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Status of Micronutrient Cations in Soils of Gujarat

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In order to delineate micronutrient deficient areas, in all 29,532 surface soil (0-15 cm) samples were collected from different regions of Gujarat in three phases during 1967 to 1992. These soils were analysed for their important physico chemical properties and contents of available micronutrient cations by standard methods (Jackson, 1967; Lindsay & Norvell, 1978). On the basis of established critical limits, deficiency percentage for the soils were worked out (Table 1). Besides, the occurrence of Zn deficiency, its associationships with important soil properties were also worked out.

The results revealed that deficiency of Mn and Cu was quite meagre, where as that of Fe and Zn was to the tune of 8 and 24 per cent, respectively. Further, the results indicated that, the least percentage deficiency for Zn-13 and Fe-3 per cent was in South and Middle Gujarat regions, respectively as against the corresponding maximum percentage of 31 and 13 in North Gujarat, Saurashtra and Kutch regions, respectively.

From the reassessment point of view the results revealed that over the years, the soil status improved and the deficiency decreased in the case of all the micronutrients barring Zn, which showed a reverse trend in Middle and North Gujarat and Saurashtra regions (Table 1). The low percentage of Zn deficiency in South Gujarat may be due to higher availability on account of higher organic carbon content in those soils. The higher percentage of deficiency of the nutrients in the initial years could be attributed to the adaptation of intensive cropping and use of high analysis fertilizers resulting in their higher exhaustion. The subsequent improvement in the soil status could be mainly due to the awarness along farmers abotut the use of micronutrients in improving the crop yields and sustaining the soil fertility. However, Zn deficiency still prevails in light textured and calcareous soils.

Relationship of Zn status with physico-chemical properties indicated that with the rise in pH of soils, the percentage of Zn deficient soils increased from 20 to 30 i.e. alkaline soils were more prone to Zn deficiency. Negative and significant coefficients of correlation obtained between the available zinc and soil pH have been

TABLE 1

Available micronutrient cations (ppm) in different regions of the Gujarat State.

Type of soil	Order	Sub-order	Period	No. of samples	Fe		Mn		Zn		Cu	
					Range (Mean)	PSD*	Range (Mean)	PSD	Range (Mean)	PSD	Range (Mean)	PSD
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
South Gujarat												
Clayey and deep black with few patches of coastal alluvial and lateritic medium black Soils.	Inceptisols Vertisols Entisols	Ochrepts Orthents Usterts Psamments Fluvents	1967-76	385	0.3-47 (5.0)	17.8	0.2-43 (6.4)	13.4	0.17-28 (1.18)	17.4	0.04-0.5 (0.12)	10.2
			1976-83	3877	0.4-165 (17.3)	2.5	2.9-490 (36.1)	1.9	0.14-18 (1.19)	12.9	0.08-15 (3.5)	0.0
			1991-92	81	4.2-54 (22.8)	1.0	8.0-96 (39.5)	0.0	0.68-5.4 (2.0)	1.0	1.7-6.5 (4.0)	0.0
			Overall	4343	0.3-165 (16.0)	4.0	0.2-490 (33.5)	6.0	0.10-28 (1.2)	13.0	0.04-16 (3.3)	2.0
Middle Gujarat												
Deep black, medium black to Loamy sand (goradu) soils	Inceptisols Entisols	Ochrepts Usterts Orthents Psamments Fluvents	1967-76	410	0.4-100 (6.8)	14.4	0.3-29 (5.0)	8.5	0.15-26 (1.4)	8.1	0.02-1.2 (0.13)	9.20
			1976-83	5124	0.6-95 (13.8)	2.0	2.7-359 (26.3)	0.9	0.05-25 (1.2)	16.7	0.08-14 (1.8)	0.92
			1984-92	1078	2.4-48 (14.8)	3.0	3.2-104 (26.5)	1.0	0.17-8 (1.2)	12.0	0.3- 9.6 (2.6)	0.00
			Overall	6612	0.4-100 (13.5)	3.0	0.3-359 (25.0)	2.0	0.05-26 (1.2)	16.0	0.02-14 (2.0)	2.00
North Gujarat												
Sandy loam to sandy soils	Inceptisols Entisols Aridisols	Ochrepts Orthids Orthents Psamments Fluvents	1967-76	359	0.4-83 (3.7)	24.3	0.8-20 (5.0)	12.0	0.11-4.9 (0.78)	29.6	0.03-0.8 (0.10)	13.4
			1976-83	4817	0.2-72 (8.4)	11.1	2.2-202 (19.9)	2.6	0.04-72 (0.98)	35.3	0.01-9.0 (1.19)	8.1
			1984-92	2305	1.8-46 (11.1)	5.3	2.8-99 (22.7)	0.5	0.70-6.6 (1.23)	13.7	0.2- 21 (1.58)	2.2
			Overall	7481	0.2-83 (9.0)	10.0	0.8-202 (20.0)	3.0	0.04-72 (1.0)	31.0	0.01-21 (1.3)	7.0

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
Saurashtra and Katch medium												
Shallow black, calcareous sandy and saline soils	Inceptisols Entisols Aridisols	Ochrepts Aquepts Orthents Psamments Fluvents Orthids	1967-76	837	0.8-16 (3.0)	10.9	0.3-44 (4.2)	8.9	0.10-19 (1.12)	16.9	0.02-1.2 (0.14)	10.1
			1876-83	6820	0.1-49 (6.9)	18.3	0.8-318 (23.0)	2.4	0.11-20 (0.86)	31.0	0.03-10.8 (1.87)	2.6
			1986-92	3439	3.0-47 (9.6)	1.3	2.7-107 (22.5)	1.3	0.10-8 (1.00)	28.6	0.3-11.9 (2.30)	0.0
			Overall	11096	0.1-49 (7.5)	13.0	0.3-318 (21.5)	5.0	0.10-20 (0.9)	30.0	0.02-12 (2.0)	4.0
Gujarat												
			1967-76	1991	0.3-100 (4.3)	15.4	0.2-44 (4.9)	10.3	0.10-28 (1.13)	17.5	0.02-1.2 (0.13)	10.5
			1976-83	20638	0.1-165 (10.9)	9.6	0.8-490 (25.6)	2.0	0.04-72 (1.02)	25.1	0.01-1 (2.00)	3.0
			1984-92	6903	1.8-54 (11.2)	2.9	2.8-107 (23.3)	1.0	0.11-8.0 (1.12)	20.7	0.20-21 (2.14)	0.7
			Gujarat	29532	0.1-165 (10.2)	8.0	0.2-490 (23.6)	4.00	0.04-72 (1.1)	24.0	0.01-21 (1.9)	4.0

*PSD = Per cent Soil Deficient.

TABLE 2

Relationship of DTPA - extractable Zn with important soil properties.

Characteristic	*% of total samples*	*Per cent**	
		Deficient < 0.50 ppm Zn	*Sufficient > 0.50 ppm Zn*
Soil pH			
< 8.0	47	20	80
8.0 — 8.5	44	30	70
> 8.5	09	30	70
EC (mmhos/cm)			
< 1.0	93	26	74
1.0 — 2.0	05	18	82
> 2.0	02	19	81
Org. C. (%)			
< 0.5	31	32	68
0.5 — 0.75	32	23	77
> 0.75	36	22	78
Av. P_2O_5 (kg/ha)			
< 25	36	35	65
25 — 50	28	25	75
> 50	36	15	85
Av. K_2O (kg/ha)			
< 250	13	38	62
350 — 500	43	25	75
> 500	44	20	80
Overall		25	75

*Per cent in respective category.

reported (Katyal and Agrawal, 1982). In case of electrical conductivity, such relationship was not very clear as more than 93 per cent of the soils were in low category. Unlike pH, a reverse trend was noticed in case of organic C content, available phosphorus and potassium contents as the percentage of Zn deficiency decreased from 32 to 22, 35 to 15 and 38 to 20, with increase in status of these nutrients, respectively.

The available nutrient status is largely influenced by the presence of soil organic matter and as such a positive relationship of organic matter with available Zn has been reported by different workers (Mehra and Basar, 1991; Gupta, 1995). The enhancement in the Zn availability in the soil is attributed to the complexing agents produced by organic matter which bind Zn in plant available form. Hence, in general, the soils poor in fertility status with alkaline reaction in nature are relatively more prone to Zn deficiency (Table 2).

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