Fertility Status on Some Tista Floodplain Soils Of Bangladesh

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Abstract
The fertility levels of Tista Floodplain of Bangladesh were assessed by using ten soil samples in order to explore fertility status on Dasiyar chora village of Phulbari Upazilla under Kurigram district order to explore possibilities to improve crop yield. The result showed that most of the soils were silt loam to silty clay loam but silty clay loam was the predominant soil textural class. The sand, silt, and clay content were 18.12 %, 54.79 % and 18.12 %, respectively where silt particle was predominant. Most of the sampling areas were cultivated with pulse, cereal crop, and potato. The sand/silt ratio and silt/clay ratio had a regular pattern which provided little heterogeneity of the studied soil. Soil reaction were ranged from moderately acidic to slightly acidic (5.67 – 6.78) where moderately acidic soils were predominant. The percentage of carbon content was very low to low. Similarly, the percentage of total nitrogen was also in low amount values. The total concentration of P, K, and S were very high content in the studied soils. The total Fe and Mn content of the studied soils were also very high. Similarly, the total Cu and Zn contents were sufficient in amount present in the studied areas. The micronutrients of the studied samples were adequate.

Keywords: Tista Floodplain Soils, Nutrients Availability, Soil Fertility Status, Soil pH, Organic Matter, Agricultural management

Introduction

Soil fertility status is a complex and dynamics system that is the important quality indicator of soil. Sustainable agriculture requires sustainability of its nutrients contents. But, it is threatened by several factors (overproduction, excess grazing, high demand of foods, inorganic fertilizer input, low management and so on) that's lead risk for sustainable production and management. Soil reaction, organic matter, physicochemical properties, micro-nutrients are the main definition of soil fertility. Organic matter is the key factor for retaining water and all other micro-nutrients [(1)]. Soil organic matter itself hold nutrients because it transports Nitrogen and Phosphorous [1]. Thirty Agro-Ecological Zones (AEZs) have been identified in Bangladesh and their crop species and fertility status vary considerably. Tista Floodplain is located in the North-Easter part of the country. Tista Floodplain is the sub-region between old Himalayan Piedmont plain in the west and right bank of north-south flowing Brahmaputra in the East. The studied fields are located in Dashier chora village of Fulbari Upazilla under Kurigram district [2]. Tista Floodplain Zone is intensively cultivated with Rice as the main crop. Wheat, potato, jute, mustard, sugarcane, cabbage, tomato, onion etc. are also grown to feed the ever-growing population. The major cropping patterns are rice-fallow-rice, wheat-jute-rice, and potato-jute-rice. The land in the Tista Flood Plain areas falls mainly under high land and medium high land categories. Most of the lands are shallowly flooded during the monsoon season.

A few research work has been done on the soils of the Tista Floodplain soils. Literature review reveals that the information regarding the Tista Floodplain soil is very limited. Thus, an attempt was taken to assess the nutrients status of the Tista Floodplain soil of Bangladesh. As an economic resource, land and its production capacity must be carefully assessed and periodically monitored in order to sustain the production of food and other basic human needs. To ensure sustainable agriculture and friendly environment, a set of best management practices should be recognized and promoted to the farmers as a package. This package should include soil testing, location specific and cropping pattern based fertilizer recommendations and maintenance of optimum organic matter level as priority.

Materials and Methods

Total ten soil samples were collected from the Tista Floodplain through a semi-detailed soil study on Dasiyar chora village of Phulabari upazilla under Kurigram district. Soil sampling areas were Samannay para, Dhopar Kura, Choto kamad, Kalir hat, Debir path, Ghoriatari, Kamalpur, Bottola, Balatari and Tonkar Mor. Composite soil samples were collected from the surface soil (0 – 15 cm). These samples were then placed separately on trays and dried in shed condition. After drying, samples were prepared for analysis by grinding and sieving using 2 mm size sieve. Then, these samples were kept in polyethylene bags with proper labeling. After that, these samples were analyzed in the laboratory. Then, these samples were kept in polyethylene bags with proper labeling. The particle size analysis of soil was carried out by hydrometer method [3] and that of textural classes were analyzed by Marshall's triangular coordinate curve as devised by USDA [4]. The pH of the soil samples was determined in the laboratory (dry soil and distilled water ratio of 1: 2.5) and measured by using a Corning glass electrode pH meter [5]. The organic

carbon content of soils was determined volumetrically by wet oxidation method as described by Jackson [5]. Total nitrogen content in soil was determined by the Micro Kjeldahl's method following concentrated sulfuric acid (H_2SO_4) digestion and alkali distillation [5]. Total P, K, and S were determined by digestion with a mixture (1:3) of concentrated HCl/HNO_3 [6]. Total P was determined by

Yellow color method, [5] S was determined after developing turbidity [7] and total K was measured by a flame photometer [7]. Total concentration of Fe, Mn, Cu and Zn in soil was analyzed by digesting the soil with aqua rezia (1:10) [5]. Total Fe, Mn, Cu and Zn were analyzed by atomic absorption spectrophotometer (AAS) [8]. To interpret the soil test values, the critical levels of each elements were used as given in the fertilizer recommendation guide [9].

Result and Discussion:

Soil texture ranged from silt loam to silty clay loam (Table 1). The variation in sand, silt and clay content in most profiles suggests that texture is mainly due to sedimentary variations rather than a result of soil forming processes. Silty clay loam is the predominant texture of the studied soil area. The mean sand, silt, and clay contents in the considered soils are 18.12 %, 54.79 %, and 27.09 %, respectively. The silt content was much higher than other particles in these soil samples and the highest silt content present in Dhopar kura. The content of sand, silt, and clay are irregular in pattern. The average sand/silt ratio and silt/clay ratio are 0.39 and 2.72 respectively (Table 1). This is the common features of Tista Floodplain soil**.**

Table 1. Particle size distribution of Tista Floodplain soils.

Location	Land use	% Sand	% Silt	% Clay	Textural Class	Sand/Silt Ratio	Silt/Clay ratio
Samannay para	*Capsicum annuum*	33.98	51.44	14.58	Silt loam	0.66	3.53
Dhopar kura	*pulse*	0.16	77.76	22.08	Silt loam	0.02	3.52
Choto kamad	*Triticum vulgare*	5.98	50.43	43.59	Silty clay	0.12	1.16
Kalir hat	*Zea mays*	43.73	38.44	17.83	Loam	1.14	2.16
Debir path	*Trichosanthes dioica*	18.05	56.95	25.00	Silty clay loam	0.32	2.28
Ghoria tari	*Oryza sativa*	0.20	64.15	35.65	Silty clay loam	0.01	1.79
Kamalpur	*Solanum tuberosum*	18.21	48.29	33.50	Silty clay loam	0.38	1.44
Bottola	*Raphanus raphanistrum*	32.29	46.41	21.30	Loam	0.70	2.17
Balatari	*Brassica nigra*	11.14	53.69	35.17	Silty clay loam	0.21	1.53
Tonkar mor	*omordica charantia*	17.49	60.31	22.20	Silt loam	0.29	2.72
Mean		18.12	54.79	27.09		0.39	2.72

The examined soil samples in the Tista Floodplain showed acidic nature. The pH values of the Tista Floodplain soils under the present study ranged within narrow limits. It ranged from 5.67 to 6.78 with a mean of 5.95 (Table 2). The highest pH was recorded in Dhopar kura whereas lowest pH found in Tonkar mor. The collected soil samples were in the range of moderately acidic to slightly acidic in nature (Table 2). Soil pH controls solubility and availability of essential plant nutrient [10].

The percentage of organic carbon ranged from 0.41% to 1.12% with a mean value of 0.84 % (Table 2). This finding has similarity with the findings of Ali (1997) who reported that most agricultural soils of Bangladesh have low carbon content [11]. In Tista Floodplain soils, carbon content was mainly low, which leads to low residual in soils. The low carbon content adversely effects on soil tilth, soil water retention, soil erosion, infiltration of air and water, and the fate of pesticides applied in soils, thus affecting environmental fitness and crop manufacture. Low carbon content results from the intensive cultivation and removal of the crop [12] .The carbon status of Bangladesh soils is not only poor but also decreasing day by day. Miah reported the 9% to 46% depletion of soil organic matter in different regions of Bangladesh over a period of 20 years from 1970 to 1990[13].

The total nitrogen content of the soil samples ranged from 0.57 % to 0.70 % with a mean of 0.64 % (Table 2).The determined soil sample contains very low nitrogen content due to deficiency of organic matter and depletion of organic matter due to temperature, Erosion, Crop removals and so on. Nitrogen losses commonly occur through leaching, surface runoff, denitrification, and ammonia volatilization [14].

Table 2. Chemical properties of Tista Floodplain soils.

Location	pH	Carbon (%)	Total N (%)	Total P (%)	Total K (%)	Total S (%)
Samannay para	5.77	0.61	0.57	0.04	0.11	0.12
Dhopar kura	6.78	1.11	0.57	0.03	0.10	0.15
Choto kamad	5.79	0.85	0.70	0.03	0.11	0.16
Kalir hat	5.89	0.41	0.57	0.03	0.12	0.15
Debir path	5.89	0.96	0.57	0.04	0.12	0.16
Ghoria tari	5.72	1.12	0.70	0.03	0.11	0.15
Kamalpur	6.20	0.99	0.70	0.03	0.12	0.16
Bottola	6.01	0.86	0.70	0.04	0.12	0.16
Balatari	5.79	0.85	0.70	0.03	0.11	0.16
Tonkar mor	5.67	0.67	0.57	0.03	0.14	0.18
Mean	5.95	0.84	0.64	0.33	0.12	0.16

The total phosphorous content of the studied soil samples ranges from 0.03 to 0.04 % with an average of 0.33 % (Table 2) The phosphorous content of studied soil samples are very low in amount. On the other hand, total potassium content of studied soil samples are high in amount. The total potassium content of studied soil samples ranges from 0.11 to 0.14 % with an average value of 0.12 % (Table 2). Besides, the total sulfur contents of studied soil samples are ranges from 0.12 to 0.18 % with an average of 0.16 % (Table 2). That indicate the sulfur content of these soils is high.

The total iron content of the studied soil samples were ranged from 1017.18 to 211.10 ppm with the average value of 578.40 ppm (Table 3). Among all calculated soil sample, the highest amount of iron content found in Debir path whereas lowest amount of iron found in Tonkar mor. The overall iron content of studied soil samples is very high. At the same way, manganese content of studied soil samples was very high. The total manganese content of the studied soil samples ranged from 274.80 to 20.34 ppm with an average of 84.28 ppm (Table 3).The highest and lowest amount of manganese found in Dhopar kura and Ghoria
tari respectively. Total Fe and Mn in Tista Floodplain soils were very high. This may lead to Fe and Mn toxicity for paddies in acidic soils [10].

Table 3. Micronutrients concentration of Tista Floodplain soils.

Location	Fe	Mn	Cu	Zn
	ppm			
Samannay para	987.16	115.72	5.44	2.71
Dhopar kura	764.71	274.80	6.59	1.49
Choto kamad	487.91	031.35	6.70	1.17
Kalir hat	273.91	112.06	3.01	10.27
Debir path	1017.18	031.02	8.44	4.16
Ghoria tari	502.92	020.34	6.58	1.13
Kamalpur	450.23	026.01	6.22	2.13
Bottola	685.67	062.03	6.68	1.47
Balatari	403.20	023.68	6.78	1.49
Tonkar mor	211.10	145.74	2.83	0.69
Mean	578.40	84.28	5.93	2.67

The total copper content of the studied soil samples were ranged from 8.44 to 2.83 ppm with an average of 5.93 ppm(Table 3).The results of studied soil samples of copper had very low variation among them. The highest values of copper was found in Debir path whereas lowest values was found in Tonkar mor (Table 3). The total copper content of studied soil samples were

in sufficient level. The total zinc content of the studied soil samples ranged from 10.27 to 0.69 ppm with an average of 2.67 ppm. (Table 3). The highest value of copper was found in Kalir hat whereas lowest value was found in Tonkar mor. These values are also close to one another. The total zinc content of studied soil samples was adequate level. The similar observation was also made by Ali [15].

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