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Short communication

Salinity, alkalinity and fertility indices of cultivated soils of Bikaner district of Rajasthan

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The salinity and alkalinity indices for cultivated soils of Bikaner district were 1.06, 2.96 and 1.04, 3.00 for surface and subsurface soils, respectively. The fertility index for organic carbon, available nitrogen, phosphorus and potassium were 1.00, 1.09,1.51 and 2.01 for surface and 1.00,1.04,1.50 and 1.96 for subsurface soils. Soils have slight salinity and moderate alkalinity problem and found to be low in organic carbon and available nitrogen, low to medium in available phosphorus and medium in available potassium.

Saline and alkali soils usually occur in association with the normal soils of the arid and semi-arid regions of Rajasthan. Salt affected soils occur to a lesser or greater extent in all the districts of the state, however, their nature is location specific. At present about 11.22 lakh hectares of land is affected by salinity and sodicity in the state (Sharma, 1998). In addition to this, considerable part of cultivated land is subjected to secondary and seasonal salinization due to poor quality of ground water. The periodically diagnosis and subsequent management of salinity, alkalinity and fertility status of the soil is of vital significance. Detailed systematic information are not yet available about salinity, alkalinity and fertility status of soils of the study area, which is essential for sustainable natural resource management. Therefore, an urgent need was felt for extensive and well planned investigation both in the field and laboratory for suggesting guidelines towards better utilization of soils of the tract.

A field survey was conducted to evaluate salinity, alkalinity and fertility indices of cultivated soils of Bikaner district of Rajasthan during 2004. One hundred seventeen composite soil samples from each depth (0-15 and 15-30 cm depth) were collected from cultivated fields during the months of April-May, 2004. The soil samples were processed and analyzed for soil pH, EC (1:2 soil water suspension), organic carbon, available nitrogen, phosphorus and potassium by using standard methods. Salinity, alkalinity and fertility indices of soils were calculated by the methods suggested by Muhr *et al.* (1965) and Seth (1967). The study area are irrigated by tubewell waters. The main crops grown are pearlmillet, cluster bean, groundnut, cotton, mung, moth and sesame in kharif and wheat, mustard, barley and gram in rabi.

Data presented in Table 1 revealed that the pH value of Bikaner district soils varied between 7.75 to 9.21 with an average value of 8.72 and 7.80 to 9.28 with an average value of 8.78 for surface and subsurface soils, respectively. Thus, the pH of study area varied from normal to alkaline. Accumulation of bases especially Na^+ under low rainfall conditions seem to be the primary reason for alkalinity. Similar result was also reported by Sharma *et al.* (2004). The electrical conductivity of surface soils ranged between 0.10 to 1.39 dS m^{-1} with an average value of 0.33 dS m^{-1}, while electrical conductivity of subsurface soils varied from 0.08 to 1.12 with an average value of 0.27 dS m^{-1}. The EC values of surface soils were slightly higher as compared to subsurface soils. The higher values of EC of surface soils might be due to high evaporation demand of the arid-ecosystem due to prevailing high temperature, low rainfall and irrigating soils with poor quality underground waters. Similar findings were also reported by Sharma *et al.* (2004). It is seen from the data (Table 1) that organic carbon, available nitrogen, phosphorus and potassium content of surface soils were varied from 0.03 – 0.42% with mean value of 0.16%, 62.76-370.65 with mean value of 152.82, 3.25- 62.31 with mean value of 17.51 and 108.78-372.54 with the mean value of 209.99 kg/ha while for subsurface soils it were varied from 0.01-0.38% with average value of 0.13 %, 56.95-307.40 with average value of 127.75, 2.20 - 53.13 with average value of 15.16 and 100.79-357.50 with the average value of 189.26 kg/ha. The organic carbon and available nitrogen of both surfaces had been found low. The low organic carbon and nitrogen content of these soils could be ascribed to occasional addition of organic material, scanty natural vegetations and poor decomposition due to low rainfall and rapid oxidation due to high summer temperature and wind erosion. The soils of the study area were found to be low to medium in available phosphorus and medium in available potassium content.

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Table 1. Chemical and fertility parameters of soils of Bikaner district

Characters	Depth (cm)	EC (dSm^{-1})	pH	Organic carbon (%)	available nitrogen (kg/ha)	available phosphorus (kg/ha)	available potassium (kg/ha)
Range	0-15	0.10-1.39	7.75-9.21	0.03-0.42	62.76-370.85	3.25-62.31	108.78-372.54
	15-30	0.08-1.12	7.80-9.28	0.01-0.38	56.95-307.40	2.00-53.13	100.79-357.50
Mean	0-15	0.33	8.72	0.16	152.82	17.51	209.99
	15-30	0.27	8.78	0.13	127.75	15.16	189.26
C.V.	0-15	74.38	2.12	48.23	39.40	55.51	23.62
	15-30	77.97	2.05	54.18	42.15	59.28	24.27

The calculated values of salinity and alkalinity indices for surface soils were 1.06 and 2.96, respectively. On the other hand, the calculated values of these indices for subsurface soils were 1.04 and 3.00, respectively (Table 2). From these indices it can be inferred that both surface and subsurface soils were moderate sodic in nature. On the basis of EC and pH of surface and subsurface soils of Bikaner district were classified into three salinity and sodicity groups as suggested by Sehgal *et al.* (1987). The majority of surface (93.16%) and subsurface (92.31%) soil samples fell under the VsM group (very slight salinity and moderate sodicity), whereas, only 3.42 and 1.71% under VsS group (very slight salinity and slight to negligible sodicity) and 3.42 and 5.98 % soil samples under VsS_1 (very slight salinity and strong sodicity) groups , respectively. The fertility index for organic carbon, available nitrogen , phosphorus and potassium were 1.00 ,1.09,1.51 and 2.01 for surface and 1.00 ,1.04,1.50 and 1.96 for sub surface soils. Therefore , soils of the study area were found to be low in organic carbon and available nitrogen , low to medium in available phosphorus and medium in available potassium (Table 3) . Based on the grouping of data according to fertility groups, surface soils of studied area were classified into seven fertility groups (1.71%) samples low in organic carbon , available nitrogen , phosphorus and potassium , 47.86% samples low in organic carbon , available nitrogen , phosphorus and medium in available potassium , 39.33% samples low in organic carbon , available nitrogen and medium in available phosphorus and potassium , 1.71% samples low in organic carbon , available nitrogen , medium in available phosphorus and high in available potassium , 0.85% samples low in organic carbon,

Table 2. Frequency distribution and salinity and alkalinity indices of soils

Parameters	Number of samples under each category	
	D_1	D_2
EC ($dS\ m^{-1}$)		
<1	110.0	112.0
1-2	7.0	5.0
2-3	-	-
>3	-	-
salinity index	1.06	1.04
pH		
<8.0	1.0	1.0
8.0-8.5	7.0	5.0
8.5-9.0	105.0	104.0
>9.0	4.0	7.0
Alkalinity index	2.96	3.00

D_1 = 0-15 cm soil depth D_2=15-30 cm soil depth

Table 3. Frequency distribution (n) and fertility index (f_i)of soils

Parameters	Number of samples under each category (n)							
	Low		Medium		High		f_i	
	D_1	D_2	D_1	D_2	D_1	D_2	D_1	D_2
SOC (%)	117.0	117.0	-	-	-	-	(100)	(100)
		1.00	1.00					
Available nitrogen (Kg/ha)	107.0	112.0	10.0	5.0	-	-	1.09	1.04
	(91.45)	(95.73)	(8.55)	(4.27)				
Available phosphorus(Kg/ha)	58.0	59.0	58.0	57.0	1.0	1.0	1.51	1.50
	(49.57)	(50.43)	(49.57)	(48.72)	(0.85)	(0.85)		
Available potassium(Kg/ha)	3.0	6.0	110.0	110.0	4.0	1.0	2.01	1.96
	(2.56)	(5.13)	(94.02)	(94.02)	(3.42)	(0.85)		

Figures in parenthesis represent per cent samples under each categories : D_1 = 0-15 cm soil depth D_2 = 15-30 cm soil depth

available nitrogen and potassium and high in available phosphorus , 7.69% samples low in organic carbon and medium in available nitrogen , phosphorus and potassium and 0.85% samples low in organic carbon, medium in available nitrogen, phosphorus and high in available potassium), while , subsurface soils classified into six fertility groups (4.28%) samples low in organic carbon, available nitrogen , phosphorus and potassium , 46.15% samples low in organic carbon, available nitrogen, phosphorus and medium in available potassium, 43.59% samples low in organic carbon, available nitrogen and medium in available phosphorus and potassium, 0.85% samples low in organic carbon , available nitrogen , medium in available phosphorus and high in available potassium, 0.85% samples low in organic carbon, available nitrogen and potassium and high in available phosphorus and 4.28% samples low in organic carbon and medium in available nitrogen , phosphorus and potassium. In nut cell majority of soils both of surface (87.19%) sub surface (89.74%) were grouped into two fertility groups soils low in organic carbon available nitrogen , phosphorus and medium in available, potassium and soils low in organic carbon , available nitrogen and medium in available phosphorus and potassium .

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