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Distribution of Available Boron in Relation to Physico-Chemical Properties in the Selected Surface and Sub-Surface Soils of New Alluvial Zone of West Bengal

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Abstract

Hot water soluble (HWS) boron was studied in the surface (0—15 cm) and associated sub-surface (15—30 cm) soil samples of new alluvial zone of zone of West Bengal. Available boron content ranged from 0.30—1.25 ppm with a mean value of 0.768 ppm in the surface soils and 0.33—1.10 ppm with a mean value 0.743 ppm in the sub-surface soil. A significant and positive relationship was found with pH, organic carbon, silt + clay and CEC values of the soils.

Key words : HWS boron, Distribution, New alluvial zone, Physico-chemical properties, soil.

Application of high analysis fertilizer, increasing intensive cropping system coupled with high yielding varieties aggravates the depltion of secondary and micronutrients, resulting nutritional imbalance in the soil-plant system. This is particularly of great concern with boron due to its nutritional importance and wide spread deficiency (1). Hence it is imperative that there is all time need to generate data base relating to the status of micronutrient distribution and their deficiency in soil. Boron is one such essential micronutrient in soil that plays an important role in growth and nutrient of crop plant and eventually in crop production (2). Besides being absorbed by the plant as an essential micronutrient, it acts as new cell developer in meristematic tissue, fruit and seed setting, involve in the regulation of the carbohydrate metabolism and its transport within the plant, DNA synthsis in meristems, synthsis of amino acids and proteins and nitrogen fixing bacteria. Basic information regarding distribution of boron in the soils of this area, which are responsible for poor crop growth, is meager to make any definite recommendation. Hence, the present investigation was carried out to study the status of available boron in the surface and sub-surface soils of new alluvial zones of West Bengal.

Methods

Soil samples were collected from various locations of new alluvial zones of West Bengal. Air-dry soil samples passed through 2 mm sieve were analyzed for mechanical analysis by hydrometer methods, pH by electrode pH meter (1 : 2 soil : water), organic carbon by Walkley and Black's wet digestion method (3). Hot water soluble boron was determined calorimetrically using azomethine -H-indicator following the methods of Wolf (4). Coefficient of correlation (*r*) value was calculated following the procedures as described by Gomez and Gomez (5).

Results and Discussion

Distribution of available boron content of the selected surface and sub-surface soils ofnew alluvial zone of West Bengal along with their relevant physico-chemical properties are presented in Table 1. The pH of the soils ranged from slightly acidic (5.6) to neutral (7.5) in reaction. The pH of the sub-surface was found to be higher as compared with surface -soils of the same site. However, soils of Kaliganj of Nadia district, Kalna and Mangalkot of Burdwan district were acidic in nature. The organic carbon status of the soil samples ranged from 0.4 to 0.95% with a mean value 0.68% and a lower range of 0.20 to 0.73% with a mean value value 0.54% was found in the surface and sub-surface layer (6). Clay content varied from-18—46%

Table 1. Distribution of available boron content along with some relevant physico-chemical properties of surface and corresponding sub-surface soils samples collected from 20 locations of new alluvial zone.

			Physico-chemical properties								
	Sampling site Block	Depth (cm)	pH	Organic carbon (%)	Sand	Silt	Clay	Silt + clay	Textural classes	CEC (meq/ 100g)	HWS boron (ppm)
1.	Sagardighi	0—15	6.2	0.47	30	50	20	70	L	7.6	0.55
		15—30	6.5	0.30	35	45	20	65	L	8.5	0.65
2.	Nabagram	0—15	6.8	0.80	8	50	42	92	Sic	20.0	0.90
		15—30	7.0	0.70	12	48	40	88	Sicl	19.5	0.95
3.	Kaliganj	0—15	5.6	0.41	18	60	22	82	Sil	6.5	0.30
		15—30	5.8	0.36	22	58	20	78	Sil	8.0	0.33
4.	Serpur	0—15	6.0	0.67	31	33	36	69	Cl	18.2	0.75
		15—30	6.1	0.59	28	32	40	72	Cl	17.0	0.82
5.	Nakashipara	0—15	6.5	0.62	24	58	18	76	Sil	8.5	0.65
		15—30	6.8	0.45	21	59	20	79	Sil	9.5	0.70
6.	Krishnanagar	0—15	6.1	0.50	19	62	19	81	Sil	8.5	0.36
		15—30	6.3	0.48	15	60	25	85	Sil	11.0	0.42
7.	Ranaghat	0—15	7.0	0.40	14	63	23	86	Sil	8.6	0.85
		15—30	7.3	0.20	14	56	30	86	Sicl	8.8	0.92
8.	Chakdah	0—15	7.1	0.95	12	64	24	88	Sil	18.1	1.25
		15—30	7.1	0.73	11	69	20	89	Sil	17.0	1.00
9.	Pursura	0—15	7.5	0.76	11	48	41	89	Sic	19.0	0.90
		15—30	7.5	0.60	14	48	38	86	Sicl	18.5	0.95
10.	Balagarh	0—15	6.7	0.68	21	47	32	79	Cl	16.4	0.70
		15—30	6.6	0.52	21	41	38	79	Cl	15.5	0.60
11.	Memari	0—15	7.3	0.70	25	45	30	75	Cl	12.5	0.75
		15-–30	7.2	0.60	25	47	28	75	L	11.5	0.50
12.	Kalna	0—15	6.0	0.76	48	26	26	52	Scl	12.2	0.70
		15—30	5.8	0.70	38	35	27	62	L	11.4	0.60
13.	Rahatpur	0—15	6.5	0.87	29	30	41	71	C	20.4	0.90
		15—30	6.8	0.72	21	30	49	79	C	18.6	0.95
14.	Burdwan	0—15	6.7	0.63	30	35	35	70	Cl	15.6	0.75
	Sadar	15—30	7.0	0.62	29	36	35	71	Cl	14.6	0.75
15.	Barsul	0—15	6.2	0.76	43	20	37	57	Cl	18.6	0.80
		15—30	6.6	0.59	46	17	37	54	Sc	1617.5	0.60
16.	Mangalkote	0—15	5.8	0.66	34	30	36	66	Cl	18.6	0.65
		15—30	6.4	0.29	37	23	40	63	Cl	20.0	0.58
17.	Balidanga	0—15	6.6	0.47	47	07	46	53	Sc	28.9	0.70
		15—30	7.0	0.26	55	04	41	45	Sc	26.0	0.55
18.	Basirhat	0—15	7.2	0.84	12	60	28	88	Sil	15.6	0.90
		15—30	7.4	0.70	13	54	33	87	Sicl	13.5	1.00
19.	Daspur	0—15	6.5	0.83	22	37	41	78	C	19.9	1.00
		15—30	6.6	0.70	22	38	40	78	C	19.0	0.90
20.	Khash chak	0—15	6.7	0.85	10	45	45	90	Sic	28.1	1.00
		15—30	6.6	0.73	8	44	48	92	Sic	26.0	1.10

and it was found that percent clay content of the surface was less compared to sub-surface layer. Whereas, the mean clay plus silt content (finer fraction) increased in the sub-surface layer over the corresponding surface layer (Table 2). The mean CEC value in the surface layer was found to be higher (16.10 me/100 g) as compared to the corresponding sub-surface layer (15.57 meq/100 g).

The regression equation indicates an important contribution of organic carbon and pH in deciding the available boron content in the soils (Table 3). It was noted that 1.046 ppm of increase in available boron was due to increase of 1% organic carbon. On the other hand, one unit of increase in the pH value resulted in an increase of 0.271 ppm of available boron.

Table2. Range and mean of available B content and some relevant soil properties of surface and sub-surface layer collected under new alluvial zone.

Soil properties	Surface horizon Range	Mean	Sub-surface horizon Range	Mean
Hot water soluble B content (ppm)	0.30—1.25	0.769	0.33—1.10	0.743
PH	5.6—7.5	6.55	5.8—7.5	6.72
Organic carbon (%)	0.4—0.95	0.68	0.20—0.73	0.54
CEC meq/100g	6.5—28.9	16.10	8—26.1	15.57
Mechanical composition (%)				
Sand	8—48	24.40	8—55.10	24.35
Silt	7—64	43.50	14—69	43.05
Clay	18—46	32.40	20—49	33.45
Silt + clay	52—92	73.60	45—92	75.65

Table 3. Regrassion equation representing the relationship between available boron and physico-chemical properties of soils.

	Soil Properties	Surface soil	Sub-surface soil
1	pH	Y=0.271 pH-1.006	Y= 0.241 PH-0878
2	Organic carbon	Y=1.046 OC + 0.0546	Y = 0.655 OC + 0.388
3	Clay	Y= 0.0107 clay + 0.424	Y = 0.01036 clay + 0.397
4	Silt + Clay	Y=0.00549 (silt + clay) + 0.353	Y = 0.00975 (silt + clay) + 0.00583
5	CEC (meq/100g)	Y= 0.01993 CEC + 0.447	Y=0.01695 CEC + 0.480

Contribution of clay, clay + silt and CEC are relatively of much smaller degree.

Available boron content ranged from 0.30 to 1.25 ppm with a mean value of 0.768 ppm found in the surface layer (7). Relatively higher amount of boron was found in the sub-surface layer than the surface layer of the same location, except a few sites where surface layer contain higher available boron. Soil of Chakda of Nadia district and Khash Chak of Midnapur (East) district shows an extremely highly content of available boron which may be result of application of more boron fertilizer during the crop production. Whereas, quite low amount of available boron was also found for the soils of both Kaliganj and Krishnanagar of Nadia district (8).

The statistical analysis (Table 4) showed a positive and significant correlation between pH (r=0.6444*), organic carbon (r =7810 **) clay (r=0.4515*), CEC (r=5782**) and hot water soluble boron of the surface soils (9).

Table 4. Correlation coefficient (r) between available boron content and some relevant soil properties of surface and sub-surface layer of the collected soils. *5% level of significant, ** 1% level of significant.

Agro-climatic zones	Surface (A) sub-surface (B)	pH	Organic carbon	Silt	Clay	Silt + clay	CEC
New alluvial zone	A	0.6444**	0.7810**	—0.2505	0.4515 *	0.3072	0.5782**
	B	0.5331*	0.5223*	—0.1263	0.4343*	0.5547*	0.4108*

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