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MANGANESE, ITS DISTRIBUTION AND RELATIONSHIP TO ORGANIC MATTER AND CALCIUM CARBONATE IN FIVE SELECTED SOIL SERIES OF BALUCHISTAN

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Five important agricultural soils of Quetta district of Baluchistan province were examined, on the profile basis for their manganese status. The profile distribution of manganese was irregular, positively correlated with organic matter and negatively correlated with calcium carbonate.

INTRODUCTION

Though the importance of trace elements in agriculture is well recognized, information of their distribution in the soil profile as the result of soil forming processes is rather meager. Information on their concentration in the genetic horizons may be useful in estimating the degree of leaching and weathering that has taken place in profile development. There are various reports (5, 7, 10) on the total content and vertical distribution of several trace elements in soils but the genetic horizons have not been designated. Toth (8) has given the profile distribution of manganese by genetic horizons for several New Jersey soils and reported four general types of manganese distribution

Type : 1. No variation in manganese content within the profile.
2. Decrease in manganese content from A to C horizon.
3. Increase in manganese content from A to C horizon.
4. No set pattern, but rather variable.

However, no such data are available for Baluchistan soils. The profile distribution of manganese by genetically designated horizons is reported herewith.

MATERIALS AND METHODS

In the collection and preparation of the soil samples, contamination with any source of the element under study was carefully avoided. The air dried

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samples were reduced by quartering and 10 grams ground to approximately 250 mesh in an agate mortar. Manganese was determined by extracting the soil with DTPA (Diethylenetriamine penta acetic acid) as described by Lindsay and Norvell (4). The extractant consisted of 0.005 M DTPA, 0.1 M TEA (Triethanolamine) and 0.01 M $CaCl_2$ buffered at 7.30 pH. Ten grams of soil were shaken with 20 ml of extractant for 2 hours and filtered using whatman filter paper No. 42. The concentration of manganese in the filterate was determined with atomic absorption spectro photometer (Model No. 1272 Beckman). The soil classification on the basis of U.S.D.A. and F.A.O. is stated in Table 1.

TABLE 1. *The classification of the soil series used in this study.*

S. No.	Soil Series	Classification According to USDA	Classification According to FAO
1	Sariab	Typic Camborthids	Haplic yermosol
2	Shabaq	Typic calciorids	Haplic yermosol
3	Shamozai	Typic camborthids	Haplic yermosol
4	Chiltan	Typic camborthids	Haplic yermosol
5	Lak	Halic camborthids	Orthic Solonchaks

RESULTS AND DISCUSSIONS

DTPA-extractable manganese is shown is Table 2. The manganese content in Sariab, Shabaq, Shanozai, chiltan and Lak series varied from 2.66 to 4.00, 1.67 to 2.17, 1.33 to 2.17, 1.67 to 2.50 and 2.30 to 5.33 ppm with the means of 2.90, 1.96, 1.75, 1.92 and 2.23 ppm, respectively. The higher figures of 4.00 and 5.33 ppm in B_{21} horizons in Sariab and Lak series apparently increase the mean in these two series, than the rest. This abrupt higher values may be due to more moist samples than others. Toth (8) also reported that the status of the soil manganese was influenced by the moisture content. Irregular distribution of the manganese in the profiles is in conformity to Toth (8) and Wright *et al.*, (10) who reported irregular distribution of manganese in the profiles. Correlation studies (Table 3) revealed that DTPA-extractable manganese was negatively correlated with lime content (-0.147). However, extractable manganese was positively correlated with organic matter at one percent level (0.534), whereas pH and cation exchange capacity were not significant. The results are partly in agreement with those of Follett and Lindsay (2) who reported that DTPA-extractable manganese was negatively correlated with soil pH and lime content

TABLE 2. *DTPA Extractable Mn and other soil analysis.*

Series	Horizon	Depth in cm	Texture			C.E.C. Meq/100 g	pH	$CaCO_3$	O.M.%	DTPA-Extractable Mn in ppm.
			Sa%	Si%	C%					
Sariab	Ap	00-12	27	65	08	7.00	8.10	19.00	0.41	2.30
	B_{21}	12-32	23	66	11	9.80	8.20	20.00	0.40	4.00
	B_{22}	32-59	41	49	10	8.10	8.15	21.50	0.23	2.66
	C_1	59-81	46	45	09	7.90	8.20	21.50	0.20	2.66
Shabaq	A_1	00-6	38	48	14	6.10	8.00	26.00	0.21	2.00
	B_{21}	6-17	36	40	24	10.20	8.00	26.50	0.28	2.17
	B_{22}	17-30	38	37	25	10.40	8.00	34.20	0.38	2.00
	C_1	30-80	42	43	15	06.60	8.10	33.50	0.12	1.67
Shamozai	A_1	00-06	32	49	19	8.50	7.75	19.00	0.24	2.17
	B_{21}	6-50	24	58	18	8.20	8.00	22.00	0.22	1.33
	B_{22}	50-81	26	57	17	7.20	8.00	24.00	0.10	1.33
	C	81-150	60	29	11	6.40	8.90	21.00	0.06	2.17
Chiltan	A_{11}	00-06	42	48	10	09.90	08.10	29.00	00.27	1.67
	A_{12}	06-20	48	43	09	08.20	08.20	30.00	00.35	1.67
	B_{22}	20-38	41	49	10	10.10	08.30	38.00	00.25	1.83
	C	38-74	49	42	09	08.20	08.10	64.00	00.18	2.50
Lak	A	00-12	32	49	19	08.50	08.10	21.00	00.40	3.00
	B_{21}	12-55	15	56	29	09.90	08.20	24.00	00.29	5.33
	B_{22}	55-95	11	51	38	11.40	08.50	28.00	00.20	2.30
	B_{23}	95-150	19	52	29	09.90	07.60	21.00	00.11	2.30

TABLE 3. *Correlation coefficient between DTPA-extractable Mn and other soil properties.*

Soil Properties	DTPA-Extractable Mn.
pH	0.123
O.M.	0.534**
$CaCO_3$	-0.147
C.E.C.	0.277

**Significant at 1% probability level.

and positively correlated with organic matter. They further reported that extractable manganese was not associated with clay content or cation exchange capacity. Nonsignificant relationship of Mn with pH in the present investigation may be attributed to no much variation in pH values of different soil series. The results are also partly in conformity with those of Salardini and Murphy (6) who obtained increased available manganese with increase in organic matter and decreased manganese with decreased calcium carbonate. Increase in available manganese due to organic matter may be due to soluble complexing of this element with organic matter as suggested by Heintze (3). Follett (1) suggested 0.0-1.0 ppm Mn as a critical level. Thus the results of the present investigation show sufficient amounts of manganese in the investigated soils.

LITERATURE CITED

Follett, R.H. 1969. Zn, Fe, Mn and Cu in Colorado soils. Ph. D. Dissertation. Colo. State Univ. p. 133.

Follett, R.H. and W.L. Lindsay, 1970. Profile distribution of Zn, Fe, Mn and Cu in Colorado soils. Colo. State Univ. Exp. Sta. Bull. 110. 31p.

Heintze, S.G. 1957. Studies on soil manganese. J. soil, Sci. 8:287-300.

Lindsay, W.L. and W.A. Norvell, 1978. Development of DTPA soil test for Zn, Fe, Mn and Cu, soil Sci. Soc. Am. J. 42:421-428.

Oertel, A.C. and J.B. Giles, 1963. Trace element content of some Queensl and soils. Aust. J. Res. 1:215-222.

Salardini, A.A. and L.S. Murphy, 1977. Effect of iron application on DTPA extractable soil micronutrients. Soil Sci. 124:219-225.

Swaine, D.J. and R.L. Mitchell, 1960. Trace element distribution in soil profiles. J. Soil Sci. 11:347-368.

Toth, J.S. 1951. Manganese status of some New Jersey Soils. Soil Sci. 71:467.

Toth, J.S. 1966. Manganese availability in soils of varying gluconite content. Soil Sci. 86:319-323.

Wright, J.R., R. Levick, and H.J. Atkinson, 1955. Trace element distribution in virgin profiles representing four great soil groups. Soil Sci. Soc. Amer. Proc. 19:340-344.