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EFFECT OF SALINITY ON SOIL CATALASE, PHOSPHATASE AND UREASE TRANSFORMATION OF PLANT RESIDUE IN SOIL

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The effect of salinity on soil catalase, phosphatase and urease has been studied. Increasing salinity level has a decreasing effect on these enzyme activities. Organic amendments enhanced enzyme activities. Soils amended with *S. aculeata* showed greater increase in activity than that amended with *D. fusca*. Microbial biomass, C mineralization and microbiol population showed a similar trend towards salinity and amendments. Carbon and nitrogen distribution in soil organic matter fractions was also greatly affected by salinity. More humic acid, carbon and nitrogen were found in the case of *D. fusca* amended soil as compared to that amended with *S. aculeata*.

INTRODUCTION

Soil is similar to a living tissue in carrying out catalytic transformations of complex substances. There are a number of enzymes present in the soil which carry out decomposition of the organic matter and its chemical transformation. These enzymes originate from animals, plants and microbial sources. There are also a number of microorganisms in the soil which play an important role in the decomposition of plant residues. Enzymes are sensitive to salt concentrations and their activities are affected in saline soils (Ashraf and Khan, 1982).

Catalase, phosphatase and urease are some of the important soil enzymes which are responsible for the decomposition of plant litter. Catalase is widely distributed in animals, plant tissues and in microorganisms. It protects the cell from the toxic effects of hydrogen peroxide being produced in the course of certain oxidation processes.

Phosphorus and nitrogen are the essential elements for the growth and maintenance of plants. These are made available to plants by the soil

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enzymes, phosphatase and urease, by decomposition of added fertilizers. This paper pertains to the effect of salinity on the soil catalase, phosphatase, urease and the transformation of plant residue in the soil.

MATERIAL AND METHODS

Soil of upper 0-30 cm. depth was sampled from Faisalabad area. It was air dried and sieved. Its physicochemical analysis was made. Soil samples were artificially salinized by adding a mixture of Na_2SO_4, $CaCl_2$, $MgCl_2$ and NaCl in a ratio of 10:5:1:4, upto four levels of EC 2.5, EC 5.0, EC 7.5 and EC 10.0 mmhos cm^{-1}. Salinized samples were also amended with *Diplachne fusca* (Am 1) and Sesbania aculeta (Am 2) separrtely and incubated in plastic containers for four weeks at 30 °C with 60% water holding capacity (WHC). Controls (Am 0) were also incubated similarly. catalase, phosphatase and urease as say, microbial populations and decomposition of plant residue were determined weekly. At the end of incubation period distribution of carbon, nitrogen and microbial biomass was estimated.

Catalase activity was determined by the Johnson and Temple (1964) method. H_2O_2 is decomposed by soil catalase and undecomposed H_2O_2 is estimated by titrating against $KMnO_4$. The rate of decomposition of H_2O_2 gives the catalase activity. Phosphatase activity was measured by Fiske and Subbarow (1925) method using phenyl phosphate as substrate. For Urease as say Bergmeyer (1965) method was employed which is based on estimation of NH_4-N released from urea.

The soil dilution plate method was employed for fungal and bacterial counts. Carbon mineralization was studied by using the method of Malik *et al* (1979). Humus composition was studied by the method used by Malik and Azam (1980). While soil biomass carbon was determined by the method of Jenkinson and Powlson (1976), which is based on the fumigation of soil $CHCl_3$.

RESULTS AND DISCUSSION

The activities of catalase, phosphatase and urease in different saline soils are presented in Table I. It is evident that catalase activity decreases with increasing salinity. The control soil showed the maximum activity whereas the highest salinity level showed the minimum catalase activity.

Table 1. *Effect of salinity and organic amendments on soil catalase, phosphatase and urease during 4 weeks of incubation*

Salinity level EC m-mhos/cm		Catalase				Phosphatase				Urease			
		Weeks of incubation				Weeks of incubation				Weeks of incubation			
		1	2	3	4	1	2	3	4	1	2	3	4
Control soil	Am_0	2.0	2.8	1.7	2.3	0.28	1.4	1.1	0.03	1.4	2.0	1.0	1.3
	Am_1	1.2	3.0	2.5	2.5	0.4	0.07	0.13	0.06	1.4	1.4	1.6	1.1
	Am_2	2.5	3.8	3.0	3.0	0.4	0.09	0.18	0.14	1.7	1.9	2.6	3.9
2.5	Am_0	1.2	2.4	2.7	2.5	0.10	0.06	0.09	0.02	0.7	0.8	0.9	0.6
	Am_1	2.3	2.8	2.2	2.1	0.15	0.07	0.09	0.09	1.5	1.7	1.9	2.5
	Am_2	2.5	3.6	3.2	3.2	0.04	0.1	0.1	0.09	2.6	3.4	2.8	3.5
5.0	Am_0	1.9	2.3	1.9	2.2	0.06	0.06	0.08	0.04	1.9	2.0	1.2	1.4
	Am_1	2.0	2.6	2.6	2.8	0.1	0.01	0.1	0.08	1.1	2.8	1.6	1.9
	Am_2	2.2	3.6	3.1	3.1	0.07	0.08	0.1	0.06	3.4	3.0	1.8	3.3
7.5	Am_0	1.1	1.1	1.8	1.9	0.03	0.05	0.05	0.04	2.0	1.9	0.9	0.9
	Am_1	1.4	2.4	3.2	2.3	0.1	0.06	0.04	0.05	1.9	2.2	2.0	1.6
	Am_2	1.4	3.6	2.4	3.0	0.2	0.14	0.05	0.04	2.7	3.4	1.6	3.6
10.0	Am_0	1.9	1.4	1.5	1.4	0.0	0.02	0.0	0.0	0.9	0.9	0.6	0.6
	Am_1	2.1	1.3	2.0	2.0	0.03	0.05	0.01	0.03	2.1	2.9	0.9	2.4
	Am_2	2.0	2.9	2.9	2.9	0.13	0.16	0.08	0.03	3.4	1.7	2.0	3.3

Table 2. *Effect of salinity on microbial population and organic matter decomposition*

Salinity level EC m-mhos/cm		Microbial population								C-mineralization			
		Bacteria × 10^6				Fungi × 10^3				mg C/100 g soil			
		Weeks of incubation				Weeks of incubation				Weeks of incubation			
		1	2	3	4	1	2	3	4	1	2	3	4
Control soil	Am_0	56	68	60	37	28	35	31	42	9	7	7	6
	Am_1	134	147	135	127	59	71	62	47	42	42	50	25
	Am_2	181	214	161	122	82	90	76	70	84	42	42	42
2.5	Am_0	63	70	56	33	24	20	19	13	9	7	31	30
	Am_1	144	176	142	108	63	73	70	55	45	45	64	27
	Am_2	184	192	186	163	101	118	104	82	28	44	44	44
5.0	Am_0	58	58	51	47	17	15	12	10	9	8	9	7
	Am_1	120	116	110	108	51	40	27	21	42	43	59	25
	Am_2	147	141	128	109	82	67	52	50	84	42	42	42
7.5	Am_0	42	49	52	44	16	13	11	9	9	9	7	7
	Am_1	105	110	105	98	44	30	29	16	37	38	52	24
	Am_2	134	130	113	96	70	62	57	47	58	29	29	29
10.0	Am_0	47	60	48	21	8	7	11	5	9	7	7	7
	Am_1	94	61	98	65	34	28	30	11	38	37	52	22
	Am_2	127	54	105	65	68	60	56	36	76	38	30	38

Amendment with *D. fusca* and *S. aculeata* had a healthy effect on enzyme activity.

Phosphatase showed a similar trend like catalase, whereas urease was stable and highly active at the lowest salinity levels. This is due to higher stability of urease and lower salt concentrations provide optimal conditions for urease activity. Amendments had a similar effect on all the enzymes.

Incubation period also affected the enzyme activities. More activity was observed in second and third week of incubation while in fourth week the activity of the enzymes decreased. Lesser availability of the substrate in the fourth week and incubation over an extended period might be the reason for this decrease in activity.

Microbial population showed a decline with increasing salinity (Table 2), whereas amendment showed an enhancement in microbial count by providing suitable ecological enviroment and more nutrition. Organic matter decomposition was also depressed by inceasing salinity.

Distribution of C and N contents in various fractions of soil organic matter (Table 3) were also affected by increase in salinity and amendments. Am_1 had more C and N contents than Am_2 in humic and fulvic acid fractions. Increase in salinity had a little effect on these fractions while it increased the Humic C and N. This is due to lower extractibility of C and N from Humin at higher salinity level.

Microbial biomass was decreased with increase in salinity whereas amendments highly increased the microbial biomass. In comparing both the amendments *S. aculeata* showed more increased than *D. fusca* in all the above paramoters except carbon and nitrogen distribution. This is due to microflora involved in decomposition of the two amendments. *S. aculeata* is decomposed mainly by the *Aspergillus* species which can tolerate higher salt concentrations.

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Table 3. *Effect of salinity and organic amendment on carbon and nitrogen distribution*

Salinity level EC m-mhos/cm		Carbon Distribution mg C-g soil			Nitrogen Distribution ppm N-g soil			Microbial Biomass	
		Humic Acid	Fulvic Acid	Humin	Humic Acid	Fulvic Acid	Humin	Biomass C mg/100g soil	% soil C in biomass
Control soil	Am_0	0.5	0.5	1.6	56	17	154	12.1	4.11
	Am_1	1.5	1.4	2.5	154	48	241	19.1	6.36
	Am_2	1.1	1.8	2.7	114	36	255	21.8	7.27
2.5	Am_0	0.5	0.5	1.5	56	17	156	12.5	4.17
	Am_1	1.5	1.4	2.5	154	49	230	21.4	7.13
	Am_2	1.0	1.2	2.7	110	38	255	23.9	7.96
5.0	Am_0	0.5	0.5	1.7	57	17	153	12.2	4 06
	Am_1	1.4	1.4	2.6	151	47	216	17 6	5.86
	Am_2	1.1	1.1	2.7	111	37	259	24.5	8.15
7.5	Am_0	0.5	0.5	1.7	54	17	159	11.0	3.666
	Am_1	1.5	1.5	2.6	158	49	244	13.9	4.62
	Am_2	1.5	1.5	2.5	180	49	243	26.4	8.80
10.0	Am_0	0.6	0.5	1.7	60	17	161	8.6	2.86
	Am_1	1.5	1.5	2.6	169	51	289	10.2	3.40
	Am_2	1.2	1.2	2.8	134	42	266	18.5	6.15

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