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EFFECT OF SALINITY ON SOME SOIL ENZYMES AND TRANSFORMATIONS OF PLANT RESIDUE IN THE SOIL

Muhammad Ashraf and K. M. Khan*

Effect of salinity and amendments on the activity of soil enzymes have been studied. With increase in salinity a gradual retarding effect on enzyme activity has been observed. Organic amendment enhanced the enzyme activity. Soils amended with *S. aculeata* showed more activity when compared with *D. fusca* amended soils. Microbial population showed similar trend toward salinity, and organic amendment. Carbon mineralization was also adversly effected by salinity. With organic amendment, the process of C mineralization was enhanced. The behaviour of C and N distribution in various soil organic matter fraction was also greatly effected by the salinity and organic amendment. More humic acid C and N was found in case of *D. fusca* amended soil as compared to the *S. aculeata* amended soil. Microbial biomass has a similar response towards salinity and organic amendment, as that of the enzyme activity.

INTRODUCTION

Soil is a dynamic biological entity. It is the home of vast number of microbes and other organisms. When salinity is introduced to the soil, many biochemical changes occur in its properties. These changes make the soil unfit for crop production. Among these biochemical changes level of activity of soil enzymes is also badly effected by the salinity. To tackle this problem, with which millions of acres of cultivated land has gone out of cultivation, various chemical and biological methods have been advanced by number of scientists. Among these, a biological method to reclaim the salt affected soil is, "Plant Succession Scheme" proposed by Sandhu and Malik (1975). Transformation of plant residue is also adversely affected by the salinity. The present study presents a data about the enzyme status of the salt affected soils and changes during transformation of plants residue in these soils.

MATERIALS AND METHODS

A sandy clay loam soil was collected after determining its physio-chemical properties, it was artificially salinized to obtain EC levels 2.5, 5.0, 7.5, 10.0

*Department of Biochemistry, University of Agriculture, Faisalabad.

mmhos/cm. Soil was amended with one per cent powdered *S. aculeata* and *D. fusca* separately. The samples were incubated for 4 weeks in plastic containers with 60 per cent WHC alongwith controls.

At weekly intervals it was analysed for the following enzymes activity :

Amylase, Cellulase, Invertase, Dehydrogenase.

C-mineralization, Microbial population were also determined weekly.

Humus composition and soil microbial biomass were determined at the end of incubation period.

Amylase and invertase activities were determined as described by Ross (1966), reducing sugars were determined by DNS reduction method.

Cellulase activity was measured by the method described by Pancholy and Rice (1973), while dehydrogenous activity was measured by the method of Skujins and McLaren (1968).

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 *et al.* (1980). While soil biomass carbon was determined by the method of Jenkinson and Powlson (1976), which is based on the fumigation of soil with $CHCl_3$.

RESULTS AND DISCUSSIONS

The results of three carbohydrases studied in the present study are presented in Table 1. It is evident from the results that soil salinity significantly effects the enzyme activity, with increasing salinity a retarding pattern was observed.

Cellulase activity was found to be the lower among the enzymes under the present study. This may be due to the fact that soils in Pakistan are generally low in organic matter. In amended soils cellulase activity significantly increased. When the two amendments were compared it was observed that in soils amended with *S. aculeata* there was more cellulase activity than *D. fusca*. This is because *S. aculeata* is easily decomposed by the microbes, with the results that more cellulosic material is available to the microbes which favour the proliferations of microorganisms. Amylase, and invertase activity showed similar response towards salinity and organic amendments. More amylase and invertase activity was observed in case of *S. aculeata* amended soils. Similar explanation for this behaviour can be coated as discussed in the case of cellulase activity. Dehydrogenase activity which is presented in Table 1, was also greatly effected by salinity, and type of organic amendments. Dehydrogenase activity depends upon the concentration of microorganisms in the soil, with increasing salinity a retarding effect on dehydrogenase activity was observed. Maximum dehydrogenase activity was observed in the case of soil amended with *S. aculeata*. An interesting feature of the enzymes activity was observed in this study that with low concentration of salts, enzyme activity is enhanced. This is a strange behaviour but can be explained on the basis that low salt concentraotion might be an optimal dose for enzyme activity.

Incubation period also played a significant role in the soil enzyme activity. Maximum activity was observed in the second and third weeks of incubation. Microbial count was also enhanced significantly with organic amendment but a retarding effect on microbial population was observed with increasing salinity thus showing that salinity had a retarding effect on growth of microorganisms. When two amendments were compared more microbial activity was observed in soils amended with *S. aculeata* than *D. fusca* amended soil.

Carbon mineralization was also greatly influenced by salinity and type of organic amendment. *S. aculeata* being easily decomposable more carbon mineralization was recorded in case of *S. aculeata* amended soils, increasing salinity showed a retarding effect (Table 2).

Carbon and nitrogen distribution in various soil organic matter fraction was also effected by the salinity and type of organic amendment (Table 2). More nitrogen and C in humic acid fraction was found with soils amended with *D. fusca*. It may be due to the fact that *D. fusca* is more lignified plant material as compared to *S. aculeata*, and lignin is the basic material for humic acid.

Estimation of biomass is always a better index of the living microorganisms in soil, results of microbial biomass are presented in Table 3. Microbial biomass-C, showed a similar trend toward salinity, and organic amendment, *S. aculeata* treated soil showed a favourable effect on biomass carbon as compared to *D. fusca* amended soil salinity adversly effect the biomass carbon. It can be concluded that different processes e.g. enzyme accumulation, C mineralization and synthesis of microbial biomass, are fairly closely related and are affected by soil environment in a similar manner.

TABLE 1. *Effect of salinity and organic amendment on amylase, cellulase, invertase and dehydrogenase activity of soil during 4 weeks of incubation.*

Salinity level EC mmhos/cm	Amylase				Cellulase				Invertase				Dehydrogenase			
	Weeks of incubation				Weeks of incubation				Weeks of incubation				Weeks of incubation			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
					mg glucose $soil^{-1}$ 24 hrs^{-1}				=				ug Farmazan g^{-1} soil 24 hrs^{-1}			
Control soil	1.9	2.0	2.0	1.7	0.5	0.3	0.3	0.3	5.7	8.2	5.2	5.8	1.5	1.5	0.5	1.25
,, + *D. fusca*	2.0	2.0	2.0	1.9	3.7	4.0	4.0	3.4	13.9	14.8	14.6	15.5	3.2	4.7	4.0	1.7
,, + *S. aculeata*	2.4	2.6	2.8	2.6	4.3	4.9	5.0	4.5	19.8	25.2	28.2	20.4	4.5	4.7	3.0	3.7
2.5	2.0	2.1	2.3	2.2	0.5	0.5	0.5	5.5	16.2	8.7	8.1	3.0	3.0	3.0	3.2	2.5
,, + *D. fusca*	2.2	2.6	2.8	2.5	4.0	4.2	4.0	3.5	11.3	14.4	14.8	15.5	4.2	4.4	4.7	3.7
,, + *S. aculeata*	2.5	2.7	2.9	2.5	4.4	4.8	4.7	4.8	17.5	21.3	19.1	31.4	4.5	4.7	4.6	4.5
5.0	1.8	2.2	1.8	1.8	0.5	0.5	0.5	0.4	5.3	5.3	5.2	4.5	1.2	1.0	0.5	0.5
,, + *D. fusca*	2.3	2.5	2.3	2.1	4.0	4.5	4.0	3.6	10.4	11.5	12.8	6.0	3.2	3.7	3.7	2.0
,, + *S. aculeata*	2.6	2.9	2.5	2.4	4.8	4.7	5.7	4.2	18.9	20.7	30.2	31.7	4.5	4.7	4.7	4.2
7.5	2.0	1.7	1.7	1.6	0.4	0.4	0.5	0.4	5.2	4.8	5.4	5.5	0.7	0.5	0.7	0.4
,, + *D. fusca*	2.3	2.5	2.4	2.1	4.0	4.2	4.1	3.7	11.8	12.4	12.4	12.3	2.7	3.0	2.2	2.0
,, + *S. aculeata*	2.8	2.6	2.5	2.3	4.6	4.6	4.2	4.0	20.0	21.3	26.5	28.7	4.5	4.5	4.5	4.2
10.0	1.7	1.6	1.8	1.7	0.4	0.4	0.3	0.3	5.0	4.9	4.6	4.5	0.7	0.5	0.5	0.5
,, + *D. fusca*	2.1	2.0	2.4	2.0	3.9	4.1	4.0	3.9	11.2	11.8	11.8	12.3	2.0	1.2	2.0	1.7
,, + *S. aculeata*	2.5	2.5	2.4	2.1	4.2	4.4	4.3	4.0	19.4	22.7	21.3	19.0	3.7	3.7	4.0	2.7

Salinity
level
EC mmhos/cm

TABLE 2. *Effect of salinity and organic amendment on microbial population and C-mineralization during 4 weeks of incubation.*

Salinity level EC mmhos/cm	Microbial population								C-mineralization			
	Bacteria × 10^{6}, Fungi × 10^{3}								mg C/100 g soil			
	Weeks of incubation								Weeks of incubation			
	1		2		3		4					
	B	F	B	F	B	F	B	F	1	2	3	4
Control soil	57	28	69	35	60	31	37	22	9.2	7.4	6.8	6.6
,, + *D. fusca*	135	60	147	72	135	63	126	47	42.7	42.6	59.5	25.5
,, + *S. aculeata*	179	82	217	90	167	76	122	70	84.5	42.3	42.3	42.2
2.5	64	24	71	19	56	20	33	12	9.2	7.5	6.8	6.7
,, + *D. fusca*	141	64	177	73	142	70	107	55	45.3	45.2	63.8	27.4
,, + *S. aculeata*	184	102	190	118	186	105	161	82	88.6	44.3	44.4	44.4
5.0	58	17	57	14	52	14	46	9	9.2	7.5	6.8	6.7
,, + *D. fusca*	118	51	115	41	109	24	107	20	42.4	42.5	59.6	25.7
,, + *S. aculeata*	151	82	142	67	128	54	109	50	84.3	42.3	42.2	42.3
7.5	41	17	48	12	51	11	43	8	9.2	7.6	6.8	6.8
,, + *D. fusca*	105	43	110	31	104	29	98	16	37.5	37.5	52.5	25.4
,, + *S. aculeata*	136	78	130	63	114	60	96	47	58.3	29.4	29.5	29.5
10.0	49	8	50	7	47	10	21	5	9.2	7.6	6.8	6.7
,, + *D. fusca*	85	45	64	29	98	30	65	11	38.2	37.7	52.2	22.2
,, + *S. aculeata*	127	70	54	59	105	56	67	37	76.3	38.4	38.6	38.5

Salinity
level
EC mmhos/cm

TABLE 3. *Effect of salinity and organic amendment on C, and N distribution of soil organic matter fraction and biomass carbon, during 4 weeks of incubation.*

Salinity level EC mmhos/cm	C and N distribution of soil organi matter fraction mg c/g soil ur N/g soil						Microbial biomass	
	Humic acid		Fulvic acid		Humin		Biomass C mg/100 g soil	% soil C in biomass
	C	N	C	N	C	N		
Control soil	0.6	56.9	0.5	17.4	1.6	153.2	12.1	4.0
,, +*D. fusca*	1.5	155.8	1.5	47.9	2.6	242.8	19.1	6.4
,, +*S. aculeata*	1.6	113.7	1.1	30.1	2.7	257.2	21.9	7.3
2.5	0.6	55.8	0.5	16.8	1.7	157.3	12.5	4.2
,, +*D. fusca*	1.5	153.7	1.5	48.6	2.5	240.9	21.5	7.2
,, +*S. aculeata*	1.1	110.4	1.1	37.8	2.7	256.3	23.9	8.0
5.0	0.6	56.8	0.6	17.7	1.6	157.3	12.2	4.1
,, +*D. fusca*	1.5	154.8	1.5	47.5	2.6	246.6	17.6	5.9
,, +*S. aculeata*	1.1	111.6	1.1	37.1	2.7	260.2	24.4	8.1
7.5	0.5	53.7	0.5	17.4	1.7	159.1	11.0	3.7
,, +*D. fusca*	1.5	157.9	1.5	48.9	2.6	244.8	13.9	4.6
,, +*S. aculeata*	1.5	161.1	1.5	48.8	2.5	242.8	26.4	8.8
10.0	0.6	60.2	0.6	17.4	1.7	160.9	8.6	2.9
,, +*D. fusca*	1.5	160.23	1.6	51.5	2.6	290.5	10.4	3.5
,, +*S. aculeata*	1.3	134.77	1.3	42.31	2.8	267.6	15.7	5.2

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