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STUDY ON SALT ACCUMULATION IN SOIL LAYERS AS AFFECTED BY DIFFERENT CONCENTRATION OF SALINE WATER

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ABSTRACT

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Soil salinity becomes a major issue in global agriculture when soil and environmental factors contribute to the accumulation of salt in soil layers above a level, adversely affecting crop production. Therefore, cultivation of salt-tolerant crops and management of soil salinity are important strategies to boost agricultural economy. The present research was conducted at Salinity Management and Research Center Batiaghata, Khulna to know the effect of saline water on salt accumulation in different layers of the soil. Results revealed that higher level of salinity was observed in the top layer soil in comparison with sub and substratum due to application of saline water (2 dS/m, 4 dS/m, 6 dS/m and 8 dS/m). The data also showed that soil salinity increased year after year.

Key words: *salt accumulation, soil layer, saline water*

INTRODUCTION

Salinity within irrigated soils clearly limits crop productivity in vast areas of Bangladesh and other parts of the world. Soil degradation caused by salinization and sodification is of great concern in the modern world because it reduces potential agricultural lands (Tanji 1990; Sadiq *et al.* 2007).

Soils are derived from chemical and physical weathering of rocks, and other geological and organic materials. Thus, they always contain some soluble inorganic and organic compounds. Rain can also lead to the accumulation of salt over time, although it contains only small amounts of salt. Wind-transported materials from soil or lake surfaces are another source of salt. Application of soluble fertilizers and soil amendments, poor quality irrigation water and capillary rise of shallow saline groundwater can together contribute to the salinization of the soil layers. Even seawater intrusion onto land, which is a growing problem as sea levels rise in many parts of the world, can deposit a large amount of salt in soil of coastal lands. The particular processes contributing salt, combined with the influence of other climatic and landscape features and the effects of human activities, determine where the salt accumulates in the landscape.

Soil salinity becomes a major issue in global agriculture. Worldwide, more than 800 million hectares of land are estimated to be salt affected (FAO 2008). These soils cover a range of soils defined as saline, saline–sodic and sodic (Ghassemi *et al*. 1995). All soil types with diverse morphological, physical, chemical and biological properties may be affected by salinity (Rengasamy 2006).

Considering the above facts, the present study was an attempt to assess the effect of saline water in concern to salt accumulation in soil and to observe the rate of salt accumulation in different layers of soil.

METHODOLOGY

The experiment was carried out at Salinity Management and Research Center (SMRC), Batiaghata, Khulna within a controlled structure. In this experiment 12 brick made micro plot was used and it was filled up with non-saline soil (1.2 dS/m). The size of micro plot was 1m × 1m × 1m. There were four treatments of applied saline water with three replications. The EC of the applied water was 2 dS/m, 4 dS/m, 6 dS/m and 8 dS/m. Salinity data was recorded at the end of June, 2015. The data were subjected to statistical analysis of variance (ANOVA) and the means were tested using Duncan's Multiple Range Test (DMRT) at 5% level of significance. The data are presented in figure as means ± standard error (SE) of three replicates.

RESULTS AND DISCUSSION

The natural soil from the depth of different layers was collected. A part of the disturbed soil samples were air-dried and mixed with distilled water at the ratio of 1:5 by weight. Then the supernatant water was taken and $EC_{1:5}$ were measured using a portable electrical conductivity meter (B-173; Horiba Ltd.). The soil pH was measured in a 1:2.5 (soil: water by weight) suspension by using a portable pH meter (B-212; Horiba Ltd.). Soluble cation concentrations were measured using an atomic absorption spectrophotometer (AAS; Z 5300; Hitachi Ltd.) in the supernatant water after centrifuge.

Table 1. Some selected properties of studied soil

Soil depth (cm)	pH	EC (dS/m)	Ca^{2+} (mg L^{-1})	Na^{+} (mg L^{-1})
0 - 10	8.0	1.4	56	81
10 - 20	7.9	1.5	48	157
20 - 40	7.9	1.5	30	194
40 - 80	8.1	1.8	08	240

The studied soil showed a silty clay texture (clay 38.2, silt 50.4 and sand 11.4 %); the pH values were 8.0, 7.9, 7.9 and 8.1 and $EC_{1:5}$ values were 1.4, 1.5, 1.5, and 1.8 dS/m at 0 to 10, 10 to 20, 20 to 40 and 40 to 80 cm soil depth, respectively. The upper soil was high calcium concentration in comparison with lower part. However, the sodium concentration was higher in the lower part of studied soil. Some selected fundamental properties of studied soils are given in Table 1.

Results in Table 2 and Figure 1 indicate that soil salinity increased due to application of saline water. Top soil showed higher salinity in comparison with sub-soil. The highest salinity (13.29 dS/m) was found at top soil for the treatment 4 (8 dS/m) after application of saline water for 4 years. The lowest salinity was found 3.01 dS/m at 75 cm soil depth after 4 years of water applied with 2 dS/m water. It was found that soil salinity was increased with higher saline water supplied. It was also found that soil salinity in top soil was higher than that in sub soil. Similarly soil salinity increased year after year as well.

Table 2. Impact of saline water on soil at different depth of controlled micro plot

Treatments	EC of applied water	EC of soil at 30 cm depth			
		2011	2012	2013	2014
T_1	2 dS/m	1.73	2.65	2.95	3.15
T_2	4 dS/m	3.12	4.29	5.13	5.37
T_3	6 dS/m	3.13	4.34	6.25	5.97
T_4	8 dS/m	3.37	6.87	7.12	7.46
Treatments	**EC of applied water**	**EC of soil at 10 cm depth**			
		2011	**2012**	**2013**	**2014**
T_1	2 dS/m	2.83	3.18	3.92	4.35
T_2	4 dS/m	5.32	6.84	7.35	7.64
T_3	6 dS/m	5.96	7.11	9.24	10.81
T_4	8 dS/m	6.41	8.24	11.69	13.29

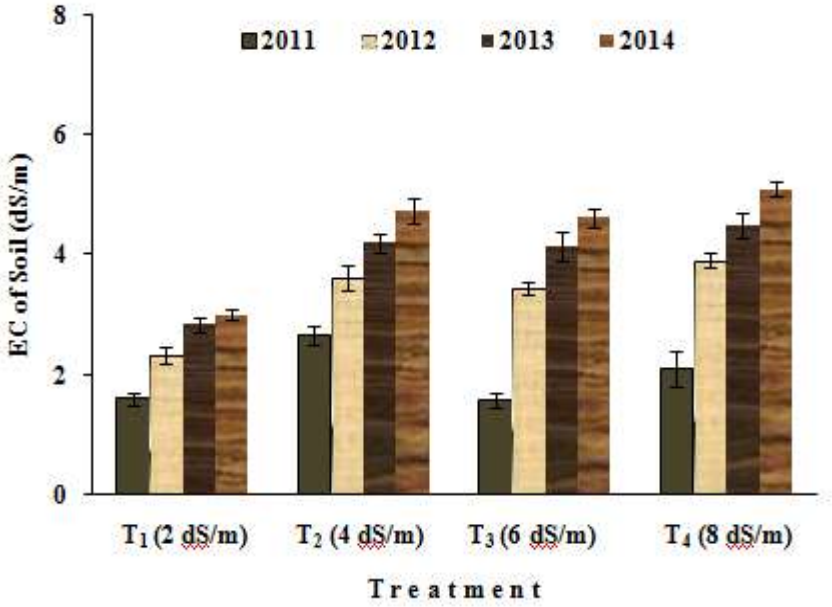

Fig. 1. The EC of soil at 75 cm depth as affected by using different concentrations of saline water. *Vertical bars* indicate ± standard error (SE) of three replicates

CONCLUSION AND RECOMMENDATION

Due to application of saline water (2 dS/m, 4 dS/m, 6 dS/m and 8 dS/m), higher salinity was observed in the top layer soil in comparison with sub and substratum. The data have also showed that soil salinity increased year after year.

Further research is needed to assess how these different types of salt influence soil structure and, hence, salt accumulation or leaching. This is important to improve productivity in irrigated crops. There is also a gap in our knowledge in identifying the predominant, or a common factor when different issues cause constraints to plant growth in different soil layers. The uncertainty in our ability to separate effects of these factors will need to be overcome for developing varieties adapted to various physicochemical constraints, in addition to salinity of soil layers.

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