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Short Communication

Status of available sulphur and micronutrients in soils of Allahabad, Uttar Pradesh

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In recent years, adoption of high yielding varieties and use of high analysis NPK fertilizers led to decline in the status of secondary and micro nutrients in soils to below normal at which productivity of crops may not be sustained. Soil is the primary source of micro nutrients, which are essential for plants. Thus, the knowledge of status of S and micronutrients is essential in improving their nutrition of crops. So far, inadequate information is available regarding the status of these nutrients in soils of Allahabad district. Therefore, present investigation was undertaken to assess the status of secondary (S) and micro nutrients (B, Fe, Mn, Cu and Zn) in soils of Allahabad district of Uttar Pradesh.

Surface (0-15 cm) soils used for the study were collected from Allahabad district at block level. Altogether a total of 648 geo-referenced soil samples were collected from farmers field of twenty blocks. The collected soil sample were processed and analysed for Fe, Mn, Cu and Zn. These micronutrients were extracted with diethylene triamine penta acetic acid (DTPA) solution (Lindsay and Norvell, 1978). Hot water soluble boron of soils was estimated as per method outlined by Berger and Truog (1940) using Azomethine- H through spectrophotometer at 420 µm. Available S (0.15% $CaCl_2$ solution extractable) was determined by turbidimetric method (Chesnin and Yien 1951).

Table 1: GPS based status available sulphur and boron in soils of Allahabad

Block	Available S (mg kg^{-1})		Available B(	
	Range	Mean	Range	Mean
Phulpur (36)	1.65-30.64	12.06	0.15-4.50	1.63
Bahadurpur (30)	1.50-35.55	12.59	0.18-6.05	2.29
Bahria (36)	2.85-35.30	12.52	0.29-7.01	2.42
Kaudihaar (36)	1.50-36.50	12.50	0.17-6.80	2.86
Soraon (24)	4.65-37.60	13.79	0.22-6..25	2.64
Holagarh (36)	3.45-47.33	13.99	0.27-6.80	2.25
Mauaima (30)	1.50-27.80	11.45	0.17-7.00	2.87
Saidabad (36)	0.90-45.85	14.08	0.25-5.95	2.15
Dhanupur (30)	2.30-31.85	12.45	0.35-6.25	2.67
Handia (24)	3.40-33.65	12.44	0.21-6.10	2.44
Pratapur (30)	2.35-24.65	11.38	0.27-6.75	2.77
Karchhana (60)	1.05-29.80	11.74	0.25-6.50	2.51
Uruwa (42)	1.50-23.70	10.44	0.23-7.02	2.64
Meja (30)	2.50-23.80	11.60	0.23-6.75	3.03
Jasra (36)	1.50-27.60	11.67	0.19-7.01	3.15
Chaka (6)	3.60-23.35	11.48	0.28-6.50	2.94
Kaundhiyara (30)	1.50-27.35	11.14	0.23-6.50	2.72
Koraon (30)	2.35-28.05	11.52	0.16-7.01	3.02
Manda (30)	1.65-28.30	12.23	0.22-6.35	2.72
Shankargarh (36)	1.50-26.50	11.63	0.15-7.02	2.88

Data in parenthesis indicate number of soil samples collected from each block

Range and mean values of available S and boron of soils are geven in Table 1. Available S (extracted by 0.15% $CaCl_2$ solution) content in Allahabad soils ranged between 0.90 and 47.33 mg kg^{-1} with an average of 11.88 mg kg^{-1}. The maximum (0.90-45.85, mean 14.08 mg kg^{-1}) and

minimum (1.50-23.70, mean 10.44 mg kg^{-1}) amounts of available S were recorded in soils of Saidabad and Uruwa block, respectively. The variation in available S may be attributed to the differences in organic carbon content, crop management practices. Singh (2015) reported similar results in Agra soils. It is well known that plant roots absorb S as SO_4-S from the soil solution. Taking 10 mg kg^{-1} as the critical limit for S about 43.6% soil samples was found to be deficient in available sulphur. Similar results were reported by Das *et al.* (2012), Singh (2015) and Raj Konwar *et al.* (2016).

Hot water soluble B ranged from 0.15 to 7.02 mg kg-1 in soils of Allahabad district of Uttar Pradesh. On an average, higher content of B was recorded in soils of Jasra block (0.15-7.01, mean 3.15 mg kg^{-1}) and minimum in soils of Phulphur (0.15-4.50, mean 1.63 mg kg^{-1}). Considering the critical limit for B as 0.45 mg kg-1 (Berger and Truog 1940), only 13.7% soil samples were found deficient in available B. On an average, almost all blocks have few pockets that exhibited B deficiency. The reason for deficiency may be attributed to high soil pH and low organic matter content. Mishra *et al.* (2016) reported similar results Singh and Yadav (2016) reported deficiency of boron in Unnao soils.

Data regarding the status of DTPA-extractable Fe, Mn, Cu and Zn in soils of different blocks of Allahabad district have been given in Table 2. The status of DTPA-Fe in soils of Allahabad ranged from 1.50 to 50.30 mg kg^{-1} with a mean value of 10.29 mg kg^{-1}. The mean content of DTPA-Fe 12.10 (varied from 2.85 to 50.30 mg kg^{-1}) was maximum in soils of Shankargarh block. On the other hand, the soils of Soraon block had minimum DTPA-Fe content 8.96 (varied from 3.96 to 16.70 mg kg^{-1}). Similar results were reported by Singh and Yadav (2017) in soils of Unnao district of Uttar Pradesh. Considering 4.5 mg kg-1 as critical limit for Fe, the soil samples were well supplied with available Fe and only 4.8% soil samples were deficient in DTPA-Fe (Singh and Yadav, 2017).

Table 2: GPS based status of available micronutrients (mg kg^{-1}) in Allahabad soils

Blocks Name	Zinc		Copper		Iron		Manganese	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Phulpur (36)	0.21-2.30	0.86	0.15-2.80	0.86	3.50-23.65	11.21	2.50-23.48	10.19
Bahadurpur (30)	0.24-2.95	1.01	0.18-3.60	1.26	2.50-26.65	11.98	2.80-25.64	12.03
Bahria (36)	0.25-3.25	1.18	0.11-4.50	1.28	3.60-18.45	10.74	1.85-34.80	14.78
Kaudihaar (36)	0.24-3.15	1.26	0.25-2.85	0.97	4.20-16.70	10.25	2.80-50.05	17.71
Soraon (24)	0.23-3.30	1.11	0.13-3.60	1.26	3.96-16.70	0.96	3.95-35.75	15.61
Holagarh (36)	0.23-3.10	1.14	0.14-4.05	1.38	4.15-18.75	10.09	3.00-51.30	17.68
Mauaima (30)	0.21-3.30	1.14	0.21-4.30	1.44	2.90-16.50	9.92	2.95-28.75	14.78
Saidabad (36)	0.26-2.85	0.89	0.13-5.70	1.69	3.65-33.70	10.77	1.95-39.70	17.16
Dhanupur (30)	0.23-3.05	1.00	0.23-7.50	1.87	4.30-15.50	9.17	2.45-43.45	15.35
Handia (24)	0.20-2.45	0.88	0.15-4.54	1.57	3.95-18.35	10.24	3.49-26.75	14.35
Pratapur (30)	0.21-3.25	0.95	0.17-6.30	1.69	3.70-15.56	9.42	3.80-38.15	13.75
Karchhana (60)	0.21-3.25	1.20	0.11-8.15	1.84	1.85-18.50	10.29	1.75-25.60	13.79
Uruwa (42)	0.23-6.30	1.28	0.16-5.10	1.59	3.70-17.65	9.34	2.85-30.75	14.04
Meja (30)	0.21-6.50	1.44	0.13-7.15	1.75	3.65-18.40	9.50	2.80-24.80	12.87
Jasra (36)	0.22-3.30	0.97	0.12-7.80	1.96	3.75-16.35	9.62	1.95-26.60	13.92
Chaka (6)	0.27-2.85	1.21	0.26-3.10	1.50	4.80-16.80	10.64	4.55-24.75	16.01
Kaundhiyara (30)	0.23-7.05	1.36	0.15-6.58	1.65	1.50-17.80	10.41	1.55-26.75	14.62
Koraon (30)	0.20-7.03	1.26	0.17-6.70	1.59	2.67-18.75	10.73	3.90-28.60	15.73
Manda (30)	0.27-3.18	1.26	0.19-7.80	1.92	3.60-16.75	10.18	3.85-28.47	14.15
Shankargarh (36)	0.22-3.18	0.83	0.24-6.40	1.52	2.85-50.30	12.10	3.80-31.60	16.73

*Data in parentheses indicate number of soil samples collected from each block

The available Mn ranged from 1.55 to 51.30 mg kg^{-1} with a mean value of 14.56 mg kg^{-1} in soils of Allahabad. High Mn content in these soils may be due to presence of magniferous concretions in the soils. Similar results were reported by Kumar *et al.* (2011) in soils of Rajasthan and Singh and Yadav (2017) in soils of Unnao district of Uttar Pradesh. Considering 2 mg kg^{-1} as critical limit for Mn, most of the soil samples were adequate in amount of DTPA-Mn.

Only 3% samples were found to be deficient in DTPA-Mn. Similar results were reported by Srivastava *et al.* (2016).

Available copper content ranged from 0.11 to 8.15 mg kg^{-1} with a mean value of 1.47 mg kg^{-1} in soils of Allahabad. The relative higher amounts of available copper were recorded in soils of Jasra block (0.12-7.80, mean 1.96 mg kg^{-1}) and lower amounts in Phulpur soils (0.15-2.80, mean 0.86 mg kg^{-1}). Based on critical value of 0.2 mg kg^{-1} of copper deficiency (Lindsay and Norvell 1978) 2.93% samples were found to be deficient. Similar results were reported by Srivastava *et al.* (2016) and Singh and Yadav (2017). Available Zn content ranged from 0.20 to 7.05 mg kg^{-1} with an average value of 1.06 mg kg^{-1} in soils of Allahabd district of Uttar Pradesh. Among the blocks of this district maximum (0.21-6.50 mean 1.44 mg kg^{-1}) and minimum (0.22-3.18, mean 0.83 mg kg^{-1}) values of DTPA-Zn were noted in soils of Meja block and Shankargarh block, respectively. Similar values of available Zn in soils of Punjab were also reported by Yadav *et al.* (2016).Considering the critical level for Zn in soils as 0.60 mg kg-1 (Lindsay and Norvell 1978), about 53.9% samples were found to be deficient. Higher deficiency of Zn in these soils may be associated with low organic carbon content and high soil pH (Singh and Yadav, 2017).

On the basis of results, it may be concluded that the deficiencies of S, B, Zn, Cu, Fe and Mn were 43.6, 13.7, 53.9, 2.9, 4.8 and 3.0%, respectively, in soils of Allahabad district of Uttar Pradesh.

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