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Short Communication

Extractable Trace Elements in Salt and Alkali Contaminated Soils of Haryana

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Saline and alkali soils are largely found in arid and semi-arid areas of the world. Agricultural productivity of nearly 5.2 lakh ha area in Haryana state of India is greatly reduced because of varying degrees of soil salinity and alkalinity. According to Takkar and Randhawa (1978) saline/sodic soils are often deficient in available micronutrients. The present study was taken up to evaluate the availability of Zn, Fe, Mn and Cu in the salt and alkali contaminated soils primarily representing Trans-Gangetic Plain region of northern India.

Seven representative soil profiles from Dhabeta, Sui, Mudlana, Panipat, Nirjhan, Narnaud and Majra villages were exposed to cover the salt and alkali contaminated soils of Jind, Panipat and Hisar districts of Haryana state which forms a part of the vast Trans-Gangetic alluvial plain. Forty five samples were collected from different horizons. The physico-chemical characteristics of the soils were determined following standard procedures. The DTPA solution (pH 7.3) was used for extracting Zn, Fe, Mn and Cu from the soil (Lindsay and Norvell, 1978) and estimated by atomic absorption spectrophotometer. Correlation and regression analysis were carried out.

The various soil characteristics vary widely within and amongst soil profiles (Table 1). Soil pH varied from 8.0 to 10.3, with highest in profile 2. The higher pH values were due to higher ESP values which ranged from 2 to 99 and CO_3'' and HCO_3' in the soil solution. The electrolyte conductivity varied from 0.93 to 38.0 dS m^{-1} with a mean of 7.0 dS m^{-1}. ECe of salt contaminated soils decreased with depth. $CaCO_3$ accumulation was observed in all the salt-affected pedons. The increase of $CaCO_3$ with depth indicates leaching of Ca and subsequent precipitation as carbonate at lower depths. The organic carbon content

Table 1. Physico-chemical properties and extractable trace element content of soil profiles

Profile No. (depth)	ESP	pH (1:2)	EC (dS m^{-1})	$CaCO_3$ (%)	O.C. (%)	Clay (%)	DTPA extractable (mg kg^{-1} soil) Zn	Fe	Mn	Cu
1(185)	67-99	9.2-10.0	1.02-38.0	2.0-18.0	0.05-0.29	4.5-23.8	0.10-0.45	5.4-13.8	14.2-35.2	0.55-1.85
2(180)	64-98	9.5-10.3	0.72-5.58	2.5-20.2	0.06-0.13	12.6-28.3	0.25-0.80	8.1-20.4	19.5-27.7	0.45-2.55
3(185)	2-5	8.2-8.5	3.54-27.0	2.0-4.2	0.17-0.63	8.2-16.5	0.20-0.85	2.4-7.8	9.7-38.2	0.95-1.55
4(200)	11-91	8.4-9.8	1.08-14.4	2.0-13.5	0.05-0.18	9.5-28.0	0.25-0.80	2.1-8.1	1.8-46.5	0.25-1.50
5(160)	25-44	8.3-8.7	4.02-24.0	3.5-12.5	0.04-0.64	8.1-30.6	0.15-0.30	2.4-6.9	2.2-9.1	0.35-1.65
6(175)	2-19	8.0-8.9	6.44-13.2	1.5-15.2	0.07-0.52	9.9-14.7	0.30-1.75	3.0-4.5	3.6-9.3	0.30-1.20
7(180)	5-9	9.5-9.9	0.93-11.4	4.0-21.2	0.08-0.11	8.0-17.5	0.15-0.60	3.9-12.3	3.0-29.2	0.25-1.95

Depth (cm) is given in parenthesis.

Table 2. Multiple regression equations relating extractable trace elements with soil properties

	ESP	pH	EC	$CaCO_3$	OC	Clay	Fe	Mn	Cu	R^2
Zn = 0.63	-0.002*	-0.059	-0.008	+0.002	+0.291	+0.002	+0.031** Zn	+0.003 Mn	+0.013 Cu	0.55*
Fe = -21.74	+0.031**	+2.327**	-0.025	-0.012	-2.246	-0.002	+7.802** Zn	-0.050 Fe	+4.138 Cu	0.83**
Mn = -9.99	+0.084*	-0.881	-0.309	+0.546	-0.754	+0.710*	+14.987 Zn	-0.875** Fe	+18.372 Mn	0.58**
Cu = 1.28	+0.001	-0.033	+0.015	-0.038**	-0.304	-0.020*	+0.043	+0.056**	+0.014**	0.84**

*, ** Significant at 1% and 5%, respectively

was low to very low which decreased with depth in all the pedons. The clay content varied from 4.5 to 30.6% with an average of 15.9%. The DTPA-extractable Zn in all the profiles and horizon was 0.10 to 0.85 mg kg^{-1} with a mean of 0.35 mg Zn kg^{-1} soil. Sangwan and Singh (1993) also reported similar results in the semi-arid soils of Haryana. Based on the critical limit of 0.61 mg kg^{-1} (Singh and Shukla, 1985) all the profiles except 6 represented low Zn status. No regular trend of distribution for DTPA-Zn with depth was observed. In different profiles, the amount of Fe, Mn and Cu extracted by DTPA ranged from 2.1 to 20.4, 1.8 to 46.5 and 0.25 to 2.55 mg kg^{-1} soil, respectively. Judging by the criterion for DTPA extractable trace elements as suggested by Lindsay and Norvell (1978), all the soil samples are adequate in Mn and Cu and low to medium in Fe status. The soils, in general, have a decreasing trend for DTPA-Fe, Mn and Cu content with increasing depth except in case of profile 3.

There is a dependence of extractable trace elements on some soil characteristics which is exhibited by significant coefficient of correlation between them. The DTPA-Zn, Fe and Cu showed significant negative correlation with $CaCO_3$ content (r = -0.31*, -0.32* and -0.63**, respectively). The DTPA-Fe, Mn and Cu showed significant positive correlation with ESP (r = 0.60**, 0.47** and 0.39**, respectively) and DTPA-Mn had significant positive correlation with clay (r = 0.34*) and with DTPA-Cu (r = 0.73**). Multiple regression analysis showed that all the soil characters together accounted for 55, 83, 58 and 84% variation in the availability of Zn, Fe, Mn and Cu, respectively (Table 2). No single soil property showed significant contribution in the distribution of all the four extractable trace elements. Majority of the soil samples were deficient in Zn, marginal in Fe and sufficient in Cu and Mn. Application of Zn fertilizers in the course of reclamation would be helpful for these salt affected soils.

References

Lindsay, W.L. and Norvell, W.A. 1978. Development of a DTP soil test method for zinc, iron, manganese and copper. *Soil Science Society of America Journal* 42: 421-428.

Sangwan, B.S. and Singh, K. 1993. Vertical distribution of Zn, Mn, Cu and Fe in the semi-arid soils of Haryana and their relationship with soil properties. *Journal of Indian Society of Soil Science* 41: 463-467.

Singh, K. and Shukla, U.C. 1985. Evaluation of critical limit of soil Zn for predicting response of maize to Zn fertilization in aridisols. *International Journal of Tropical Research* 3: 288-292.

Takkar, P.N. and Randhawa, N.S. 1978. Micronutrients in Indian agriculture. *Fertilizer News* 23: 3-26.