter | $0.183^{*}$ | $0.732^{**}$ | $0.855^{*}$ |
| Nitrogen | $0.373^{*}$ | $0.402^{NS}$ | $0.019^{NS}$ |
| Bacterial count | $0.288^{*}$ | $0.955^{**}$ | $0.932^{*}$ |

**Table IV. Correlation between the activity of different enzymes with physico-chemical characteristics of soils under sugarcane cultivation**

| Characteristics | Phosphatase | Urease | Dehydrogenase |
|---|---|---|---|
| pH | $-0.0136^{NS}$ | $0.294^{NS}$ | $-0.270^{NS}$ |
| EC | $-0.4994^{*}$ | $0.509^{*}$ | $-0.270^{NS}$ |
| Organic matter | $0.176^{*}$ | $0.914^{**}$ | $0.228^{*}$ |
| Nitrogen | $0.356^{*}$ | $0.594^{**}$ | $0.294^{*}$ |
| Bacterial count | $0.354^{*}$ | $0.922^{**}$ | $0.985^{*}$ |

NS= Non-significant; *= Significant; **= Highly significant

Salt concentration is an important factor which can change enzyme activity in soils and is represented by EC which was found to be negatively correlated with the activity of all the three enzymes in wheat cultivated soil. In case of sugarcane soil, there was negative correlation with phosphatase and positive with urease activity. The inverse correlation of EC with enzyme activity can be explained by the fact that increase in salinity decreases the microflora in soil and in turn enzyme activity is decreased (Frankenberg & Binghan, 1982; Ahmad & Khan, 1988). The range of EC was found 1.3-2.9 and 0.55-2.65 m mhos/cm in wheat and sugarcane cultivated soil samples, respectively.

The total organic matter is one of the best indices of fertility of the soil. It provides an essential element i.e. carbon, for plant growth. The results revealed that correlation of carbon content with enzyme activities in both soils of wheat and sugarcane was significantly positive. These results are contradictory to those of Nielson and Eiland (1980), and Cox and Hutchinson (1980), who reported that decrease in organic phosphorus levels increased the enzyme activity. On the other hand, the results of this study were comparable with those of Tarafdar and Roy (1981) and Dick *et. al.* (1983), who reported that urease and phosphatase activity in soils of West Bengal were significantly and positively correlated with the organic matter. Organic matter was found to be in the range of 0.67-3.04 and 0.41-2.95 % in wheat and sugarcane cultivated soil samples, respectively.

Nitrogen is an essential constituent of proteins and nucleic acids and many other organic molecules which play important role in plant life. The chief source of nitrogen is nitrate ion contents of the soil. In wheat crop cultivated soil samples, the correlation of nitrogen content with enzyme activity was positive but non significant while in sugarcane cultivated soil showed significantly positive correlation with all the enzymes under study (Table III & IV), indicating that the soils having high nitrogen source have high enzyme activity. The total nitrogen in wheat and sugarcane cultivated soil samples was found to be 0.011-0.059 and 0.02-0.078%, respectively.

The microbes in the soil represent the activity and fertility of the soil as they are the main source of enzymes in soil. There was significantly positive correlation between the viable bacterial count and enzymes activity in both types of soils. As bacteria and fungi increase in soil phosphatase activity increases (Nakas *et al.*, 1987).

## CONCLUSIONS

Dehydrogenase and phosphatase activity in sugarcane cultivated soil was more than that in wheat cultivated soil; whereas, urease activity was almost similar in both types of soils.

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**(Received 26 March 1999; Accepted 02 May 1999)**