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DISTRIBUTION OF MANGANESE IN SOILS OF SOUTH-EAST RAJASTHAN

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ABSTRACT

Twenty eight samples from seven soil profiles of south-east Rajasthan (Udaipur district) were studied for different forms of manganese. They contained 385-945 ppm total, 44.9 - 227.2 ppm active, 41.5 – 224.2 ppm easily reducible, 3 - 7.3 ppm available, 1.7 – 6.2 ppm exchangeable and 0.75 – 2.95 ppm water soluble manganese. Black soils contained more manganese than red soils. Both total and active manganese generally decreased with depth. Easily reducible, available and exchangeable forms of manganese decreased with depth and appear to be a function of pH (r=0.47, 0.79 and 0.65, respectively). Exchangeable manganese was found to be associated with clay content (r=0.42) and calcicum carbonate (r=0 57). Water soluble manganese decreased with depth and clay (r=0.69) but increased with organic carbon (r=0.78).

INTRODUCTION

Differences in the alluvial deposits and topographical situations cause marked variations in manganese contents. The soil by nature being a complex and heterogeneous mass, the field to field variations are further accentuated by organic matter additions, texture etc. In the present study, manganese contents of a group of soils having similar characteristics are reported, reflecting their limitations to crop production and management practices.

MATERIAL AND METHODS

According to the textural classes, lime status, heavy mineral associations and major geological formations in the region, seven profiles were selected for studies in Udaipur district (south-east Rajasthan). These profiles (1-7) were in villages Bijnol, Fatehnagar, Railmagra, Dingri, Malikhera, Dhariyavad and Menar, respectively. Samples from four depths in each profile were drawn and analyzed for different forms of manganese by the methods described by Jackson (1958). Exchangeable manganese was extracted from soil with neutral normal ammonium acetate solution and reducible manganese was extracted with neutral ammonium acetate solution containing 0.2 per cent hydroquinone. Manganese in the extracts was determined colorimetrically by per-iodate method.

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RESULTS AND DISCUSSION

Soil parent materials control the total content of micronutrient elements in the surface soils as also throughout the soil profiles in all the soil groups (Oertel, 1961). pH, organic matter, calcium carbonate, amount and nature of the soil clay and drainage patterns markedly affect the contents of total and available micronutrient elements in the soil profiles, the effect varying with the degree of weathering. Due to alkaline reaction and coarse texture of this soil, manganese is easily converted into higher valence state and thus its mobility along the profile is restricted. The distribution of total and various forms of manganese in the seven profiles at different depths is given in Table 1. Physico-chemical properties of the respective profiles are given in Table 2 and correlation coefficients of different forms of Mn with the soil characteristics are given in Table 3.

Table 1. Physico-chemical characteristics of the soil profile affecting manganese distribution

Profile No. & Village	Depth (cms)	Clay (%)	pH	$CaCO_3$ (%)	Organic carbon (%)
1 Bijnol	0-20	18·16	9.4	5.2	0.44
	20-45	23.42	8.8	4.2	0.42
	45-70	36.07	8.4	3.1	0.30
	70-90	36.89	8.1	1.5	0.20
2 Fatehnager	0-20	27.90	7.9	2.1	0.75
	20-45	28.70	7.5	2.0	0.75
	45-70	18.20	7.4	1.8	0.65
	70-90	17.90	7.2	0.9	0.45
3 Railmagra	0-20	10.85	8.6	1.0	0.65
	20-45	14.70	8.4	1.5	0.85
	45-70	18.05	8.2	1.5	0.43
	70-90	17.45	8.1	1.5	0.39
4 Dingri	0-20	19.02	8.7	1.8	0.65
	20-45	20.81	8.5	2.0	0.65
	45-70	26.81	8.4	2.0	0 52
	70-90	29.91	8.0	2.5	0.35
5 Malikhera	0-20	34.87	8.7	1.5	0.75
	20-45	32.91	8.6	1.5	0.65
	45-70	39.82	8.5	2.5	0.55
	70-90	44.51	8.2	1.5	0.50
6 Dhariyavad	0-20	21.12	7.5	2.5	0.75
	20-45	27.53	7.2	1.8	0.56
	45-70	28.15	7.2	1.6	0.52
	70-90	33.85	7.0	1.9	0.31
7 Menar	0-20	34.47	8.2	1.5	0.75
	20-45	39.10	8.0	2.0	0.55
	45-70	42.14	8.0	2.4	0.42
	70-90	35.32	7.5	2.4	0.35

Total Manganese

Total manganese (385-945ppm) generally decreased with depth. It was well within the range (289.6-1099 ppm) reported for this region by Saxena and Baser (1964).

It was observed that total manganese content generally decreased with increase in pH (r=0.34), and organic carbon (r=0.15) and increased with increasing clay content (r=0.41). A higher level of manganese in clayey soils was noted also by Yadav and Kalra (1964), Saxena and Baser (1964), and Johri et al. (1978).

Table 2. Distribution of different forms of manganese

Profile and village	Depth (cm)	Manganese (ppm) Total	Available	Easily reducible	Exchangeable	Water soluble
1. Bijnol	0-20	638	4.59	110.10	3.27	1.32
	20-45	619	6.44	76.29	5.23	1.21
	45-70	595	7.22	55.28	6.27	0.95
	70-90	538	3.35	41.57	2.50	0.85
2. Fatehnagar	0-20	656	3.00	147.22	2.05	2.95
	20-45	580	5.72	122.67	3.41	2.31
	45-70	685	5.96	111.55	4.25	1.71
	70-90	510	3.56	85.55	2.81	0.75
3. Railmagra	0-20	843	4.40	148.35	2.85	1.55
	20-45	706	4.12	83.75	2.70	1.42
	45-70	693	4.09	80.10	2.75	1.34
	70-90	595	3.01	75.28	1.74	1-27
4. Dingri	0-20	945	7.65	124.49	4.50	2.80
	20-45	888	6.30	110.28	4.25	2.20
	45-70	895	5.65	114.24	3.85	1.80
	70-90	908	4.55	108.20	2.85	1.70
5. Malikhera	0-20	845	4.73	170.25	3.28	1.45
	20-45	790	4.20	175.28	2.85	1.35
	45-70	784	3.27	190.54	2.02	1.25
	70-90	685	3.10	202.65	1.90	1.20
6. Dhariyavad	-20	735	6.40	175.25	4.80	1.60
	20-45	690	5.30	175.28	3.75	1.55
	45-70	840	5.25	209.15	3.85	1.40
	70-90	890	3.03	224.20	1.75	1.28
7. Menar	0-20	635	5.25	140.38	4.05	1.20
	20-45	590	4.90	150.21	3.85	1.05
	45-70	547	3.70	130.25	2.75	0.95
	70-90	386	3.16	120.75	2.21	0.95

Table 3. Correlation (r) among different factors and forms of manganese

Forms of Mn	r value			
	pH	$CaCO_3$	Clay	Organic carbon
Total	−0.34	-0.07	+0.41*	−0.15
Active	−0.18	−0.21	-0.15	−0.14
Easily reducible	−0.47*	+0.09	+0.25	−0.17
Available	−0.79*	−0.51*	−0.44*	+0.28
Exchangeable	−0.65*	−0.57*	−0.42*	0.19
Water soluble	−0.22	−0.20	−0.69*	+0.76*

* Significant at 5% level

Active Manganese

The easily reducible and available manganese together form the fraction called 'active manganese'. Active manganese (44.92-227.29 ppm) decreased with depth and with increase in clay content. Its correlations with the soil factors studied were non-significeant and seemed to be a function of total manganese. Similar observations have been made by Randhawa et al. (1961), Saxena and Baser (1964) and Mishra and Tripathi (1972).

Manganous manganese, which is liable to be converted to higher oxides at higher pH, possibly contributes to available manganese. It is more in acid soils than in normal soils of pH 7.0 or above (r=0.79). The amount of available manganese is also influenced by calcium carbonate (r=0.51). The relation between organic carbon and available manganese (r=0.28) indicates that a higher amount of organic matter would be helpful in the reduction of higher oxides. Available manganese decreased with clay content (r=0.44).

Exchangeable Manganese

Exchangeable manganese (1.74 - 6.27 ppm) was more in surface soils than in lower horizons. This form of manganese is dependent upon pH (r=0.65) as its contents are richer in acid soils than in normal soils of pH 7.0 or above (cf Yadav and Kalra, 1964). Biswas and Gawande (1964) stated that exchangeable manganese is more related to pH than clay content of soils. A significant negative correlation with clay content (r=0.42) was observed.

Water soluble manganese

The amount of water soluble manganese (0.75-2.95 ppm) characteristically decreased with depth in all the soils. A significant negative correlation with clay content (r=0.69) and positive (r=0.78) with organic carbon was found (cf Agarwal and Reddy, 1972).

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