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CHEMICAL PROPERTIES OF DIFFERENT SALINE AND NON SALINE SOILS OF BANGLADESH

A.K. AZAD[1] AND P. BALA[2]

[1]Lecturer, Agriculture, Mrigi Shoheed Diandt College, Baliakandi, Rajbari, Bangladesh; [2]Lecturer, Agriculture, Lalmia City College, Gopalganj, Bangladesh.

Corresponding author & address: Pronay Bala, Email: kbdpronay@yahoo.com
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ABSTRACT

Azad AK, Bala P (2011) Chemical properties of different saline and non-saline soils of Bangladesh. *J. Soil Nature* 5(1), 1-5.

Soil samples were collected from saline locations of Bangladesh namely Sunderban- forest, Nohati, Doratanaghat, Alipur, Budhhata, Rahimpur, Kula, Dumki, Amati, Rajbari and non-saline BAU Farm, Mymensingh to study some chemical properties. The organic carbon content varied from 0.42 to 1.24 per cent and the CEC from 13.18-to 30.92 me/100g soil. Both CEC and organic carbon contents decreased with increasing soil depths. The studied soils were nearly neutral or slightly alkaline in reaction. The cations such as Na^+, K^+, Ca^{2+} and Mg^{2+} decreased with increasing soil depths. The SAR, ESP and ESR values were recorded higher at the surface layer. The available sulphur values varied from 9.11 to 40.01 ppm, and values decreased with increasing soil depths. EC values varied from 0.387 to 9.357 dSm^{-1}.

Key words: *soil samples, salinity, chemical properties,*

INTRODUCTION

Bangladesh has a wider range and greater complexity of lands. Earlier soils of Bangladesh were divided into 20 general soil types and 537 soil series. At present, the soils of Bangladesh are divided into thirty Agro-Ecological Zones. There is thirty per cent coastal area present in Bangladesh. Out of 2.85 million hectares of coastal and off-shore areas about 0.833 million hectares are arable lands, which constitutes about 52.8 per cent of the net cultivable area and is affected by varying degrees of soil salinity. For research planning and better crop production, the basic data on chemical properties of saline and non-saline soil are very much important. These characteristics of an area are very much important to determine the types of crop to be grown.

Chemical characteristics of soils represent the nature of genetic process, its development and present nutrient status. So, for evaluating the characteristics of soil profile and present fertility status of soil, chemical analysis has got much important once. The proper fertilizer use depends on the nutrient content of the soil. As a consequence of human activities over a long period of time, the vegetation as well as soil properties are also changed (Quddus 1997). So, a person dealing with soil should be acquainted with the chemical properties and then may decide either the soil is suitable for plant growth.

The severity of salinity problem in Bangladesh increases with the drying of the soil. During the wet monsoon the severity of salt injury is reduced due to dilution of the salt in the root zone of the standing crop. Fertility status of the most saline soils ranges from low to very low with respect to organic matter content. The dominant crop grows in the saline areas is local transplanted *aman* rice with poor yields. Scarcity of quality irrigation water during dry season limits cultivation of *boro* rice and *rabi* crops and *aus* cultivation during *kharif* season. Crop production in the saline soils is constrained by salt accumulation in the root zone. Crop production is possible in the salt-affected soils when the salt concentration in the root-zone is diluted or leached down below the root zone. In the light of above discussion the present piece of research work was undertaken to evaluate the nutrient status and chemical properties of saline and non-saline soils of Bangladesh.

MATERIALS AND METHOD

The soil and water samples were collected from saline and non-saline locations of Bangladesh namely Sunderban forest, Nohati, Doratanaghat, Alipur, Budhhata, Rahimpur, Kula, Dumki, Amati, Rajbari and non saline BAU Farm. The soil samples were analyzed during 2009 in the Soil Science Laboratory, BAU, Mymensingh for different parameters. The analytical methods followed by the soil samples are given below:

pH was determined by Glass elecrtrode pH meter (Jackson 1962), Organic carbon (%) was determined by Wet oxidation method (Walkley and Black, 1934), Exchangeable K, Ca, Na and Mg (meq/100g) were determined by Ammonium acetate extraction method (Coleman *et al.* 1959) and Available S (ug/g) was determined by Calcium phosphate extraction method (Petersen 1996).

SAR (Sodium adsorption ratio) was calculated by the following formula

$$SAR = \frac{Na^+}{1/2\sqrt{Ca^{2+} + Mg^{2+}}}$$

% BSP (Base saturation percentage) was estimated using the under mentioned formula.

$$\%\ BSP = \frac{Na^+ + K^+ + Mg^{2+} + Ca^{2+}}{CEC} \times 100$$

ESP (Exchange sodium Percentage) was determined from the given relationship.

$$\% \ ESP = \frac{EchangeableNa^{+}}{CEC} \times 100$$

ESR (Exchangeable Sodium ratio) was calculated using the following formula:

$$ESR = \frac{ExchangeableNa^{+}}{CEC - exchangableNa^{+}}$$

Electrical Conductivity of Soil Extract (ECe) was determined by Electrical Conductivity meter and calculated by using the following formula

ECe = Ect X Ft

Where,
ECe = Electrical Conductivity of Soil Extract at 25^0C
Ect = Electrical Conductivity of Soil Extract at t^0C
Ft = Temperature correction factor at t^0C

RESULTS AND DISCUSSION

Table 1, 2 and 3 showed the chemical properties and nutrient status of soils. The different criteria of those soil are discussed under following headings:

Organic carbon

The data on organic carbon content of soils are shown in table 1. The organic carbon content was higher in 0-15 cm soil depth and decreased with increasing depths in all soils studied. Sood and Kanwar (1986), Anwar (1993) and Sahoo *et al*. (1995), also observed similar decreasing trend of organic carbon content with increasing depth in different soils. This variation might be possibly for addition of organic matter in surface layer and presence of compact plough pan in the sub-surface layer. The highest value of organic carbon was found 1.24% in Sunderban forest at 0-15 cm soil depth and the lowest value was observed 0.42% in Dumki at 30-45 cm of soil depth.

Soil pH

The highest pH content (8.26) was observed at 30-45 cm depth of Rahimpur soil. On the other hand, the lowest soil pH content (7.19) was found at 0-15 cm depth of Amati soil (Table 1). These were very close to the results of Rahman (1986), SRDI (1993) and Anwar (1993).

Cation Exchange Capacity (CEC)

Soils of Alipur crop field showed the highest values of CEC at all depths because of relatively high clay contents of the soil. Because of low clay and organic carbon contents of the soils of BAU Farm, the CEC values were relatively smaller there. Our observation is also supported by Rahman (1987) who found that the CEC value raising from 12.7 to 20.7 me/100g soil in two salt affected areas of Bangladesh.

Available cation concentration (K^+, Na^+, $Ca^{2+}$and Mg^{2+})

The highest value of K^+ was found 0.905me/100g soil in Alipur at 0-15 cm soil depth and the lowest was 0.029 me/100g soil in BAU Farm at 30-45 cm soil depth. Concentration varied remarkably between different depths of soil. The highest value of Na^+ was found to be 7.380me/100g in Sunderban soil at 0-15 cm depth. The highest value of Ca^{2+} was found to be 7.593me/100g soil in Nohati at 0-15 cm soil depth and the lowest was 1.830 me/100g soil in Amati at 30-45 cm soil depth. The highest amount of Mg^{2+} (0.880me/100g soil) was observed in Amati at 30-45 cm soil depth.

SAR, ESP, BSP and ESR

The highest value of SAR was found to be 5.23-me/100g soils in Amati at 0-15cm soil depths and the lowest was 0.16-me/100g soils in BAU Farm at 30-45 cm soil depth. This result is supported by Sadhu & Dash (1993) who reported that the SAR value ranged between 2.7 to 5.23 me/litre at different area of salt affected soils of Orissa (India). The highest value of ESP was found to be 30.15 in Sunderban forest at 0-15 cm soil depth and the lowest was 1.44 in BAU Farm at 30-45 cm soil depth. This result is supported by Sadhu & Dash (1993) who reported that the ESP value ranged between 3.5 to 48.8 in salt affected area of Astaranga. The highest value of BSP was found 74.94 in Sunderban forest at 0-15 cm soil depth and the lowest was 43.79 in BAU Farm at 30-45 cm soil depth. The BSP was higher in topsoil compared to sub soil. This result is supported by Reconnaissance Soil Survey Report (1967) and found that the BSP value was found to be 69.30 from the salt affected soils of Bangladesh at surface layer. The highest value of ESR was found to be 43.16 in Sunderban forest at 0-15 cm soil depth and the lowest was 1.46 in BAU Farm at 30-45 cm soil depth.

Available sulphur

The highest value of sulphur was found 40.01 ppm in Doratanaghat at 0-15 cm soil depth and the lowest value was 9011 ppm in Rahimpur at 30-45 cm soil depth. The available sulphur content of soil also showed decreasing trend. Our observation supported by Islam (1983) who reported that the sulphur deficiency in Bangladesh soils is becoming wide spread and acute. Our result is also supported by Chowdhury (1992) who reported that the available sulphur of soil decreased with increasing of soil depth and the available sulphur of Old Brahmaputra Floodplain soil varied from 4.00 to 20.00 ppm.

Electrical Conductivity (EC)

The highest value of EC was found to be 9.356 dSm^{-1} in Sunderban (Mangla Port) at 0-15 cm Soil depth and lowest 0.387 dSm^{-1} in BAU farm at 30-45 cm Soil depth. This result is supported by Sharma *et al*. (1987).

CONCLUSION

The results indicated that the organic carbon content was higher (1.24%) in Sunderban at 0-15 cm depth and lower (0.42%) in Dumki at 30-45 cm soil depth compared to other soils. The Cation Exchange Capacity (CEC) of all soils varied from 13.18 to 30.92 me/100g of soil. The highest CEC values gradually decreased with increasing depth. The pH value was nearly neutral or slightly alkaline in all the study areas. The concentrations of cations such as K^+, Na^+, Ca^{2+} and Mg^{2+} was found as 0.029 to 0.905, 0.190 to 7.380, 1.830 to 7.593 and 0.880 to 6.637 me/100g soil and these cation decreased with increasing soil depths. The values of SAR, ESP, BSP and ESR were recorded at the surface layer and decrease with increasing depth. The highest value of sulphur was found in Doratanaghat at 0-15 cm depth and lowest value was in Rahimpur at 30-45 cm soil depth. The highest EC value was observed 9.357 dSm^{-1} in Sunderban forest of Bagerhat district at 0-15 cm soil depth. The farmers can grow their crops successfully with use of soil test value (STV), chemical based fertilizer along with organic manure.

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Table 1. Organic carbon, soil reaction (pH) and CEC of ten selected saline and non-saline soils of Bangladesh

Location	Types of soil	Soil depth (cm)	Organic Carbon (%)	pH	CEC (me/100g soil)
Sunderban, Manglaport, Bagerhat	Saline	0-15	1.24	8.01	24.48
		15-30	1.13	8.17	22.49
		30-45	0.95	8.00	21.96
Nohati, Rupsa, Khulna	Saline	0-15	0.91	8.18	22.94
		15-30	0.56	8.02	21.90
		30-45	0.46	8.09	19.68
Doratana ghat Bagerhatbazar Bagerhat Sadar	Saline	0-15	0.88	7.28	23.59
		15-30	0.71	7.82	21.96
		30-45	0.72	7.72	26.61
Alipur, Satkhira,	Saline	0-15	0.91	7.45	30.92
		15-30	0.71	7.84	29.95
		30-45	0.72	7.72	26.61
Budhhata, Asasuni, Satkhira	Saline	0-15	0.94	7.21	30.05
		15-30	0.75	7.31	29.39
		30-45	0.59	7.51	24.22
Rahimpur, Kaligonj, Satkhira	Saline	0-15	0.86	8.01	22.59
		15-30	0.74	8.20	21.52
		30-45	0.67	8.26	19.04
Kula, Asasuni, Sathkhira	Saline	0-15	0.68	7.21	24.42
		15-30	0.57	7.32	23.31
		30-45	0.49	7.47	20.75
Dumki, Lebukhali, Patuakhali	Saline	0-15	0.86	7.30	22.06
		15-30	0.64	7.50	20.31
		30-45	0.42	7.52	17.99
Amati, Barguna.	Saline	0-15	0.64	7.19	20.67
		15-30	0.57	7.31	18.00
		30-45	0.53	7.88	15.61
BAU Farm, Mymensingh	Non-saline	0-15	0.80	7.45	15.78
		15-30	0.57	7.71	14.15
		30-45	0.52	7.68	13.18

Table 2. Available K^+, Na^+, Ca^{2+} and Mg^{2+} status of ten selected saline and non-saline soils of Bangladesh

Location	Types of soil	Soil depth (cm)	K^+ (me/100g soil)	Na^+ (me/100g soil)	Ca^{2+} (me/100g soil)	Mg^{2+} (me/100g soil)
Sunderban, Manglaport, Bagerhat	Saline	0-15	0.619	7.380	6.367	3.980
		15-30	0.571	5.740	5.447	2.320
		30-45	0.588	5.093	4.447	2.000
Nohati, Rupsa, Khulna	Saline	0-15	0.188	4.670	7.593	3.200
		15-30	0.079	3.427	6.753	2.280
		30-45	0.057	2.383	5.390	2.000
Doratana ghat Bagerhatbazar Bagerhat Sadar	Saline	0-15	0.848	5.953	6.017	3.492
		15-30	0.825	4.723	5.107	3.110
		30-45	0.794	4.280	4.127	2.923
Alipur, Satkhira,	Saline	0-15	0.905	6.910	7.413	6.637
		15-30	0.825	6.433	6.553	5.613
		30-45	0.697	4.570	5.763	4.360
Budhhata, Asasuni, Satkhira	Saline	0-15	0.796	6.620	7.140	5.543
		15-30	0.762	6.110	6.420	4.743
		30-45	0.693	4.647	4.120	3.473
Rahimpur, Kaligonj, Satkhira	Saline	0-15	0.790	6.272	5.870	3.230
		15-30	0.756	5.670	5.233	2.730
		30-45	0.694	4.530	4.250	1.210
Kula, Asasuni, Sathkhira	Saline	0-15	0.183	5.420	5.910	4.237
		15-30	0.177	4.230	4.910	3.430
		30-45	0.130	3.883	3.997	2.910
Dumki, Lebukhali, Patuakhali	Saline	0-15	0.229	4.893	5.890	3.550
		15-30	0.105	3.307	4.323	3.013
		30-45	0.080	3.670	3.660	2.120
Amati, Barguna.	Saline	0-15	0.131	5.953	2.190	2.973
		15-30	0.080	4.440	2.553	1.010
		30-45	0.036	4.160	1.830	0.880
BAU Farm, Mymensingh	Non-saline	0-15	0.091	0.347	5.970	3.620
		15-30	0.030	0.260	4.220	2.107
		30-45	0.029	0.190	3.330	2.223

Table 3. Values of SAR, ESP, BSP, ESR available S and EC of ten selected saline and non-saline soils of Bangladesh

Location	Types of soil	Soil depth (cm)	SAR (me/100g soil)	ESP %	BSP %	ESR	Available S(ppm)	EC ($dSm^{-1)}$
Sunderban, Manglaport, Bagerhat	Saline	0-15	4.58	30.15	74.94	43.16	26.15	9.357
		15-30	4.12	25.52	62.59	34.27	23.50	7.913
		30-45	4.01	23.19	56.78	30.19	24.21	8.111
Nohati, Rupsa, Khulna	Saline	0-15	2.48	20.36	68.23	25.56	23.72	4.658
		15-30	2.35	15.65	57.26	18.55	22.00	3.856
		30-45	1.75	12.10	49.94	13.78	21.23	3.286
Doratana ghat Bagerhatbazar Bagerhat Sadar	Saline	0-15	3.86	25.24	69.14	33.75	40.01	5.929
		15-30	3.29	21.51	63.46	27.40	38.50	4.528
		30-45	3.19	20.30	25.48	2.923	30.50	4.144
Alipur, Satkhira,	Saline	0-15	3.69	22.35	70.69	28.78	13.23	5.362
		15-30	3.68	21.48	65.54	27.35	12.92	4.190
		30-45	2.87	17.17	57.83	20.74	12.12	3.219
Budhhata, Asasuni, Satkhira	Saline	0-15	3.72	22.03	66.89	28.25	12.32	7.553
		15-30	3.65	20.79	61.14	26.26	10.18	6.228
		30-45	3.37	19.19	53.39	23.74	9.56	4.275
Rahimpur, Kaligonj, Satkhira	Saline	0-15	4.45	29.78	73.55	42.40	11.89	7.976
		15-30	4.02	26.34	66.86	35.77	10.76	5.947
		30-45	3.49	23.79	61.37	31.22	9.11	6.219
Kula, Asasuni, Sathkhira	Saline	0-15	3.40	22.19	64.49	28.53	12.12	4.452
		15-30	2.93	18.15	54.66	22.17	11.08	3.592
		30-45	2.91	18.17	52.60	23.01	10.12	3.021
Dumki, Lebukhali, Patuakhali	Saline	0-15	3.19	22.18	66.01	28.50	15.23	4.671
		15-30	2.4	16.28	53.00	19.45	13.89	3.837
		30-45	3.05	20.40	52.97	25.63	12.77	3.459
Amati, Barguna.	Saline	0-15	5.23	28.80	54.41	40.45	13.34	6.326
		15-30	4.70	24.67	44.91	32.74	11.96	5.887
		30-45	5.05	26.64	4.24	36.3	10.35	5.388
BAU Farm, Mymensingh	Non-saline	0-15	0.22	1.93	63.54	2.25	14.20	0.461
		15-30	0.21	1.84	46.76	1.87	13.24	0.427
		30-45	0.16	1.44	43.79	1.46	11.13	0.387