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A STUDY ON SOME BLACK TERAI SOILS OF BANGLADESH

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Abstract

Three pedons studied representing the *Bhajanpur*, *Panchagarh* and *Ruhea* of the Black Terai soils (Humic Dystrudepts) indicated that maximum genetic color development has taken in the upper zone due to significant contribution of organic matter. Sand was the dominant fraction with higher sand: silt ratio. The soils were acidic in nature with low C and N content and CEC. Ca^{2+} was the dominant cation where as Mg^{2+} was very scanty. Bulk mineralogical analysis showed that soils were enriched with quartz, muscovite or potash mica, orthoclase, illite and zeolite.

Key words: Black Terai Soils, Soil properties

Introduction

Black Terai soils are located at the Panchagarh district of Bangladesh and comprises of some coalesced alluvial fans formed by the river, washing the adjacent Himalayan slope. Only a part of this piedmont plain falls within the terrestrial limit of Bangladesh which may be regarded as the alluvial toe slope of the Himalayas (Ruhe 1960). The lands between the Mahananda and Ghoramara rivers in the northern part of the Panchagarh district consist of Black Terai soils with an area of 83,408 hectares (Idris and Uddin 2013). Brammer and Hesse (1970) called them problem soils due to their low magnesium contents with low cropping intensity. Literature review reveals that the information regarding the Black Terai soils is very limited (Hussain *et al*. 1982 and Uddin *et al*. 2012). Thus, an attempt was taken to assess the physicochemical properties of the Black Terai soils of the Himalayan piedmont floodplain.

Materials and Methods

Three pedons representing the major series of the Black Terai soils comprising of Bhajanpur (Humic Endoaquepts), Ruhea (Humic Dystrudepts), and Panchagarh (Humic Dystrudepts) belonging to Panchagarh district were taken into consideration. A total of 20 soil samples were collected in the month of February 2010. The morphological description of the pedons was made according to USDA (2003). Soil organic carbon (Jackson 1975), total nitrogen (Page *et al.* 1982) and soil pH was determined with a pH meter at a soil- solution ratio of 1:2.5. The particle size analysis was determined by

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hydrometer method (Day 1965) and that of textural classes by Soil Survey Staff (1993). Ammonium acetate extractable Ca and Mg were determined by Atomic Absorption Spectrophotometer, while K+ and Na+ were determined by Flame photometer. Identification of bulk minerals of surface soils of Bhajanpur and Panchagarh was made on the basis of their characteristic basal reflections (Jackson 1975).

Results and Discussion

Bhajanpur pedon includes moderately well drained, very dark grayish brown (10YR 3/2) to Pale olive (5Y 6/3), very friable, sandy loams having an A1 horizon with umbric nature less than 30 cm thick. The soil is developed in old Himalayan piedmont alluvium and assumed to have formed under rhizomatous grasses. Panchagarh pedon includes intermittently and seasonally flooded, imperfectly and poorly drained, very dark grayish brown (10YR 3/2)) to light olive brown (2.5 Y 5/4), sandy clay loams having an A1 horizon with an umbric epipedon. These soils are developed on the same parent material. Ruhea pedon formed as that of Bhajanpur soil which is intermittently to very shallowly flooded, imperfectly and poorly drained, very dark brown (10YR 2/2) to olive brown (2.5Y 4/4), sandy loam with a thick A1 horizon lies on sandy substratum varying 20-40 inches from the surface. The occurrence of an umbric epipedon at the surface and a cambic B horizon below appears to be the most conspicuous feature of all soils. Hussain (1982) pointed out that the Black Terai soils have developed in the past under a set of soil forming factors that do not exist at present. The original grassy vegetation has been cleared and as a result the development of the umbric epipedon is not a current process of soil formation. The soils show the variations of colour with depth and development of colour in soils may be regarded as an intrinsic genetic property (Buntley and Westin 1965).

The results show that sand is the dominant fraction in the profiles ranging from 70 to 80 percent in these soils with a mean value of 73.7 percent in the surface soils with sandy loam in texture (Table 1). The amount of silt in the present soils was relatively small (Table 1). The vertical distribution pattern of the soil separates was almost irregular in nature which indicates the heterogeneity of the parent materials. The sand: silt ratio in these soils varied from 3.7 to 6.1. The percentage of clay in the profiles ranged from 2 to 12 percent (Table 1). Silt/clay ratio in these soils was also low and varied from 1.4 to 4.0. This ratio indicates that sand: silt ratio plays an important role in vertical movement of soil water. The vertical distribution pattern of the clay fraction shows a slight accumulation in the B horizons of Bhajanpur and Panchagarh soils and AP2 and A11 horizon in Ruhea soil.

The soil organic carbon contents of three pedons ranged from 0.06 to 2.16 percent (Table 1). The organic carbon has been reported higher in Panchagarh (1.22%) than the other two pedons (0.97, 0.92 %). This finding is in agreement with Hossain *et al*. (1972). The reaction of all the soils was acidic, pH ranging from 3.15 to 5.40. The surface soils were more acidic than the underlying horizons in all the pedons. High rainfall and the light texture of these soils, caused intense leaching and may be regarded as the main cause of acidity. The phenomenon of low pH in the surface

Table 1. Physico-chemical properties of the studied pedons.

Soil Pedons and Horizons	Sand (%)	Silt (%)	Clay (%)	Sand/ Silt ratio	Silt/Clay ratio	Organic C %	Total N %	C/N ration	pH
Bhajanpur									
AP1	80	13	07	6.1	1.8	1.85	0.22	9.0	4.00
AP2	78	13	09	6.0	1.4	1.29	0.156	9.0	5.40
A11	75	15	10	5.0	1.5	1.19	0.112	10.6	4.00
B1	73	17	10	4.2	1.7	1.13	0.126	9.0	4.21
B2	70	19	11	3.7	1.7	0.28	0.056	5.0	4.20
C	70	19	11	3.7	1.7	0.08	0.056	2.0	4.72
Mean	74.3	16.0	9.7	4.8	1.6	0.97	0.12	7.4	4.42
Panchagarh									
AP1	70	19	11	3.7	1.7	2.16	0.182	11.8	4.00
AP2	71	17	12	4.1	1.4	1.85	0.182	10.1	4.20
A11	73	15	10	4.8	1.5	1.66	0.126	13.1	4.33
A2	75	15	10	5.0	1.5	1.39	0.126	11.0	4.92
B22	73	15	12	4.8	1.2	1.35	0.107	12.6	4.90
C1	73	19	8	3.8	2.4	0.12	0.042	3.0	5.25
C2	75	20	5	3.7	4.0	0.06	0.056	2.0	5.39
Mean	72.8	17.1	9.7	4.2	1.9	1.22	0.11	9.08	4.71
Ruhea									
AP1	72	18	10	4.0	1.8	1.48	0.308	5.0	4.10
AP2	72	16	12	4.5	1.3	1.31	0.28	5.0	4.00
A11	70	18	12	3.8	1.5	1.25	0.168	8.0	4.44
A12	75	18	7	4.1	2.5	1.25	0.14	9.0	4.38
B11	75	18	7	4.1	2.5	0.71	0.196	4.0	4.34
B12	78	20	2	3.9	10.0	0.71	0.056	6.0	4.65
C	78	20	2	3.9	10.0	0.08	0.084	1.0	4.68
Mean	74.2	18.2	7.4	4.0	4.2	0.92	0.17	6.0	4.37

horizons compared to that in the lower horizons may also be attributed to the seasonally flooded condition of these soils (Brinkman 1970). The total nitrogen content of the pedons ranged from 0.042 to 0.31 percent showing a similar distribution pattern like that of organic carbon. The mean C/N ratio in the pedons is 7.5 which indicates that the organic fraction in these soils has been well mineralized.

The cation exchange capacity of the soils ranged from 6.0 to 11.2 cmol/kg soils (Table 2). Similar results had been also reported by Uddin *et al.* (2012) for some Himalayan piedmont plain soils. The low CEC of the soils may be due to their lower clay and organic matter contents. Among the exchangeable bases Ca^{++} is the dominant cation followed by Mg^{++} and K^{+}. Amount of exchangeable K^{+} and Na^{+} was also very small

(Table 2). Hossain *et al*. (1972) had reported that the soils which have a high amount of weathering mica contain small amounts of K^+ in the exchange position.

Table 2. Cation Exchangc Capacity and Exchangeable Cations in the studied Pedons.

Soil pedons and Horizons	CEC cmol/kg Soil	Exchangeable Bases (cmol+/Kg soil)			
		Ca^{++}	Mg^{++}	K^+	Na^+
Bhajanpur					
AP1	10.9	6.1	0.1	0.6	0.5
AP2	11.1	6.0	0.0	0.6	0.5
A11	10.7	6.0	0.1	0.4	0.4
B1	10.1	5.2	0.1	0.5	0.5
B2	8.8	4.1	0.1	0.5	0.3
C	8.8	4.0	0.0	0.5	0.3
Mean	10.06	5.2	0.06	0.05	0.04
Panchagarh					
AP1	10.6	6.0	0.1	0.0	0.4
AP2	10.3	6.5	0.0	0.3	0.3
A11	9.8	5.5	0.01	0.3	0.3
A12	10.7	6.0	0.1	0.4	0.5
B22	10.7	5.8	0.0	0.3	0.5
C1	9.3	4.1	0.1	0.2	0.3
C2	8.8	4.0	0.1	0.2	0.4
Mean	10.2	5.4	0.05	0.31	0.38
Ruhea					
AP1	11.2	6.6	0.1	0.4	0.2
AP2	10.8	6.2	0.1	0.3	0.2
A11	9.8	4.8	0.1	0.3	0.3
A12	9.3	4.1	0.0	0.2	0.3
B11	9.3	4.8	0.0	0.3	0.4
B12	6.2	1.2	0.1	0.4	0.3
C	6.0	1.0	0.1	0.2	0.4
Mean	8.94	4.1	0.7	0.3	0.3

In Bhajanpur soil, the bulk minerals identified were quartz, muscovite (potash mica), zeolite and illite whereas those in the Panchagarh soil, were quartz, muscovite (potash mica), orthoclase and bytownite. The occurrence of minerals in Bhajanpur and Panchagarh soils followed the order Quartz>Muscovite or potash mica>Zeolite>Illite, and Quartz>bytownite>Orthoclase>Muscovite or potash mica respectively. In the Black Terai soils, the main magnesium bearing mineral appears to be mica (Huizing 1970), which during transformation to expanding lattice minerals may not release appreciable amount of magnesium (Jackson 1975).

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