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Study of distribution pattern of various forms of manganese in relation to soil parameters in the soils of Sanganer panchayat samiti of Jaipur district

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Abstract

One hundred and twenty five samples from Sanganer panchayat samiti of district Jaipur were examined for different forms of manganese and physico- chemical characteristics. Samples were classified according to their pH and EC values. water soluble manganese was significantly correlated with various soil characteristics under normal soil conditions, none of the soil characteristics were correlated with hydroquinone with organic carbon.

Keywords- Water soluble Mn, exchangeable Mn, hydroquinone reducible Mn

Introduction

The soils of Sanganer Panchayat Samiti of semi-arid north eastern plain zone of Jaipur district are irrigated, course textured, sandy with low water holding capacity, low in organic carbon content, low in available nitrogen, medium in available phosphorus, and potash content. Major and micronutrients are play an important role in increasing and stabilizing the yield of crops. Regarding that the significant increase due to Manganese fertilization was observed in many crops, i.e. wheat, barley, mustard and chickpea etc. Takkar and Nayar (1981) have also reported that there is a possibility of manganese reaching in coarse textured soils therefore they become respond its application through external INS-77 more uptake of manganese and its concentration in results an increase in yield with applied manganese on barley, cluster bean and mung bean. Present state of knowledge on manganese for state of Rajasthan is inadequate, and therefore the soils of Sanganer Panchayat Samiti of Jaipur district were collected and examined for various physico-chemical properties as well as distribution (Kumar & Saxena, 1993 ; Kumar & Saxena, 1989) of various forms of manganese. Baser (1968) analyzed a large number of samples from various parts of the state and concluded that application of manganese may be useful .In order to generate some understanding; it was felt necessary to carry out studies on the manganese status of Jaipur district with particular stress on sanganer panchayat samiti. In present studies an intensive survey on sanganer panchayat samiti was carried out for manganese status.

Changes in manganese parameters under salt affected situations are described for areas neighboring Jaipur. Most of the desert soils were found to be deficient in available Mn but the information regarding the study of the distribution patterns of manganese is very scanty and fragmentary.

Materials and methods

Investigations was provide a better understanding and information for the distribution of manganese in soils and few significant correlations are established in various manganese fractions i.e. water soluble manganese, exchangeable manganese, hydro-quinone, reducible manganese and various physio-chemical characteristics such as pH, EC, Calcium carbonate, Organic Carbon etc. For the analysis of Mn pattern in soil, one hundred and twenty five samples were selected and categorized in six major groups based on their pH values. Most of the soils under study were sandy- loam and loamy-sand. These soils were examined for various manganese parameter and their physicochemical characteristics, according to the standard methods.

Manganese fractions were determined by periodate method given by Jackson (1973). Soil pH was determined in 1: 2 soil water suspensions by pH meter. EC was determined in 1:2 soil water extract by conductivity meter method. Organic carbon was determined by Walkley and Black (1934). Method calcium carbonate was determined by rapid titration method sited by piper (1950). Water soluble Mn, exchangeable hydroquinone reducible Manganese was determined by procedures of Shermen and Harmer (1943). In order to supplement these studies present project was taken. Critical limit was calculated and analyses given by Sherman *et. al*. (1942). The range for pH EC reported by Batra (2004) For the purpose of investigation of soils are classified into

1. pH less than 8.0 and EC less than 4.0 dSm^{-1}
2. pH less than 8.0 and EC above 4.0 dSm^{-1}
3. pH between 8.0 - 8.5 and EC above 4.0 dSm^{-1}
4. pH between 8.0 to 8.5 and EC less than 4.0 dSm^{-1}
5. pH above 8.5 and EC above 4.0 dSm^{-1}
6. pH above 8.5 and EC less than 4.0 dSm^{-1}

The range and average value of pH and EC reported by Batra (2004) as

7. pH 7.2 to 8.9 EC 0.9 to 3.9 dsm^{-1} normal soil.
8. pH 7.5 to 8.0 EC 1.3 to 67.8 dsm^{-1} saline soil.
9. pH 9.0 to 10.4 EC 9.8 to 21.6 dsm^{-1} alkali soil.

Results and discussion

The Table-1 describes the range and average values of Mn for normal, Saline, Saline-alkali and alkali soils. Water soluble manganese in these soils was usually low. Saline soils exhibited the least values of exchangeable manganese. On the whole it did not vary much, but the normal soils on the whole had fair amounts of available Manganese. Both saline and saline-alkali soils had hydroquinone reducible Manganese well below 50 ppm, but saline-alkali soils provide highest quantity of reducible Manganese. Saxena and Baser (1964) found water soluble manganese 0.089 to 0.60 ppm, exchangeable 0.02 to 1.462 ppm, hydroquinone reducible manganese 69.4 to 386.6 ppm in the soils of Mewar. It was reported that available manganese in different soil groups of Rajasthan ranged from 1.0 to 17.0 ppm.

These range on the whole & explained the position of Manganese well below 50 ppm, but saline-alkali soils exhibited highest quantity of reducible Manganese. But things became more clear when correlation coefficient values for the same were considered. The samples with pH less than 8.0 and EC less than 4.0 had positive significant correlation

with calcium carbonate and clay content. r = 0.518* and r = 0.554* respectively. Sharma et al (1985) also reported that DTPA - manganese was positively and significantly correlated with clay (r = 0.890*) Silt (r = 0.870*) and organic carbon (r = 0.900*) contents of the soil. This relationship is valid only under normal soil situation.

Table -1 Range and average values of some soil Manganese parameters in Sanganer Panchayat Samiti areas

Manganese Parameter Mn(ppm)	Soil pH less than 8.0		Soil pH between 8.0 to 8.5		Soil pH above 8.5	
	EC Less than 4.0	EC Less than 4.0	EC Above 4.0	EC Above 4.0	EC Less than 4.0	EC Above 4.0
Water soluble	Tr-4.11 (0.989)	0.26-2.38 (0.84)	Tr-7.50 (1.60)	Tr-7.00 (1.27)	0.02-7.80 (1.53)	0.002-4.56 (2.41)
Exchangeable	0.60-6.20 (2.880)	1.20-4.50 (2.23)	0.75-10.00 (3.64)	0.58-16.5 (4.52)	0.58-16.5 (3.80)	0.58-8.10
Readily available	0.19-10.31 (3.852)	1.99-6.88 (3.07)	0.75-17.50 (5.22)	0.58-16.59 (5.79)	0.78-10.15 (4.84)	-
Hydroquinone reducible	13.00-50.30 (30.534)	25.00-40.00 (31.70)	11.50-81.00 (29.09)	13.00-96.00 (39.55)	12.00-50.00 (28.65)	-
Active	13.19-53.49 (34.027)	27.06-46.88 (34.77)	12.56-86.37 (34.35)	16.11-111.00 (16.88)	12.78-65.40 (33.48)	-

*- Tr – Traces. Figures in parenthesis denotes average values

Table -2 Range some physicochemical characteristics

Physicochemical characteristics	Soil pH less than 8.0		Soil pH between 8.0 to 8.5		Soil pH above 8.5
	EC < 4.0	EC < 4.0	EC < 4.0	EC < 4.0	EC <4.0
pH	7.2-7.9 (7.67)	7.0-7.8 (7.56)	8.0-8.4 (8.28)	8.0-8.5 (8.23)	8.6-9.2 (8.81)
EC dSm^{-1} At 25°C	0.3-3.6 (1.83)	4.1-5.8 (4.86)	1.2-3.7 (2.71)	4.1-6.4 (5.45)	1.4-3.2 (2.26)
Organic Carbon (%)	0.01-0.37 (0.15)	0.02-0.21 (0.13)	0.03-0.21 (0.30)	0.17-0.37 (0.31)	0.08-0.29 (0.69)
Calcium Carbonate (%)	0.5-3.0 (1.21)	1.0-3.0 (2.00)	0.4-3.0 (1.26)	0.6-2.5 (1.30)	0.2-1.4 (0.82)
Clay (%)	6-15.0 (10.43)	8.0-14.0 (11.0)	6.0-14.0 (12.56)	6.0-19.4 (14.20)	7-17.0 (10.87)
Textural Class	Loamy Sand	Sandy Loam Loamy Sand	Sandy Loam Loamy Sand	Sandy Loam Loamy Sand	Sandy Loam Loamy Sand

Water soluble manganese was significantly correlated in soil with pH less than 8.0 and EC above 4.0 "r" values for the same was 0.926*. * WS water soluble manganese; ** Exchangeable manganese, *** Hydroquinone reducible Manganese. In the soils with pH less than 8.0 and EC less than 4.0 the exchangeable manganese was significantly correlated with calcium carbonate (r = 0.522*) and clay (r = 0.613*).

Table-3 Correlation coefficient 'r' values between soil characteristics and manganese Parameters

Correlations	Soil pH < 8.0		Soil pH between 8.0 - 8.5		Soil pH >8.5
	EC < 4.0	EC > 4.0	EC < 4.0	EC > 4.0	EC < 4.0
*W.S Manganese Vs pH	0.926**	0.177	0.079	0.216	0.447
*W.S Manganese Vs CaCO3	0.518**	0.013	0.416*	0.029	0.315
*W.S Manganese Vs clay	0.554**	0.075	0.017	0.044	0.083
**Exch. Manganese Vs CaCO3	0.552**	0.111	0.063	0.054	0.043
***Red. Manganese Vs CaCO3	0.025	0.074	0.345**	0.197	0.097
Hyd. Red. Manganese Vs EC	0.073	0.266	$0.776^{*} \times 10^{-3}$	0.277	0.600*
Active Manganese Vs PH	0.045	0.033	0.634**	0.092	0.071
Active Manganese Vs O.C	0.740**	$0.542^{*} \times 10^{-2}$	0.044	0.096	0.084
*W.S Manganese Vs Exch. Manganese	0.848**	0.876**	0.015	0.158	0.238
*W.S Manganese Vs ***Hydroquinone Red. Manganese	0.735**	0.139	0.066	0.350	0.295
**Exch. Manganese Vs ***Hydroquinone Red. Manganese	0.489**	0.446**	0.087	0.361	0.265

Various soil characteristics appeared to be non- significant in soils of pH less than 8.0 and EC above 4.0. Under normal soil situation calcium carbonate and clay had a definite relationship but this relationship broke down under saline and saline alkali situations. In normal soil situations all the manganese fractions of the soils significantly correlated at 1% level i.e water soluble manganese vs. pH less 8.0 EC less than 4.0 water soluble manganese vs exchangeable manganese (r = 0.848*) significantly correlated. Water soluble manganese V/s hydroquinone reducible manganese (r = 0.735*), exchangeable manganese V/s reducible Manganese (r = 0.489*) showed a significant correlation .All other soil categories exhibited a non-significant relationship. In the soils with pH 8.0 to 8.5 and EC less than 4.0 dSm^{-1} only water soluble manganese is correlated with calcium carbonate (r = 0.518*). Thus in all the soils normal in character there was a definite relationship between water soluble manganese and calcium carbonate. Water soluble manganese exhibited a significant relationship with various soil characteristics in all soil categories. Readily available manganese showed non-significant relationship with various characteristics in all categories but the calcium carbonate (r = 0.545*) was positively correlated with the fraction of manganese in the soils with pH 8.0 to 8.5 and EC. Less than 4.0 dSm^{-1}. In all the categories none of the soil characteristics could be correlated with hydroquinone reducible manganese except in the soils pH above 8.5 and EC. Less than 4.0 dSm^{-1} (r = 0.600) was significantly correlated by hydroquinone reducible manganese. The active Manganese was correlated significantly with organic carbon (r = 0.740) at 1% level in soils

with pH less than 8.0 and EC less than above 4.0 dSm^{-1}. It is also significantly correlated with pH (r = 0.634) at 1% level in soils with pH 8.0 to 8.5 and EC above 4.0.

The significant correlation for Water soluble manganese V/s $CaCO_3$ (Table 2) were observed for normal soils only and salt affected soil have no such correlations between water soluble manganese and $CaCO_3$. Water soluble manganese had a relationship with clay only in non-saline soils below pH 8.0. Exchangeable manganese Vs $CaCO_3$ relationships are also valid at 1% significance in normal soils. Reducible manganese and $CaCO_3$ also had a significant correlation in non-saline soils with pH between 8.0 to 8.5.

The reducible manganese in alkali soils bears a correlation with EC. Active manganese V/s pH exhibited a significant correlation at 1% level of significance for saline soils and in normal soils with pH below 8.0 it had a significant correlation with organic carbon also.

On the whole it could be inferred that manganese parameters exhibited changes under various salinity-alkalinity situations. Sharma *et.al* (2006) reported a significant and positive correlation with organic carbon. Sharma *et. al* (2003) reported a significant and positive correlation between organic carbon and available micronutrients.

Table-4 DTPA extractable Zn and organic carbon after harvesting T erecta as influenced by application of FYM and zinc in torripssamments in semi-arid eastern plain zone of rajasthan

Levels of FYM t ha^{-1}	DTPA extractable Zn (mg Kg^{-1})	Organic Carbon (%)
10.00	3.038	0.320
20.00	3.324	0.325
30.00	3.447	0.377
LSD= 0.05	N.S	0.027
levels of Zn Kg ha-1		
0.00	0.667	0.310
5.00	4.482	0.346
10.00	4.660	0.365
LSD =0.05	0.592	0.027
interaction		
FYM x Zn	N.S	N.S

Relationships between manganese parameter themselves are given in Table-2. It was only in normal situations that water soluble manganese had significant correlations with exchangeable manganese and reducible manganese also. Exchangeable manganese and water soluble manganese have significant correlation at 5% level for saline soils with pH less than 8.0.

Conclusion

Soil pH plays a significant role in transformation of soil acidity parameters, availability of nutrients, Fractions of organic matter, NPK use efficiency and other related parameters. Therefore, the soils are categorized in six important soil groups based on their pH and EC values. The present study indicates that a high percentage of samples in all categories exhibit manganese deficiency in Sanganer tehsil. The positive correlation coefficient values provide the useful data to characterize the micronutrient distribution pattern. In normal soil situation all the manganese fractions of the soil are significantly correlated while other soil categories exhibit a non significant relationship. The water soluble manganese exhibited significant relationship with various soil characteristics in all soil categories. The manganese distribution was positively correlated with organic carbon and clay content. However, the hydroquinone reducible manganese exhibits a non-significant relationship with all soil characteristics.

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