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DETERMINATION OF MACRO NUTRIENT STATUS OF TOP SOILS IN THE TISTA MEANDER FLOODPLAIN OF BANGLADESH

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ABSTRACT

Soil fertility in Bangladesh has declined over time. As a result, deficiency of nutrient has arisen which is likely to produce negative impact on crop yield. Soil test is an indicator of fertility status of an area. With this perspective, a study was done to determinate macronutrients status across the Tista Meander Floodplains (AEZ 3). Fifty soil samples at 0-15 cm depth were collected from 50 sites across the AEZ 3. The samples were kept into plastic bottles for physical and chemical analysis. All analysis was done following standard methods. Although not significant, soil pH has decreased based on the earlier information (SRDI, 1998). The soil test value explored that soil organic matter has increased in AEZ 3 but not generalized. The general consensus is that soil organic matter has declined over time particularly in high land and medium high land, with intensive cropping. Concerning the soil analysis results, the N content remains almost unchanged, the available P and S levels are increased in most cases. The exchangeable K status has generally declined; Ca level has always increased but the Mg level increased not in all samples.

Key words: Soil, macro nutrients, values.

Introduction

Tista Meander Floodplain (AEZ 3) is one of the important AEZ amongst 30 distinguishes agro ecological zones in Bangladesh. The present study was concentrated in this AEZ which covers most of Rangpur, eastern parts of Panchagar and Dinajpur, northern Bogra and parts of Jaipurhat, Naogaon and Rajshahi districts. Eight general soil types occur in this zone of which non-calcareous grey floodplain soils and non-calcareous brown floodplain soils predominate. The major land type of AEZ 3 comprises 35% highland and 51% medium highland, 4% medium lowland and others 10% (FRG, 2012). Texturally the soils are loam and sandy loam. Tista Meander Floodplains are moderately acidic throughout, low in organic matter content on the high land, but moderate in the low lands. Fertility level, in general is low to medium but the status of K and CEC is medium in most of the places (Banglapedia, 2015). The SRDI has generated bench line information of different nutrients status across the AEZs of the country. Agricultural productivity is directly linked to nutrient availability and its uptake. To sustain higher crop yields, application of nutrient deficient in soil is required. An understanding of efficient methods to correction of nutrient deficiency in a specific cropping system is desirable. Thus, sufficient fertility level of a soil can play a significant role in achieving higher crop yields. Here regular monitoring of soil nutrient status is perquisite site for further consideration. Keeping the above points in view, the present study was carried out to achieve the determination of macro nutrients status in Tista Meander Floodplain (AEZ 3) soils of Bangladesh.

Materials and Methods

Soil fertility in Bangladesh has declined over time. As a result, deficiency of new nutrient and also micronutrient has arisen which is likely to produce negative impact on crop yield. Soil test is an indicator of fertility status of an area. With this perspective, a study was done to delineate micronutrients status across the Tista Meander Floodplains (AEZ 3). The methodology is described below.

Collection of soil samples: Soil sampling was done from different sites of AEZ 3 based on the land type, soil series and cropping pattern. Altogether 50 soil samples from 0-15cm depth were collected from intensively cropped areas. After collection, the soil samples were put in the polythene bags and every bag was tagged with the information of sampling number, soil depth and collection date.

Preparation of soil samples: Every soil sample was spread on a brown paper in the laboratory for air-drying and some unwanted materials viz. stones, pebbles, gravels, plant roots etc. were removed prior to air-drying. The air-dry soil was ground by mortar & pestle and screened through a 2-mm (10-mesh) sieve. The samples were kept into plastic bottles for physical and chemical analysis.

Analysis of soil samples: The basic properties of soils included pH and organic matter contents, whereas macronutrients included N, P, K, S, Ca & Mg contents. All analysis was done following standard methods, as described in the following Table 1.

Table 1. Methods of soil analysis

Soil props.	Analytical methods
pH	Soil pH was determined by glass-electrode pH meter maintaining 1:2.5 soil-water ratios (McLean, 1982).
Organic carbon	The organic C was determined by the wet oxidation method (Nelson and Sommers, 1982), then the amount of organic matter was calculated by multiplying the percent organic carbon with the van Bemmelen factor 1.73 (Piper, 1950).
Total N	Total N content of soil was determined by micro-Kjeldahl method stated by Bremner and Mulvaney (1982).
Available P	Phosphorus was determined by spectrophotometer at 660ηm wavelength afforested by Bray and Kurtz (1945).
Exchangeable Ca, Mg & K	These elements were extracted from soil by 1M CH_3COONH_4 with a 1:10 soil-extractant ratio and the extractable amount was determined for Ca and Mg were determined by flame AAS, whereas K was determined by flame photometer following the procedure of Barker and Surh (1982).
Available S	Extraction of soil S was done by 0.15% $CaCl_2$ solution as described by Page et al. (1982). The S content in the extract was determined turbidimetrically using a spectrophotometer at 420ηm wavelength (Jones *et al.*, 1972).

Results and Discussion

Soil pH and organic matter: The mean value of pH of studied soils was the highest as 5.60 (Sample ID 14) and lowest as 4.39 (Sample ID 46). The mean value of soil pH was 5.05 (Table 2) which revealed that most of soil samples were found in 'strongly acidic' interpretation class (4.5-5.5).

Organic matter (OM): OM contents, it varied from 0.38 to 3.51 %, which appeared the higher OM in the studied soils. The increased organic matter content indicates a good soil management with addition of organic matter from some sources. However, the increased soil organic matter may not generalize. The general consensus is that soil organic matter has declined over time particularly in high land and medium high land, with intensive cropping.

Macronutrients status: Total N content of soils varied from 0.02 (Sample ID 16) to 0.18 % (ID 31), available P from 5.00 (Sample ID 27) to 165.70 (Sample ID 6) mg kg^{-1} and available S from 46.50 (Sample ID 33) to 138.20 mg kg^{-1} (Sample ID 24), with the corresponding mean values of 0.11%, 30.94 mg kg^{-1} and 65.64 mg kg^{-1}. Exchangeable K content of soils ranged from 0.07 (Sample ID 47) to 0.35 (Sample ID 6) cmol kg^{-1}, Ca content from 1.78 (Sample ID 37) to 7.78 (Sample ID 1) cmol kg^{-1} and Mg content from 0.26 (Sample ID 40) to 1.54 (Sample ID 24) cmol kg^{-1}; their average values being possessed 0.14 cmol kg^{-1}, 3.67 cmol kg^{-1} and 0.66 cmol kg^{-1}, respectively (Table 2).

Working with thirty five composite soil samples from intensive crop growing sites, which covered 17 AEZs of Bangladesh, Shil *et al.* (2016) stated that tested soils appeared to be deficient (<0.12%) in N content. 68.6% soil samples had the low level of available P while only 8.6% retained it an optimum amount. About 80% contained low level of available S (7.9-14.7 mg kg^{-1}) although coastal regions soils hold higher amount of available S. Study revealed that 40% of the collected soils were very low, 31.4% were low, 8.6% each of medium and optimum, and 11.4% contained high level of exchangeable K.

Table 2. Top soil characteristics of Tista Meander Floodplain in Bangladesh

Sample ID	pH	OM (%)	Ca	Mg	K	Total N (%)	P	S
			(cmol kg^{-1})				mg kg^{-1}	
1	5.10	2.41	7.78	1.36	0.11	0.12	5.30	56.30
2	5.55	3.06	6.13	1.09	0.09	0.15	5.16	56.30
3	5.46	2.51	5.64	0.85	0.13	0.13	9.72	73.00
4	5.08	2.41	3.66	0.75	0.10	0.12	6.45	55.50
5	4.80	1.10	1.92	0.36	0.13	0.06	145.30	51.10
6	5.40	1.38	3.91	1.19	0.35	0.07	165.70	60.30
7	4.45	1.96	2.04	0.45	0.20	0.10	15.89	48.90
8	5.26	2.58	3.89	0.61	0.13	0.13	7.10	62.40
9	4.80	2.03	3.07	0.57	0.12	0.10	8.05	52.30
10	5.00	2.61	3.75	0.74	0.12	0.13	12.36	51.00
11	5.07	2.51	4.90	0.91	0.17	0.13	34.63	66.10
12	4.85	2.37	3.31	0.48	0.10	0.12	32.27	61.60
13	5.10	1.75	3.14	0.52	0.12	0.09	15.29	73.00
14	5.60	1.96	3.75	0.49	0.10	0.10	10.97	82.60
15	5.32	3.20	4.57	0.70	0.15	0.16	10.75	60.80
16	4.98	0.38	3.77	0.61	0.13	0.02	11.07	54.20
17	5.11	1.00	2.89	0.44	0.16	0.05	68.18	56.90
18	5.29	2.41	4.38	0.74	0.16	0.12	8.18	62.70
19	5.43	2.99	7.37	1.22	0.12	0.15	11.49	81.50
20	5.08	2.10	3.27	0.62	0.17	0.11	14.60	58.60
21	4.90	1.79	3.10	0.50	0.16	0.09	9.11	60.00
22	4.99	1.72	3.84	0.53	0.19	0.09	15.53	63.70
23	5.24	2.51	4.15	1.17	0.17	0.13	20.64	93.10
24	5.50	2.65	5.78	1.54	0.14	0.13	6.07	138.20
25	5.41	2.27	3.87	0.92	0.15	0.11	7.20	84.00
26	4.85	3.03	3.52	0.88	0.14	0.15	6.86	79.70
27	5.15	1.96	3.09	0.68	0.10	0.10	5.00	80.40
28	5.23	2.41	4.08	1.33	0.15	0.12	7.42	97.80
29	5.41	2.72	4.62	1.06	0.15	0.14	11.43	59.40
30	5.33	2.89	3.18	0.59	0.16	0.15	12.81	65.60
31	5.21	3.51	4.16	0.76	0.15	0.18	11.16	54.90
32	5.36	2.24	2.48	0.37	0.14	0.11	22.51	53.30
33	5.15	2.85	3.13	0.42	0.11	0.14	13.16	46.50
34	5.35	2.34	3.39	0.53	0.15	0.12	30.34	64.00
35	5.20	2.37	1.96	0.30	0.15	0.12	69.65	50.60
36	4.73	1.62	1.98	0.31	0.12	0.08	55.73	69.10
37	4.78	1.58	1.78	0.28	0.21	0.08	85.18	60.80
38	4.73	1.13	2.47	0.40	0.16	0.06	33.95	64.00
39	4.85	1.99	2.59	0.38	0.12	0.10	26.43	60.90
40	4.55	0.79	2.39	0.26	0.14	0.04	46.21	52.60
41	4.83	1.51	3.33	0.46	0.15	0.08	26.99	68.70
42	4.84	2.68	3.93	0.50	0.12	0.13	6.95	67.60
43	4.94	1.72	3.64	0.51	0.12	0.09	53.18	71.40
44	4.46	2.27	2.61	0.31	0.11	0.11	75.12	64.00
45	5.01	1.82	3.16	0.58	0.09	0.09	22.45	69.90
46	4.39	1.93	3.00	0.37	0.09	0.10	37.46	46.60
47	4.70	2.54	3.20	0.33	0.07	0.13	32.32	48.50
48	4.97	2.13	3.41	0.60	0.18	0.11	44.51	47.30
49	4.90	1.89	3.30	0.37	0.09	0.10	28.93	71.70
50	4.99	2.24	2.90	0.46	0.08	0.11	15.37	49.10
Maximum	5.60	3.51	7.78	1.54	0.35	0.18	165.70	138.20
Minimum	4.39	0.38	1.78	0.26	0.07	0.02	5.00	46.50
Mean (n=50)	5.05	2.15	3.67	0.66	0.14	0.11	30.94	65.64
SD	0.29	0.63	1.25	0.32	0.04	0.03	32.96	15.93

The calcareous soils (AEZ 10, 11, 12 and 13) contained very high level of Ca. Non calcareous soils also showed fairly good level of Ca content except AEZ 1, 3, 23 and 29. Portch and Islam (1984) studied 63 soil samples from different regions of Bangladesh and found that 100% of them were deficient in N and also found that 41% of soils contained P below the critical level while 35% were below the optimum level. Bhuiyan (1991) reported that about 4 million ha of land was potentially deficient in S. Islam *et al*. (1992) reported that about 50% of the cultivable areas of Bangladesh found to be low in exchangeable K, 30% areas medium and the rest 20% areas (southern areas) were high to very high level of exchangeable K.

Conclusion

Concerning the soil analysis results, the N content remains almost unchanged, the available S status increased but P level increased in most cases. The exchangeable K status has generally declined, the Ca level has always increased and the Mg level increased in all samples except soil samples ID nos. 5, 6, 7, 9, 10, 41, 43, 17, 21, 36 and 39 where it rather decreased.

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