

Status of sulphur and micronutrients in medium black soils of Dewas district, Madhya Pradesh

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In Madhya Pradesh zinc deficiency was observed in alluvial soils (86%) followed by mixed red and black soils (68%), red and yellow soils (62%), medium black soils (61%), deep black soils (35%) and skeletal soils (31%) (Khamparia *et al.* 2009). About 44 per cent soil samples were found deficient in sulphur and 61 per cent soil samples were deficient in Zn (Rathore *et al.* 1995).

Soybean-wheat/soybean-chickpea is predominant cropping system in medium black soils of Dewas district (Tomar *et al.* 1995). Besides these crops, oilseed, pulses, fodder and vegetables etc. are also grown. The increased production per unit area of these crops led to more removal of nutrients and thereby deficiency of nutrients. The information on micronutrients and sulphur status in district is inadequate and hence an attempt has been made for the delineation of these nutrients.

Dewas district lies between 22°23'20" N to 23°06'08" latitude and 75°55'19" E to 77°59'35" E longitudes. Using GPS, two hundred and two soil samples (0-15 cm) were collected from cultivators field. The soil samples were air-dried, powdered and passed through 2 mm sieve before analysis. pH, EC,

organic carbon and calcium carbonate were determined by following the standard procedures. Available (Zn, Cu, Fe and Mn) were extracted by DTPA-CaCl₂ solution and analyzed using atomic absorption spectrophotometer (Lindsay and Norvell 1978). Hot water soluble boron in soil was analyzed by azomethine-H method as outlined by Berger and Truog (1939). The available sulphur was extracted by 0.15 per cent CaCl₂ solution and the concentration of sulphur was determined by the turbidimetric method spectrophotometrically (Chesnin and Yien 1951). Nutrients index of each nutrient was determined by the formula: Nutrient Index = (NL*1) + (NM*2) + (NH*3)/NT

Where NL is number of samples falling in low category of nutrient status, NM is number of samples falling in medium category of nutrient status, NH is number of samples falling in High category of nutrient status and NT is the total number of samples analyzed for nutrient (Parker *et al.* 1951).

The physico-chemical properties of the soils are presented in table 1. The pH of the soils ranged from 6.2 to 8.4 with low EC and organic carbon.

Table 1. Physico-chemical properties soils

Tehsils	pH	EC (dSm ⁻¹)	CaCO ₃ (g kg ⁻¹)	O.C (g kg ⁻¹)
Khategaon	6.9-8.3	0.12-0.28 (0.19)	20.0-60.0 (38 -6)	2.80-5.10 (3.95)
Kannod	6.2-8.2	0.14-0.29 (0.22)	5.0-60.0 (29.9)	1.70-5.80 (3.90)
Sonkachh	6.9-8.3	0.16-0.29 (0.24)	10.0-55.0 (30.9)	2.70-4.70 (3.60)
Tonk Khurd	6.4-8.0	0.12-0.30 (0.19)	10.0 -55.0 (31.1)	2.60-4.80 (3.90)
Bagli	6.7-8.4	0.15-0.30 (0.21)	10.0-55.0 (32.6)	1.90-4.80 (3.70)
Dewas	6.8-8.2	0.16-0.42 (0.25)	10.0-60.0 (36.0)	1.70-5.80 (3.30)
Dewas District	6.2-8.4	0.12-0.42 (0.22)	5.0 -60.0 (33.3)	1.70-5.80 (3.70)

Figures within parantheses indicate mean value

Table 2. Available micronutrients in soils

Tehsil	No. of samples	Zn (mg kg ⁻¹)		Cu (mg kg ⁻¹)		Fe (mg kg ⁻¹)	
		Range	PSD	Range	PSD	Range	PSD
Khategaon	18	0.23-1.10 (0.50)	66.7	0.56-2.20 (1.28)	66.7	4.6-13.5 (8.2)	66.7
Kannod	39	0.17-1.60 (0.51)	69.2	0.27-5.22 (1.72)	69.2	4.6-22.5 (7.7)	69.2
Sonkachh	29	0.07-4.90 (0.58)	82.8	0.67-4.15 (1.60)	82.8	4.5-09.2 (5.2)	82.8
Tonk Khurd	27	0.10-0.69 (0.39)	88.9	.88-4.80 (2.03)	88.9	4.6-16.0 (6.6)	88.9
Bagli	31	0.13-0.93 (0.54)	61.3	0.78-4.98 (2.74)	61.3	4.6-18.0 (8.0)	61.3
Dewas	58	0.04-4.10 (0.60)	67.2	0.24-5.90 (1.52)	67.2	4.5-15.0 (6.1)	67.2
Dewas District	202	0.04-4.90 (0.49)	72.7	0.24-5.90 (1.80)	72.7	4.5-22.5 (6.8)	72.7

PSD - Per cent Sample Deficient; Figures in parentheses indicate mean value

Table 3. Distribution of available micronutrients and sulphur

Tehsil	No. of samples	Mn (mg kg ⁻¹)		B (mg kg ⁻¹)		S (mg kg ⁻¹)	
		Range	PSD	Range	PSD	Range	PSD
Khategaon	18	2.2-11.2 (5.1)	16.7	0.30-2.44 (0.86)	16.7	6.9-35.7(15.3)	22.2
Kannod	39	1.7-25.7 (6.1)	7.7	0.36-2.18 (1.08)	7.7	6.9-43.3(19.3)	7.7
Sonkachh	29	1.7-9.0 (3.8)	10.3	0.30-3.50 (2.00)	10.3	2.4-37.5(14.1)	31.0
Tonk Khurd	27	1.9-25.4 (6.3)	0.0	1.06-3.09 (1.70)	0.0	2.4-28.4(12.0)	37.0
Bagli	31	1.7-14.8 (6.6)	3.2	0.42-3.09 (1.61)	3.2	0.9-26.6(10.0)	58.1
Dewas	58	1.8-18.0 (4.8)	0.0	0.55-3.28 (1.58)	0.0	0.9-50.2(12.6)	58.6
Dewas District	202	1.7-25.7 (5.4)	5.0	0.30-3.49 (1.49)	5.0	0.9-50.2(13.7)	38.6

Table 4. Soil fertility status of Dewas district

Nutrients (mg kg ⁻¹)	Per cent samples under different categories			Nutrient Index	Nutrient Index classes
	Low	Medium	High		
Zn	72.7	24.3	3.0	1.30	Low
Cu	0.0	93.6	6.4	2.06	Medium
Fe	0.0	84.6	15.4	2.15	Medium
Mn	0.0	54.0	46.0	2.46	High
B	5.0	32.7	62.3	2.57	High
S	38.6	44.6	16.8	1.78	Medium

The DTPA-Zn varied from 0.04 to 4.9 mg kg⁻¹ with a mean value 0.49 mg kg⁻¹ and about 72.7 per cent soil samples were deficient (Table 2) for DTPA-Zn against the critical limit of 0.6 mg kg⁻¹ (Follet and Lindsay 1970). The DTPA-Cu and Fe in soils varied from 0.24 to 5.90 and 4.50 to 22.5 mg kg⁻¹ with mean value of 1.80 and 6.80 mg kg⁻¹, respectively and these samples were sufficient in Cu and Fe content as per guidelines proposed by Follet and Lindsay (1970).

The DTPA-Mn in soils varied from 1.70 to 25.70 mg kg⁻¹ with mean value of 5.4 mg kg⁻¹. Considering 2.0 mg kg⁻¹ DTPA-Mn as critical limit (Follet and

Lindsay 1970), none of the soils samples were deficient in available Mn content. Available B (hot water soluble) content of these soils varied from 0.30 to 3.49 mg kg⁻¹ with mean value 1.49 mg kg⁻¹ and accordingly 5.0 per cent soil samples of Dewas district were found to be deficient in available boron as per criteria proposed by (Berger and Truog 1939).

Available S content (Table 3) in soils varied from 0.9 to 50.2 mg kg⁻¹ with a mean value 13.7 mg kg⁻¹. Considering 10 mg kg⁻¹ as the threshold value (Balanagoudar and Satyanarayan 1990) about 38.6 per cent soil samples were found to be deficient in Dewas

district. Considering soil nutrient index (Table 4), the soils of Dewas district were high in Mn and B, medium in Cu, Fe and S, while low in case of Zn.

The simple correlation study indicated that pH had negative correlation with DTPA-Cu ($r = 0.371^{**}$), DTPA-Fe ($r = +0.683^{**}$), DTPA-Mn ($r = 0.683^{**}$) while organic carbon had positive relationship with DTPA-Zn ($r = 0.353^{**}$), DTPA-Cu ($r = 0.404^{**}$), DTPA-Mn ($r = 0.237^{***}$), available S ($r = 0.256$) and available B ($r = 0.233$).

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Received : May 2011

Accepted : January 2012