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STUDIES ON ENZYME ACTIVITY IN NORMAL AND SALINE SOILS

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ABSTRACT

Twenty samples each of normal and saline soils were taken. Their physico-chemical properties, total bacterial count and enzyme activity was determined. The enzymes studied were cellulase, invertase and dehydrogenase. It was found that higher concentrations of soluble salts decreased nitrogen and carbon contents. Enzyme activity decreased gradually with increasing salinity and at Ec level of 38.01 mmho/cm all the enzymes employed in this study were inactive. Bacterial counts also showed a declining trend with increase in salinity. The decline in enzyme activity and bacterial count appeared to be associated with a change in osmotic potential of the soil water phase, specific ion toxicities and a salting out effect of soluble salts on enzyme protein.

INTRODUCTION

Increasing salinity is a great threat to the crop production in Pakistan. Accumulation of salts has hampered good crop production in some areas and inhibited it completely in others. The rapid increase in unproductive salted land is adversely affecting our economy. Soil is characterized as a biological body. There are a number of enzymes present in soil which help in the release of essential elements for growth and nutrition of plants. However, microbial growth and nitrogen transformations and decomposition of organic matter are affected by high concentrations of soluble salts to the extent of reducing yields of crops. There is very little information available in the literature dealing with the effects of salinity on soil enzyme activity. In this paper effects of salinity on three biologically important enzymes i. e., cellulase, invertase and dehydrogenase are reported.

MATERIALS AND METHODS

Twenty samples each of normal and saline soils were collected from different areas of Faisalabad Division. pH of the soil samples was determined with

Table 1. *Physico-chemical properties and enzyme activities of normal soils*

S. No.	Ec mmhos/cm³	Total C (%)	Total N (%)	Total bacterial count x 10^6	Invertase activity (mg glucose/ g soil)	Cellulase activity (mg glucose/ g soil)	Dehydrogenase activity (µg Formazan g soil)
1	0.68	1.14	1.020	106	4.71	0.37	1.23
2	0.75	0.64	6.032	88	4.15	0.41	1.26
3	0.83	0.75	0.071	79	4.08	0.41	1.44
4	0.85	0.64	0.320	99	3.98	0.37	1.86
5	0.88	0.75	0.054	177	4.01	0.37	2.87
6	1.08	0.37	0.041	103	3.91	0.39	1.98
7	1.21	0.81	0.120	130	3.98	0.38	1.69
8	1.32	0.29	0.032	98	3.24	0.48	1.75
9	1.44	0.82	0.052	108	4.13	0.45	2.30
10	1.55	0.20	2.021	111	3.04	0.40	2.00
11	1.62	0.63	0.028	125	3.08	0.46	4.20
12	2.05	0.30	0.029	115	3.22	0.49	4.38
13	2.15	0.94	0.078	109	4.13	0.49	4.91
14	2.72	0.83	0.027	129	3.93	0.53	3.98
15	2.82	0.69	0.023	142	4.05	0.57	5.20
16	3.05	1.33	0.065	101	2.81	0.38	3.54
17	3.18	0.52	0.029	106	2.93	0.31	3.12
18	3.21	0.78	0.039	102	3.01	0.42	4.63
19	3.23	0.42	0.031	186	3.10	0.51	4.86
20	3.69	0.67	0.039	96	3.84	0.47	3.00

Note : Each value in the table is an average of three repeats.

Table 2 . *Physico-chemical properties and enzyme activities of saline soils*

S. No.	Ec mmhos/cm³	Total C (%)	Total N (%)	Total bacterial count x 10^6	Invertase activity (mg glucose/ g soil)	Cellulase activity (mg glucose g soil)	Dehydrogenase activity (µg Formazan/ g soil)
1	4.21	1.02	0.051	91	2.75	0.40	1.93
2	4.76	0.22	0.015	68	3.05	3.30	2.10
3	5.16	0.31	0.020	75	2.86	0.31	1.50
4	6.3	0.32	0.019	88	2.12	0.32	1.56
5	6.63	1.10	0.120	68	2.63	0.25	1.46
6	7.90	0.41	0.043	62	2.22	0.24	1.10
7	7.98	0.29	0.016	59	2.90	0.26	1.34
8	10.12	0.44	0.035	96	2.24	0.18	0.65
9	10.75	0.50	0.040	82	2.01	0.14	0.68
10	11.34	0.37	0.032	79	2.02	0.19	0.54
11	11.55	0.70	0.035	57	1.93	0.21	0.68
12	13.02	0.42	0.038	59	1.67	0.16	0.33
13	14.28	0.38	0.052	62	1.85	0.13	0.37
14	15.37	0.70	0.051	49	1.31	0.09	0.39
15	17.95	0.20	0.045	57	1.42	0.05	0.14
16	18.85	0.38	0.035	61	1.86	0.08	0.38
17	19.86	0.61	0.021	58	0.39	0.03	0.29
18	25.28	0.31	0.023	42	0.04	—	0.20
19	38.01	0.20	0.015	55	—	—	—
20	70.56	0.19	0.015	36	—	—	—

Note : Each value in the table is an average of three repeats.

pH meter by dipping glass electrode in soil paste, whereas electrical conductivity (Ec) of the soil extract was measured with conductivity meter. Total nitrogen was determined by Macro Kjeldahl's apparatus as described by Jackson (1960). The carbon contents were determined by Walkley (1935) method. For total bacterial count soil extract agar medium was used as described by Page *et al* (1980). Invertase activity was determined by the method described by Ross (1966) and cellulase activity by the modified method of Pancholy and Rice (1973). For dehydrogenase activity Burns (1978) method was employed.

RESULTS AND DISCUSSION

Physico-chemical properties and enzyme activity of normal soils are given in Table 1. Table 2 shows the physico-chemical properties and enzyme activity of saline soils. The criterion for soil classification as normal or saline was Ec level. Soils having Ec values below 4 mmho/cm^3 were treated as normal and those having Ec values above 4 mmho/cm^3 were saline. Total nitrogen, total carbon and bacterial count showed a decreasing trend with increase in salinity. However, there were some variations in this trend.

Enzyme activity decreased with increasing Ec, however, the degree of inhibition varied among the enzymes assayed. Cellulase was the most affected enzyme and at Ec 25.28 mmho/cm^3 there was no cellulase activity. The activity of invertase and dehydrogenase was absent at 38.01 mmho/cm^3. This showed a greater stability of invertase and dehydrogenase compared to cellulase.

The decrease in activity of enzymes may be due to a change in osmotic potential of the soil water phase which can promote microbial cell lysis releasing intracellular enzymes which become vulnerable to attack by soil proteases. Zantu and Bremner (1977) reported that urease added to soils rapidly decreased already present urease activity. Other possible explanation may be that enzyme proteins are subjected to a 'Salting out' effect due to high concentrations of soluble salts. Specific ion toxicities may cause nutritional imbalance for microbial growth and subsequent enzyme synthesis (Frankenberger and Bingham, 1982).

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