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Micronutrient availability in soils from Washi Tehsil of Osmanabad district

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Abstract
The present research work was carried out during the year 2012-13 to study the micronutrient availability in soils from Washi Tahsil of Osmanabad district. For this purpose 180 representative soil samples were collected from 30 villages of Washi tahsil. Collected soil samples were categorized into different soil orders. From each village 2 soil samples of Vertisol (> 30 cm), Inceptisol (10-30 cm) and Entisol (0-10 cm) were collected. These soil samples were analysed for micronutrient properties.
Result indicated that, the soils were sufficient in available Fe, Mn, Zn, Cu and B which ranged between (0.48- 7.20 mg kg^{-1}), (1.06- 13.98 mg kg^{-1}), (0.10- 1.65 mg kg^{-1}), (0.26- 9.17 mg kg^{-1}) and (0.03-1.18mg kg^{-1}), respectively, whereas the soils of Washi tahsil was low to medium in DTPA-Fe and Zn content. DTPA-Mn, Cu and HWS-B content in these soils was moderate to high.

Keywords: Micronutrients, Vertisol, Inceptisol, Entisol

Introduction
Osmanabad district is the south western part of Marathwada region of Maharashtra state. This district comprises 8 tahsils, out of these, Washi tahasil is selected for study. Geographically, Osman Abad district is located between $18^0 28'$ to $19^0 28'$ North altitude and $76^0 25'$ to $77^0 25'$ East latitude. The geographical area of Osmanabad district is 7512.40 sq.km. The climate of the area is hot and dry having average annual rainfall 767.5mm. The major soils of the district were derived from "Deccan trap" rocks. The soils (Osmanabad district) are dominant in Smectite clay minerals, while Chlorite and IL lite were moderately found in few soils. The geographical area of Washi tahsil is 53.03 sq.km. Washi tahsil, there is cultivation of different cereals, pulses, oilseed and horticultural crops. Average annual rainfall was 715.6 mm.
Every primary and secondary nutrient play important role in soil to maintain the soil fertility and agricultural production. Macronutrients (N, P and K) and micronutrients (Zn, Fe, Mn, Cu and B) are important soil elements that control soil fertility. Soil fertility is one of the important factors controlling yields of the crops. Micronutrients are important for maintaining soil health and also increasing productivity of crops. These are needed in very small amounts. The soil must supply micronutrients for desired growth of plants and synthesis of human food. The deficiencies of micronutrients have become major constraints to productivity, stability and sustainability of soils.

Materials and Methods
Out of 54 villages of Washi tahsil 30 villages were selected for this study. The villages were selected randomly in such way that it should cover whole area of the tahsil. Total 180 soil samples were collected from thirty villages and six soil samples from each village of Washi tahsil were collected according to their representative depths. Further, from each village depth wise 2 soil samples of Vertisol (> 30 cm) Inceptisol (10-30 cm) and Entisol (0-10 cm), respectively. These soil samples were dried and processed. The samples were analysed for DTPA-Fe, DTPA-Mn, DTPA-Zn, DTPA-Cu and hot water soluble boron (HWS-B). Micronutrients were estimated as per the procedure described by Lindsay and Norvell (1978).For this 10 g finely sieved soil (0.5 mm) was taken in 20 ml of 0.005 M DTPA solution (Diethylene Triamine Penta Acetic Acid) containing 0.1 M triethanol amine and 0.01 M calcium chloride, adjusted to pH 7.3 with HCl for two hours and then filtered and filtrate was subjected to measurement on Atomic Absorption Spectrophotometer (AAS-200), at different wavelengths for Fe, Zn, Mn and Cu. Available boron was determined from soil samples by using Azomethine-H on spectrophotometer at 420 nm wavelength (Gupta, 1979).

Result and Discussion

Soil micronutrient status

The data on DTPA- Fe, Zn, Mn, Cu and H.W.S-B and their categorization were tabulated in 1 Table 2.

DTPA-Fe: The data presented in table 1 revealed that the DTPA-Fe of Vertisols, Inceptisol and Entisols ranged from 1.26- 6.36, 0.48-4.98 and 1.15 to 7.20, with mean values of 3.17, 2.21 and 3.07, respectively. Among three categorizations, it showed that low DTPA- Fe was found in Vertisol (33 %), Inceptisol (65 %) and Entisol (47%), respectively, while the medium DTPA- Fe was found in Vertisol (52 %), Inceptisol (30 %) and Entisol (35 %), respectively, and high DTPA- Fe was found in Vertisol (15 %), Inceptisol (5 %) and Entisol (18 %), respectively (Fig. 1). The data narrated that the DTPA-Fe content of these soils was found maximum low in Inceptisol, medium in Vertisol and high in Entisol, respectively. The data indicated that the soils of Washi tahsil were low to medium in DTPA- iron content. Out of 60 soil samples, 20,39 and 28 samples were low, 31,18,21 samples were medium and 9,3 and 11 samples were categorized as high in DTPA-Fe status in Vertisol, Inceptisol and Entisol respectively.

Table 1: Status of available micronutrient in soil of Washi tahsil of Osman Abad district

Soil orders	No of samples		DTPA-Fe (mg kg^{-1})	DTPA-Mn (mg kg^{-1})	DTPA-Zn (mg kg^{-1})	DTPA-Cu (mg kg^{-1})	HWS-B (mg kg^{-1})
Vertisols	60	Range	1.26-6.36 (3.17)	1.06-12.6 (5.82)	0.12-1.60 (0.59)	0.48-9.17 (3.37)	0.03-1.18 (0.56)
Inceptisols	60	Range	0.48-4.98 (2.21)	1.30-12.4 (6.10)	0.10-1.35 (0.61)	0.63-6.66 (2.60)	0.05-1.15 (0.63)
Entisols	60	Range	1.15-7.20 (3.07)	1.09-13.98 (6.36)	0.13-1.65 (0.60)	0.26-6.14 (1.95)	0.03-1.15 (0.66)

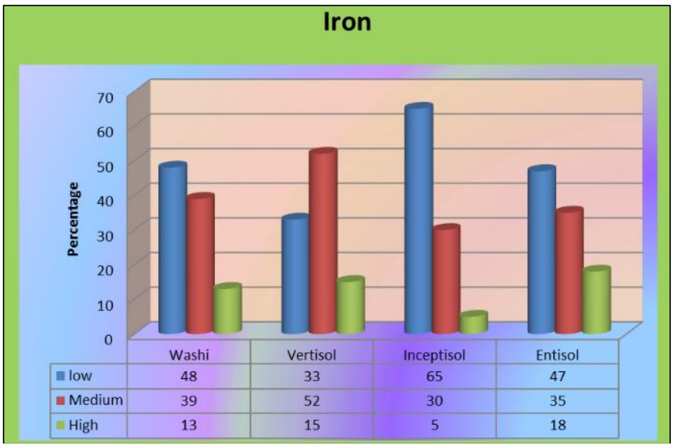

Fig 1: Status of DTPA- Fe content in soils of Washi tahsil

The perusal of data showed that, soils of Washi tahsil was low to medium in DTPA- Fe content. This low Fe content in soil may be due to irrigation water and high in bicarbonates (HCO_3) that may aggrivate Fe deficiency, probably because of the high pH levels associated with HCO_3 accumulation. These results are in accordance with the results reported by Mehra *et al*. (2004) [1]. Malewar and Ismail (1999) [6] noticed the range of DTPA- Fe in between 0.36 to 25.14 mg kg^{-1} in soils of Marathwada. The similar results were also reported by Ram *et al*. (1999) [9] in the soils of Bundelkhand.

DTPA-Mn: The DTPA-Mn of soils varied from 1.06 to 12.6, 1.30 to 12.4 and 1.09 to 13.98 mg kg^{-1}, in Verisol, Inceptisol and Entisol, respectively. The soils of Washi tahsil were 10 per cent low, 32 per cent medium and 58 per cent high in DTPA-Mn content. Among three categorizations, it showed that low DTPA- Mn was found in Vertisol (15 %), Inceptisol (8 %) and Entisol (8 %), respectively, while the medium DTPA- Mn was found in Vertisol (32 %), Inceptisol (30 %) and Entisol (35 %), respectively, and high DTPA- Mn was found in Vertisol (55 %), Inceptisol (62 %) and Entisol (57 %), respectively (Fig.2). The data narrated that the DTPA-Mn content of these soils was found maximum low in both Entisol and Inceptisol, medium DTPA- Mn was found in Entisol. High DTPA- Mn was found in Inceptisol. The value indicated that the soils of Washi tahsil were medium to high in DTPA- Mn content. In Vertisol among the 60 soil samples, 9 samples were low (< 2 mg kg^{-1}), 18 samples were moderate (2 to 5 mg kg^{-1}) and 33 samples were high (> 5 mg kg^{-1}) in DTPA-Mn content. Out of 60 soil samples, 5 samples were low (< 5mg kg^{-1}), 18 samples were medium (2 to 5 mg kg^{-1}) and 37 samples were high (> 5 mg kg^{-1}) in DTPA-Mn content in Inceptisol. In Entisol, 5 samples were low (< 5mg kg^{-1}), 21 samples were medium (2 to 5 mg kg^{-1}) and 34 samples were high (> 5 mg kg^{-1}) in DTPA-Mn content.

The data illucited showed that soils of this tahsil were medium to high in DTPA-Mn content. The high status of Mn in these soils might be due to the fact that lower oxidation (reduced) status of Mn are more soluble than higher oxidation state at normal pH range of soil, Oxidation of divalent Mn^{++} to trivalent Mn^{++} by certain fungi and bacteria, also some organic compounds synthesized by micro-organisms or released by plants as root exudates have oxidizing or reducing power. These results were reported by Leelavathi *et al*. (2009) [9].

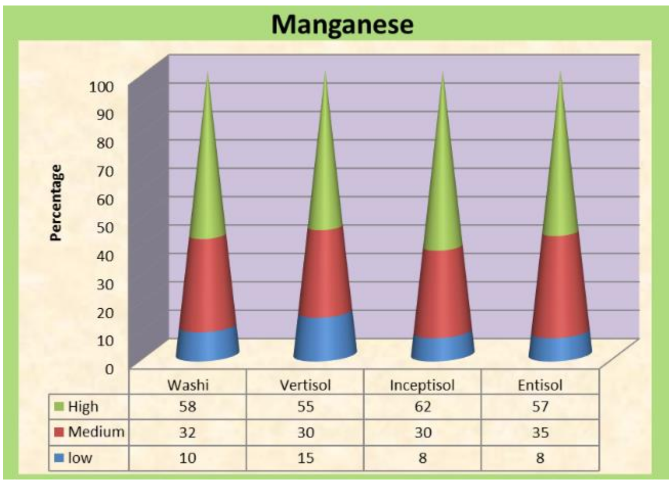

Fig 2: Status of DTPA-Mn content in soils of Washi tahsil

DTPA-Zn: The data in table 1 showed that the DTPA Zn content in the soils of washi tahsil varied from 0.12-1.60 mg kg^{-1}, 0. 10-1.35 mg kg^{-1}, and 0. 13-1.65 mg kg^{-1}, in Verisol, Inceptisol and Entisol. respectively. The soils of Washi tahsil were 62 per cent low, 32 per cent medium and 6 per cent high in DTPA-Zn content. Among three categorizations, it showed that low DTPA- Zn was found in Vertisol (60 %), Inceptisol (60 %) and Entisol (65 %), respectively, while the medium DTPA- Zn was found in Vertisol (33 %), Inceptisol (35 %)

and Entisol (27 %), respectively, and high DTPA- Zn was found in Vertisol (7 %), Inceptisol (5 %) and Entisol (8 %), respectively (Table 2, Fig. 3). The data narrated that the DTPA-Zn content of these soils was found maximum low in Entisol, medium in Inceptisol and Vertisol, whereas high in Entisol. The data indicated that the soils of Washi tahsil were low to medium in DTPA- zinc content. Out of 60 samples, 36, 36 and 39 samples are low (< 0.60 mg kg^{-1}) in DTPA-Zn content in Vertisol, Inceptisol and Entisol, respectively.

The data in nutshell indicated that DTPA-Zn content in Washi soils were low to medium. Majority of these soils were marginal or poor in DTPA- Zn content. This might be due to high pH, low organic matter along with presence of $CaCO_3$ appeared to be mainly responsible for the low amount of DTPA- zinc. Alkaline condition the zinc cations are charged largely to their oxides or hydroxides and thereby lower the availability of zinc. These results are in confirmatory with results of Mehera *et al*. (2004).

Table 2: Categorization of micronutrients (DTPA-Fe, Zn, Mn, Cu and H.W.S.-B) in soils of Washi tahsil

Parameters		Soil order											
		Vertisol			Inceptisol			Entisol			Washi		
Fe		Low (<2.5)	Medium (2.5-4.5)	High (>4.5)	Low (<2.5)	Medium (2.5-4.5)	High (>4.5)	Low (<2.5)	Medium (2.5-4.5)	High (>4.5)	Low	Medium	High
	%	33	52	15	65	30	5	47	35	18	48	39	13
	No of samples	20	31	9	39	18	3	28	21	11	87	70	23
Mn		Low (<2.0)	Medium (2.0-5.0)	High (>5.0)	Low (<2.0)	Medium (2.0-5.0)	High (>5.0)	Low (<2.0)	Medium (2.0-5.0)	High (>5.0)	Low	Medium	High
	%	15	30	55	8	30	62	8	35	57	10	32	58
	No of samples	9	18	33	5	18	37	5	21	34	19	57	10
Zn		Low (<0.6)	Medium (0.6-1.2)	High (>1.2)	Low (<0.6)	Medium (0.6-1.2)	High (>1.2)	Low (<0.6)	Medium (0.6-1.2)	High (>1.2)	Low	Medium	High
	%	60	33	7	60	35	5	65	27	8	62	32	6
	No of samples	36	20	4	36	21	3	39	16	5	111	57	12
Cu		Low (<0.3)	Medium (0.3-0.5)	High (>0.5)	Low (<0.3)	Medium (0.3-0.5)	High (>0.5)	Low (<0.3)	Medium (0.3-0.5)	High (>0.5)	Low	Medium	High
	%	-	2	98	-	-	100	-	-	100	00	0.55	99.5
	No of samples	-	1	59	-	-	60	-	-	60	-	1	179
HWS-B		Low (<0.1)	Medium (0.1-0.5)	High (>0.5)	Low (<0.1)	Medium (0.1-0.5)	High (>0.5)	Low (<0.1)	Medium (0.1-0.5)	High (>0.5)	Low	Medium	High
	%	5	45	50	2	21	77	5	32	63	4	33	63
	No of samples	3	27	30	1	13	46	3	19	38	7	59	114

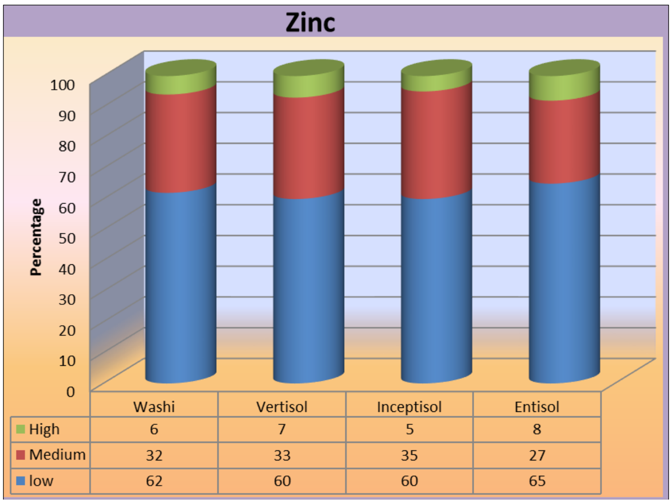

Fig 3: Status of DTPA-Zn content in soils of Washi tahsil

DTPA-Cu: The DTPA- Cu content in the soils of Washi tahsil were ranged from 0.48 to 9.17 mg kg^{-1}, 0.63-6.66 mg kg^{-1} and 0.26-6.17 mg kg^{-1} with a mean value of 3.37 mg kg^{-1}, 2.60 mg kg^{-1} and 1.95 mg kg^{-1}in Vertisol, Inceptisol and Entisol. respectively (Table 1). The soils of Washi tahsil were 0 per cent low, 0.55 per cent medium and 99.45 per cent high in DTPA-Cu content. Among three categorizations, it was observed that low DTPA- Cu was found in Vertisol (0 %), Inceptisol (0%) and Entisol (0%), respectively, while the medium DTPA- Cu was found in Vertisol (2 %), Inceptisol (0 %) and Entisol (0 %), respectively, and high DTPA- Cu was found in Vertisol (98 %), Inceptisol (100 %) and Entisol (100 %), respectively (Table 2 Fig. 4). From the data, it was inferred that the DTPA- Cu content of these soils was found medium in Vertisol and high DTPA- Cu was found in Vertisol, Inceptisol and Entisol, respectively. The value indicated that the soils of Washi tahsil were high in DTPA-copper content.

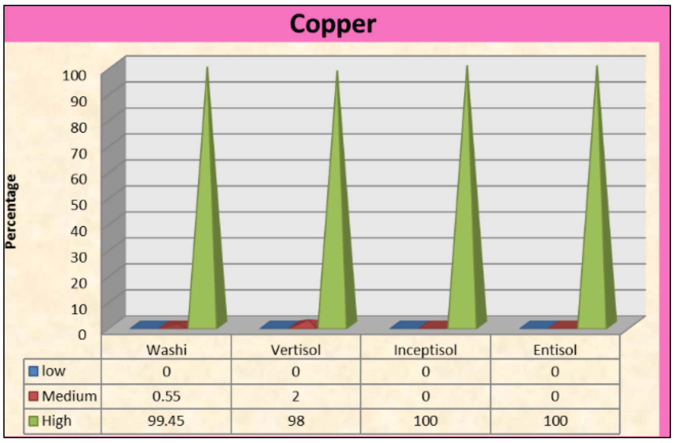

Fig 4: Status of DTPA-Cu content in soils of Washi tahsi

The high content of DTPA-Cu in these soils was might be due to presence of Cu minerals like Cuprites and chalcocite, etc. in the parent material. Tiwari and Mishra (1990) [11] studied micronutrient in Tal land soils of Bihar and reported that DTPA-Cu varied from 0.7 to 1.4 ppm. Patil and Sonar (1994) [8] reported that the Cu in swell-shrink soils of Maharashtra which were varied between 0.73 to 3.02 mg kg^{-1}. The variation in Cu content could be attributed to the difference in geology, physiology and degree of weathering in these soils.

The similar results were also reported by Sahoo *et al.* (2010) [10].

HWS-B: The HWS- B content of these soils was varied from 0.03 to 1.18 mg kg^{-1},0.05-1.15 mg kg^{-1} and 0.03-1.15 mg kg^{-1} in Vertisol, Inceptisol and Entisol, respectively (Table 1).The soils of Washi tahsil were 4 per cent low, 33 per cent medium and 63 per cent high in HWS-B content. Among three categorizations, it showed that low HWS- B was found in Vertisol (5 %), Inceptisol (2 %) and Entisol (5 %), respectively, while the medium HWS- B was found in Vertisol (45 %), Inceptisol (21 %) and Entisol (32 %), respectively, and high DTPA- Fe was found in Vertisol (50 %), Inceptisol (77 %) and Entisol (63 %), respectively. (Fig.5). The data in nutshell indicated that the HWS- B content of these soils was found maximum low in Entisol and Vertisol, medium in Vertisol and high in Inceptisol, respectively. The data in the table 2 indiacated that the soils of Washi tahsil were medium to low in HWS- boron content. In Inceptisol out of 60 soil samples, only 1 sample was low (<0.1mg kg^{-1}), 13 soil samples were medium (0.1 to 0.5 mg kg^{-1}) and 46 samples were high (> 0.5 mg kg^{-1}) in HWS-B content. Out of soil 60 samples, 3 samples were low (<0.1mg kg^{-1}), 19 samples were medium (0.1 to 0.5 mg kg^{-1}) and 38 samples were high (> 0.5 mg kg^{-1}) in HWS-B content in Entisol.

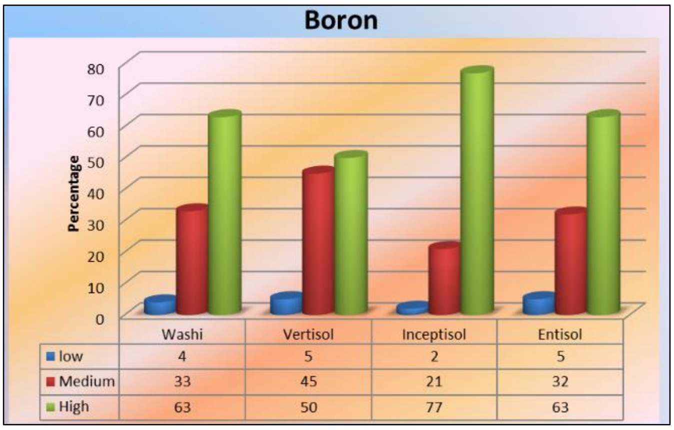

Fig 5: Status of HWS -B content in soils of Washi tahsil

The data showed that soils of Washi tahsil were moderate to high in HWS- B content. This high B status in soil may be due to the accumulation of B in highly soluble form of calcium and sodium borates and boron occurs mostly in organic matter in the surface soil. These results are in accordance with the results reported by Malewar (2005) [5] and Chudhari and Shukla (2004) [1].

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