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Available micronutrient status of Rajasthan soils

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Abstract

In view of scanty information on micronutrient status of soils of Rajasthan the present study was undertaken. Results of the study indicate that soils of the state specially of the western plains, have low to marginal deficiency of Zn, Cu, Fe and Mn. These micronutrients need to be added to soils keeping in view of agriculture with high yielding varieties.

Introduction

The yield of crops is maintaining a plateau in large areas of Rajasthan, in spite of increasing use of high yielding varieties, fertilizers and irrigation water. Various reports indicate deficiencies of plant nutrients particularly micronutrients essential for crop growth. The information available on DTPA - extractable micronutrients status of the soils of Rajasthan are scanty (Baser and Saxena 1970; Sharma *et al.* 1985; Chattopadhyay *et al.* 1996). Hence, a study was undertaken to estimate the available micronutrient status of the soils occurring on various physiographic regions of Rajasthan.

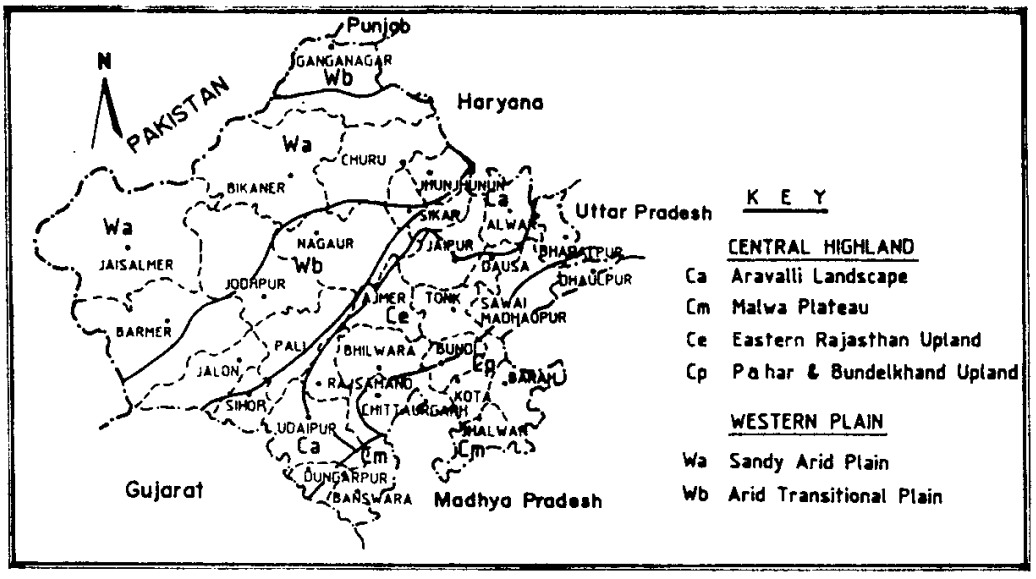

Fig. 1 Physiographic region of Rajasthan

Materials and Methods

About three thousand surface (0-15 cm) samples on regular grid basis were collected from soils occurring on the western plain and central high lands of Rajasthan (Fig. 1). Soil samples (< 2 mm) were extracted for available micronutrients using DTPA following Lindsay and Norvell (1978). The concentration of Fe, Mn, Cu and Zn in the extract was estimated on UNICAM 939/959 Atomic Absorption Spectrophotometer. The contents of micronutrients in soils were grouped in four categories namely low

marginal, adequate and high and mapped using GIS technique. Area under each category was calculated using curvimeter (Ushikata X-plan 360 i). The limits of deficiency and toxicity are as reported by Shyampura and Sehgal (1996).

Results and discussion

The results of the soil test for the status of available micronutrients showed wide variation. The geographical distribution of the soil test values (Table 1) is discussed below:

The sandy arid plain (Wa) : Sandy arid plain stretches over an area of about 13.7 m. ha which accounts for about 40 per cent of the total geographical area of Rajasthan. Due to extremely light texture and high $CaCO_3$ content the soils are mostly deficient in Zn content. Only about 30 per cent of the area had no constraint in Zn fertility. In case of Cu, the entire sandy arid plain showed marginal to acute deficiency. About 45 per cent area located in the extremely western sand dunes had an acute to marginal deficiency in Fe fertility. Mn was deficient in about 85 per cent of the area. It is possibly due to high $CaCO_3$ (40-50%) and pH values around 8.9.

Arid-semi arid transitional plain (Wb) : The soils were mostly adequate to high in Zn content. Only about 25 per cent area showed low levels in Zn fertility as compared to Cu, which was deficient in about 90 per cent of the area. In case of Fe, severe to marginal deficiency in almost 64 per cent area was observed in various parts of Jalore and Jodhpur districts. About 69 per cent of the area had marginal to acute deficiency in available Mn and such areas were mainly located in the districts of Pali, Jodhpur and Nagaur districts.

The Aravalli landscape (Ca) : Aravalli landscape constitutes about 13.8 per cent of the total geographic area of Rajasthan in which only 1.52 per cent area had deficiency of Zn. The rest of the areas had adequate to high content of available Zn. About 58 per cent area lying in Udaipur, Ajmer and Alwar districts was found to be deficient in available Fe fertility in the south-eastern part of Aravalli. In 35 per cent area located mainly in the districts of Sirohi, Ajmer and in parts of Nim Ka Thana the soils were deficient in available Mn.

The Eastern Rajasthan upland (Ce) : The soils were, in general, adequate to high in available Zn content. But only 20 per cent area in parts of Bhilwara and Jaipur districts showed low to marginal content of available Zn. The deficiency of Cu is acute in about 79 per cent area. Only 20 per cent area in Kapasan, Nasirabad and in a few pockets near Bharatpur showed constraint in Fe fertility. Mn deficiency was observed in several parts of Tonk and Chittorgarh and in some adjoining areas of Udaipur.

Pathar and Bundelkhand uplands (Cp): This landform constitutes almost 7.19 per cent of the total geographical area of Rajasthan of which only 16 per cent area was deficient in Zn content. Thus the soils, in general, were adequate to high in Zn fertility. Wide spread Cu deficiency (about 72%) was found in the black soils of Kota and Sawai Madhopur. This might be due to the precipitation of Cu as $Cu(OH)_2$ in the inter layers of the smectitic group of clay minerals and their consequent fixation in the layer lattice silicates (Joshi *et al.* 1981). Fe deficiency in about 40 per cent area located mainly in the south-western parts bordering Madhya Pradesh was severe. Similarly acute deficiency of Mn was noticed in the low lying areas where due to clayey nature of the soils, the availability of Mn was decreased (Joshi *et al.* 1981).

Table 1. Availability of micronutrients in soils of different physiographic forms of Rajasthan (area in M ha)

Micro-nutrient	Category	Physiography													
		Wa		Wb		Ca		Ce		Cm		Cp		Total	
		Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%
Zn	Low	3.62	10.57	0.68	1.99	0.25	0.72	0.50	1.44	0.10	0.32	0.28	0.82	5.43	15.86
	Marginal	3.63	10.62	1.41	4.13	0.27	0.80	1.05	3.06	-	-	0.12	0.36	6.48	18.97
	Adequate	4.84	14.18	3.72	10.89	0.25	6.58	2.64	7.72	0.61	1.77	1.50	4.37	15.56	45.51
	High	1.64	4.78	1.09	3.17	1.93	5.64	1.05	3.09	0.34	0.99	0.56	1.64	6.61	19.31
	Total	13.73	40.15	6.90	20.18	4.70	13.74	5.24	15.31	1.05	3.08	2.46	7.19	34.08	99.65
Cu	Very low	11.22	32.80	2.21	6.46	0.52	1.52	1.10	3.22	0.10	0.03	0.32	0.96	15.38	44.99
	Low	2.11	6.17	2.20	6.43	1.70	4.95	1.88	5.50	0.04	0.10	0.50	1.44	8.43	24.59
	Marginal	0.40	1.18	1.92	5.64	0.55	1.60	1.17	3.40	0.33	0.98	0.71	2.08	5.08	14.88
	Adequate	-	-	0.55	1.60	1.22	3.58	1.03	3.00	0.25	0.72	0.70	2.06	3.75	10.96
	High	-	-	0.02	0.05	0.71	2.09	0.06	0.19	0.42	1.25	0.23	0.65	1.44	4.23
	Total	13.73	40.15	6.90	20.18	4.70	13.74	5.24	15.31	1.05	3.08	2.46	7.19	34.08	99.65
Fe	Low	5.02	14.68	4.18	12.23	0.61	1.79	0.61	1.80	0.26	0.76	0.22	0.64	10.90	31.90
	Marginal	1.18	3.46	0.24	0.72	0.44	1.29	1.45	1.30	0.44	1.30	0.74	2.17	3.49	10.24
	Adequate	3.78	11.06	1.24	3.64	2.44	7.13	2.82	8.23	0.08	0.80	1.15	3.38	11.71	34.24
	High	3.75	10.85	1.24	3.59	1.21	3.53	1.36	3.98	0.07	0.22	0.35	1.00	7.98	23.27
	Total	13.73	40.15	6.90	20.18	4.70	13.74	5.24	15.31	1.05	3.08	2.46	7.19	34.08	99.65
Mn	Low	7.03	20.54	3.09	9.05	1.30	3.80	2.26	6.60	0.11	0.30	0.71	2.09	14.50	42.38
	Marginal	4.62	13.50	1.61	4.68	0.38	1.11	0.23	0.68	0.01	0.04	0.14	0.42	6.99	20.43
	Adequate	1.64	4.83	1.25	3.67	0.49	1.41	0.41	1.19	0.03	0.11	0.33	0.98	4.15	12.19
	High	0.44	1.26	0.95	2.78	2.53	7.42	2.34	6.84	0.90	2.63	1.28	3.70	8.44	24.65
	Total	13.73	40.15	6.90	20.18	4.70	13.74	5.24	15.31	1.05	3.08	2.46	7.19	34.08	99.65

Malwa plateau (Cm) : Soils in the Malwa Plateau were adeuqate/high in Zn and Cu except in the extremely southern parts bordering M.P. The soils in the upper elevation were richer in the micronutrient elements except Fe as compared to soils in the lower elevations and plains. The possible reasons could be the acidic pH and lower $CaCO_3$ in the hill soils compared to the pediment and plains (Sahoo *et al.* 1995). Large area (about 66%) in this landscape suffers from marginal to acute deficiency of available Fe. In case of Mn no deficiency was noticed in the entire Malwa Plateau region.

From the above results it is evident that about 34.83, 84.46, 41.14 and 62.81 per cent areas of the state suffer from deficiency of Zn, Cu, Fe and Mn respectively. The areas are mainly located in the western plains. The use of fertilizers containing these four micronutrients needs utmost consideration specially, if high yielding and fertilizer responsive crop varieties are raised. It is also necessary to maintain a reserve pool by applying suitable dose of the micronutrients in the areas where the deficiency has not been observed at present but have marginal levels. Intermittent soil tests however will safeguard the reserve pool against exhaustion.

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