AN AGRO-PEDOLOGIC STUDY OF THE SOILS OF SYLHET FOOTHILLS, EAST PAKISTAN

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The present investigation deals with the agro-pedologic study of the soils occurring in a portion of the foothills of Sylhet, the major tea-growing area in East Pakistan. The N,P, and K status of the soils was studied on horizon basis to find out the pattern of distribution of these elements.

Introduction

The locality wherefrom the present soils have been collected is the major tea-growing region of East Pakistan. With the growing need for the expansion of tea plantation in the country, it was assumed that an investigation on the elements of major agronomic importance, i.e., nitrogen, phosphorus and potassium might prove helpful to land-users. In this paper an attempt has been made to study the profile distribution of the different forms of N-P-K to assess their interplay in plant nutrition on the one hand and the influence they exert on the pedogenic characteristics of the soils on the other.

Materials and Methods

The soil samples were collected on a natural horizon basis from a portion of the foothills of Sylhet which are situated at a distance of 180 miles north-east of Dacca. The area under investigation covers about 30 sq. miles. It consists of conspicuous hills and valleys which have a Lang's rain factor' of 225.67 and presents an ideal condition for the production of tea. The climate of the region is wet, monsoonic, and the annual rainfall is about 200″. On the hill tops the major portion is occupied by mixed deciduous forest and a small portion is under tea plantation. In the valley region rice is the main crop. Native grass also covers a considerable area.

From six soil profiles 29 soil samples were collected for laboratory study. The soil types were tentatively named after their surface texture and locality names as follows:

Hill Soils.—(1) Salia Sandy Loam (Salia SL), (2) Mughlipara Fine Sandy Loam (Mughlipara FSL), and (3) Lackatoorah Loamy Sand (Lackatoorah LS).

Valley Soils.—(1) Nacksapara Silty Clay Loam (Nacksapara SCL), (2) Khakurpara Silty Clay (Khakurpara SC), and (3) Salehpur Silty Loam (Salehpur SL).

Different forms of nitrogen, phosphorus and potassium were determined. For the estimation of ammoniacal and nitrate nitrogens Piper's methods [2] were followed. The percentage of organic nitrogen was obtained by subtracting inorganic nitrogen from total nitrogen.

Available phosphorus (0.002N H_2SO_4-soluble) was determined by Troug's method,[3] modified by Lynch, Davis and Mc Naught.[4] Inorganic (0.2N H_2SO_4-soluble), organic, sesquioxide-bond (acidoxalate-soluble) and aluminium-bound (2.5 percent CH_3COOH-soluble) phosphorus were determined by the methods given by Mattson *et al.*[5]. Iron-bound phosphorus was obtained by deducting aluminium-bound phosphorus from the sesquioxide-bound phosphorus.

Available potassium was determined by Dyer's method.[6] For the determination of total and adsorbed potash, Piper[2] was followed. Fixed potassium in soil and clay was obtained by deducting both available and adsorbed K_2O from the total K_2O on soil and clay respectively. Fixed K_2O in non-colloid fraction was obtained by deducting fixed K_2O in clay from the fixed K_2O in soil. Organic carbon was determined by Piper's method.[2]

Results and Discussion

Relationship Among Available N-P and K.—It is nowadays a universally known fact that there

is a close correlation between plant growth and the available N-P-K in soil. The available N-P-K in turn hold a relationship among themselves as has been put forward by Sircar and Sen.[7] According to Russell[8] the ideal relative proportion of available N, P and K should be:

$$N:P_2O_5:K_2O = 1:1:1.5.$$

The ratios in the present soils are given in Table 1.

TABLE 1.—AVAILABLE NPK IN THE SURFACE HORIZON (A_{1A}).

Soil type	Milligram percent			Ratio Relative		
	Nitrogen N	Phosphorus P_2O_5	Potassium K_2O	N :	P_2O_5 :	K_2O
Salia SL	4.00	0.82	8.00	1.00 :	0.20 :	2.00
Mughlipara FSL	3.10	0.83	12.00	1.00 :	0.26 :	3.87
Nacksapara SCL	3.30	0.77	7.00	1.00 :	0.23 :	2.12
Salehpur SL	3.00	0.67	12.00	1.00 :	0.22 :	4.00
Lackatoorah LS	4.00	0.53	9.00	1.00 :	0.13 :	2.25
Khakurpara SC	4.40	0.54	8.00	1.00 :	0.11 :	1.81

DISTRIBUTION OF THE DIFFERENT FORMS OF NITROGEN

The different forms of nitrogen and their distribution pattern down the profiles are presented in Table 2.

Organic Nitrogen.—In the soils the organic nitrogen forms the bulk of total nitrogen. In the case of hill soils this form of nitrogen shows gradual decrease down the profiles. A close correlation exists between organic nitrogen on the one hand and organic phosphorus and organic carbon on the other.

Ammoniacal and Nitrate Nitrogen.—The vertical distribution pattern of ammoniacal as well as No_3-nitrogen is irregular. In the hill soils (Salia SL, Mughlipara FSL, and Lackatoorah LS) nitrate nitrogen content is higher near the surface and in the case of the valley soils (Nacksapara SCL, Salehpur SL) accumulation of nitrate nitrogen is found in the lower horizons. Ammoniacal nitrogen accumulates in the surface horizons in both hill and valley soils.

DISTRIBUTION OF THE DIFFERENT FORMS OF PHOSPHORUS.

Available Phosphorus.—This form of phosphorus shows no preferential accumulation in any profile. Of the total phosphorus very small amount is in the available form.

Inorganic Phosphorus.—In the valley soils the inorganic phosphorus increases with depth which indicates that eluviation of this form of phosphorus has taken place. In the soils occurring on the hill tops preferential accumulation is however found near the surface. (Table 3).

Organic Phosphorus.—The surface enrichment of organic phosphorus has taken place in all the soils with the exception of Mughlipara FSL. It is an indication of the laterisation process in operation in the present soils.

In Table 4 the vertical distribution of organic carbon, organic nitrogen and organic phosphorus and their interrelationships has been presented.

Many workers determined the C/P and N/P ratios of the soils in different times. Scholenberger[9] calculated the average N/P ratio of soils around 10. Kaila[10] found the average C/P and N/P ratios to be 130 and 8.4 respectively. Likewise, Karim and Khan[11] found the average ratios of C/P and N/P to be 121.96 and 11.8 respectively in some soils of East Pakistan. Ghani and Aleem[12] found the C/P ratio to be around 50 in some Indian soils. In the present investigation the average C/P and N/P ratios are 228.78 and 27.04 respectively and therefore are not in conformity with the results obtained by the above authors (Table 4).

Sesquioxide-bound Phosphorus.—*R_2O_3-bound phosphorus has experienced eluviation in all the soils (Table 5). Sesquioxide-bound phosphorus shows a general correlation with loss on acid treatment and also with free sesquioxides content of the soils under study (Table 6).

Aluminium-bound Phosphorus.—This form of phosphorus has shown a surface enrichment in Salia SL, Salehpur SL and Nacksapara SCL. Free alumina is found to show a direct correlation with Al-bound phosphorus (Table 6).

Iron-bound Phosphorus.—Vertical distribution of Fe-bound phosphorus in the soils is rather erratic. It shows a direct relationship with free iron oxide.

* $R_2O_3 = (Fe_2O_3 + Al_2O_3$.

TABLE 2.—DISTRIBUTION OF THE DIFFERENT FORMS OF NITROGEN IN SOILS.

Soil type and horizon	Depth in inches	Total N %	Organic N %		Ammoniacal N %		Nitrate N %	
				*		*		*
Salia SL								
A_{IA}	1-5	0.086	0.082	95.34	0.0025	2.90	0.0015	1.74
A_{IB}	7-15	0.064	0.061	95.15	0.0019	2.96	0.0012	1.87
A_2(?)	17½-24	0.041	0.038	93.65	0.0017	4.14	0.0009	2.19
B	28-47	0.023	0.021	90.87	0.0014	6.08	0.0007	3.04
—	50-70	0.021	0.019	90.47	0.0015	7.14	0.0005	2.38
Mughlipara FSL								
A_I	1-6	0.124	0.121	97.50	0.0020	1.61	0.0011	0.88
—	7-16	0.071	0.068	96.47	0.0016	2.25	0.0009	1.26
—	22-34	0.034	0.031	90.29	0.0026	7.64	0.0007	2.05
B	38-58	0.044	0.041	93.63	0.0012	2.72	0.0016	3.63
BC	60-75	0.021	0.018	86.66	0.0019	9.04	0.0009	4.28
Nacksapara SCL								
A_{IA}	1-4	0.214	0.212	98.46	0.0022	1.02	0.0011	0.51
A_{IB}	5-9	0.206	0.203	98.30	0.0026	1.26	0.0009	0.43
AB(?)	15-27	0.056	0.053	95.17	0.0019	3.39	0.0008	1.42
B_I	40-60	0.078	0.075	96.15	0.0013	1.66	0.0017	2.18
B_2	64-80	0.108	0.105	97.03	0.0020	1.85	0.0012	1.11
Salehpur SL								
A_{IA}	1-4	0.157	0.154	98.08	0.0021	1.33	0.0009	0.57
A_{IB}	4-14	0.109	0.105	96.60	0.0025	2.29	0.0012	1.10
A_2(?)	16-21	0.016	0.014	86.87	0.0012	7.50	0.0009	5.62
B_I	24-30	0.034	0.031	92.35	0.0018	5.29	0.0008	2.35
B_2	36-58	0.027	0.024	90.37	0.0016	5.92	0.0010	3.70
Lackatoorah LS								
A_{IA}	1-6	0.104	0.100	96.15	0.0023	1.21	0.0017	1.63
A_{IB}	8-19	0.071	0.068	97.04	0.0012	1.69	0.0009	1.26
A_2(?)	25-43	0.053	0.051	95.28	0.0014	2.64	0.0011	2.07
—	48-55	0.020	0.017	87.00	0.0017	8.50	0.0009	4.50
C(?)	55+	0.019	0.017	89.47	0.0012	6.30	0.0008	4.73
Khakurpara SC								
A_I	1-6½	0.105	0.101	95.80	0.0029	2.76	0.0015	1.43
A_2	8-14	0.067	0.063	93.28	0.0032	4.77	0.0013	1.94
B_I	20-38	0.037	0.034	91.08	0.0024	6.48	0.0009	2.43
B_2	42-63	0.019	0.017	88.94	0.0009	4.73	0.0012	6.31

* Expressed as percentage of total nitrogen.

TABLE 3.—DISTRIBUTION OF THE DIFFERENT FORMS OF PHOSPHORUS* IN SOILS.

Soil type and horizon	Total P	Available P	Inorganic P	Organic P	R_2O_3-P	Fe-P	Al-P	Adsorbed P
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Salia SL								
A_{IA}	13.21	0.82	1.30	4.25	0.46	0.22	0.24	5.58
A_{IB}	12.23	1.02	0.86	2.50	0.58	0.45	3.13	6.98
A_2(?)	11.84	1.00	0.66	1.24	0.53	0.41	0.12	7.65
B	12.69	0.75	0.46	1.34	0.39	0.31	0.08	4.05
—	16.50	0.73	0.46	0.75	0.70	0.61	0.09	8.95

(*Table 3 continued*)

(*Table 3 continued*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Mughlipara FSL								
A_I	28.48	0.83	0.88	5.03	0.85	0.72	0.13	10.26
—	29.60	0.87	2.92	5.67	1.56	1.49	0.07	12.06
—	23.78	0.77	1.44	2.46	1.20	1.17	0.07	7.96
B_I	23.43	0.86	0.77	6.32	0.35	0.28	0.07	11.54
BC	18.25	1.04	0.41	1.56	1.57	1.45	0.12	5.65
Nacksapara SCL								
A_{IA}	26.77	0.77	0.60	5.06	1.20	1.11	0.09	5.34
A_{IB}	24.10	0.86	0.52	5.34	1.56	1.49	0.07	6.01
AB(?)	22.00	0.66	0.66	4.20	0.67	0.56	0.11	3.86
B_I	27.20	0.63	1.21	4.94	0.92	0.86	0.06	8.55
B_2	15.94	0.67	1.44	2.10	1.75	1.67	0.08	4.62
Salehpur SL								
A_{IA}	16.38	0.67	0.43	1.46	0.54	0.43	0.11	3.60
A_{IB}	21.58	0.67	0.55	2.11	0.45	0.34	0.11	6.08
A_2(?)	16.83	0.63	0.63	1.86	0.56	0.43	0.13	2.72
B_I	15.85	0.53	0.96	2.68	0.69	0.60	0.09	4.70
B_2	17.07	0.74	1.06	1.24	0.47	0.39	0.08	3.22
Lackatoorah LS								
A_{IA}	9.51	0.53	0.46	2.70	0.60	0.52	0.08	2.83
A_{IB}	9.09	0.87	0.39	2.08	0.47	0.39	0.08	2.90
A_2(?)	13.09	0.78	0.30	1.43	0.35	0.27	0.08	3.00
—	10.00	0.57	0.45	2.68	0.56	0.46	0.10	2.60
C(?)	13.14	0.48	0.41	1.86	0.52	0.38	0.14	2.68
Khakurpara SC								
A_I	**27.78**	0.54	0.60	3.92	0.48	0.41	0.07	2.60
A_2	**15.94**	0.90	0.46	1.70	0.54	0.46	0.08	3.12
B_I	30.15	0.68	0.63	2.20	0.83	0.72	0.11	6.28
B_2	24.20	0.76	0.89	2.63	0.88	0.81	0.07	4.24

* Expressed as mg.%.

TABLE 4.—RELATIONSHIP OF ORGANIC PHOSPHORUS WITH ORGANIC CARBON AND ORGANIC NITROGEN.

Soil type and horizon	Carbon %	Nitrogen %	Phospho-rus %	c/N	c/P	N/P
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Salia SL						
A_{IA}	0.665	0.082	0.0043	8.10	154.65	19.06
A_{IB}	0.458	0.061	0.0025	7.50	183.20	24.40
A_2(?)	0.231	0.038	0.0015	6.07	192.50	31.66
B	0.136	0.021	0.0013	6.47	104.61	16.16
—	0.106	0.019	0.0007	5.57	151.42	27.14

(*Table 4 continued*)

(*Table 4 continued*)

(1)	(2)	(3)	(3)	(4)	(5)	(6)
Mughlipara FSL						
A_I	1.443	0.121	0.0050	11.92	288.60	24.20
—	0.720	0.068	0.0057	10.58	126.31	11.92
—	0.312	0.031	0.0025	10.06	124.80	12.40
B_I	0.227	0.041	0.0060	5.53	37.83	6.83
BC	0.117	0.018	0.0016	6.50	73.12	11.25
Nacksapara SCL						
A_{IA}	2.086	0.212	0.0050	9.84	417.20	42.40
A_{IB}	2.476	0.203	0.0053	12.19	467.16	38.30
AB(?)	0.468	0.053	0.0040	8.83	117.60	13.25
B_I	0.559	0.75	0.0049	7.45	114.08	15.30
B_2	0.858	0.105	0.0020	8.17	429.00	15.30
Salehpur SL						
A_I	1.504	0.154	0.0015	9.76	1002.06	120.66
A_{IB}	0.789	0.105	0.0020	7.51	394.50	52.50
A_2(?)	0.412	0.046	0.0019	8.95	216.84	24.21
B_I	0.247	0.031	0.0027	7.96	91.48	11.48
B_2	0.195	0.024	0.0013	8.12	150.00	18.46
Lackatoorah LS						
A_{IA}	1.326	0.100	0.0027	13.26	491.11	37.37
A_{IB}	0.668	0.069	0.0021	9.68	318.09	32.85
A_2(?)	0.292	0.051	0.0014	5.72	208.57	36.42
—	0.136	0.017	0.0027	8.00	50.37	6.29
C(?)	0.097	0.017	0.0019	5.70	51.05	8.94
Khakurpara SC						
A_I	0.916	0.101	0.0039	8.25	234.61	25.89
A_2	0.487	0.063	0.0017	7.73	286.47	37.05
B_I	0.234	0.034	0.0022	6.88	106.36	15.45
B_2	0.136	0.017	0.0026	8.00	52.30	65.30

*See Table 2 for depth.

TABLE 5.—PERCENTAGE* COMPOSITIONS OF THE DIFFERENT FORMS OF PHOSPHORUS IN SOILS.

Soil type and horizon	Available P	Inorganic P	Organic P	R_2O_3-P	Fe-P	Al-P	Adsorbed P
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Salia SL	%	%	%	%	%	%	%
A_{IA}	6.21	9.84	32.10	3.48	1.67	1.82	42.24
A_{IB}	8.34	7.03	20.44	4.74	3.68	1.06	57.07
A_2(?)	8.45	5.57	10.47	4.47	3.46	1.01	60.30
B	5.91	3.62	10.56	3.07	2.44	0.63	31.91
—	4.42	2.79	4.55	3.03	2.48	0.55	54.24
Mughlipara FSL							
A_I	2.91	3.09	17.66	2.93	2.53	0.46	36.02
—	2.94	9.86	19.16	5.27	5.03	0.24	40.74
—	3.24	6.06	10.34	5.05	4.92	0.29	32.34
B_I	3.67	3.03	26.97	1.49	1.19	0.30	49.25
BC	5.70	2.24	8.55	8.60	7.94	0.66	30.96

(*Table 5 continued*)

(*Table 5 continued*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Nacksapara SCL							
A_I	2.88	2.24	18.90	4.48	4.15	0.34	19.95
A_{IB}	3.57	2.16	22.16	6.47	6.18	0.29	24.94
AB(?)	3.00	3.00	19.09	3.04	2.54	0.50	17.55
B_I	2.32	4.45	18.16	3.38	3.16	0.22	31.43
B_2	4.20	9.03	13.17	12.00	10.48	0.50	28.98
Salehpur SL							
A_{IA}	4.09	2.62	8.91	3.29	2.62	0.67	21.98
A_{IB}	3.10	2.55	9.78	2.09	1.57	0.51	28.17
A_2(?)	3.73	3.74	11.05	3.33	2.55	0.77	16.28
B_I	3.66	6.06	16.91	4.35	3.78	0.57	29.65
B_2	4.33	6.21	7.32	2.75	2.28	0.47	18.86
Lackatoorah LS							
A_{IA}	5.57	4.84	28.39	6.31	5.47	0.84	29.76
A_{IB}	9.57	4.29	22.22	5.17	4.29	0.88	31.90
A_2(?)	5.96	2.29	10.92	2.67	2.06	0.61	22.92
—	5.70	4.50	26.80	5.60	4.60	1.00	26.00
C(?)	3.65	3.12	14.15	3.96	2.89	1.06	20.09
Khakurpara SC							
A_I	1.94	2.16	14.11	1.73	1.47	0.25	9.36
A_2	5.68	2.88	10.66	3.39	2.89	0.50	19.57
B_I	2.25	2.09	7.30	2.75	2.39	0.36	20.83
B_2	3.14	3.68	10.87	3.64	3.35	0.29	17.52

*Computed as percentage of total phosphorus.

TABLE 6.—CHEMICAL ANALYSES OF SYLHET SOILS.

Soil type	Horizon	Free Fe_2O_3 %	Free Al_2O_3 %	Free R_2O_3 %	Loss on acid treatment %
(1)	(2)	(3)	(4)	(5)	(6)
Salia SL	A_{IA}	1.47	1.35	2.82	1.37
	A_{IB}	2.55	1.66	4.21	1.27
	A_2(?)	1.72	1.05	2.77	0.47
	B	3.26	2.23	5.49	0.60
	—	2.28	1.54	3.82	0.55
Mughlipara FSL	A_I	1.67	1.98	3.65	2.72
	—	3.37	2.95	6.32	2.28
	—	3.59	1.60	5.19	1.37
	B_I	2.78	1.82	4.60	3.43
	BC	3.51	2.38	5.89	1.76
Nacksapara SCL	A_{IA}	0.79	2.29	3.08	4.09
	A_{IB}	0.69	2.25	2.94	4.36
	AB(?)	2.49	2.08	4.57	3.02
	B_I	3.01	2.35	5.36	4.23
	B_2	0.55	1.54	2.09	3.92
Salehpur SL	A_{IA}	0.73	0.62	1.35	2.46
	A_{IB}	3.19	0.85	4.04	3.33
	A_2(?)	2.71	0.66	3.37	0.97
	B_I	1.91	1.06	2.97	2.67
	B_2	0.58	0.95	1.53	2.57

(*Table 6 continued*)

(*Table 6 continued*)

(1)	(2)	(3)	(4)	(5)	(6)
Lackatoorah LS	A_{1A}	1.68	1.29	2.97	1.87
	A_{1B}	2.94	0.53	3.47	1.37
	A_2(?)	2.16	0.75	2.91	1.00
	—	2.43	0.80	3.23	1.45
	C(?)	3.43	1.92	5.35	0.93
Khakurpara SC	A_1	2.23	1.35	3.58	3.65
	A_2	0.72	1.19	1.91	1.11
	B_1	2.33	2.56	4.89	2.26
	B_2	1.51	2.26	3.77	1.40

*R_2O_3 = (Fe_2O_3 + Al_2O_3)

Sub-surface enrichment of Fe-bound phosphorus is found in all the soils with the probable exception of Mughlipara FSL (Table 3).

Adsorbed Phosphorus.—The adsorbed phosphorus content is found to be higher in the hill soils than those on the valley floor with the exception of Lackatoorah LS.

Mattson,[5] Stout [13] and Black[14] have shown that phosphate adsorption in soils may be correlated mainly with kaolinitic minerals. In the present investigation the soils have considerable amount of kaolinitic clay as also is evident from the low cation exchange capacity (8-19 m.e.%.), and thus exhibit phosphate adsorption to a marked degree which in some cases go as high as 66 percent of the total phosphorus (Table 5).

In the light of Birch's[16] findings it may be stated that adsorbed phosphorus may be available to plants when adequate amounts are stored up. In the present investigation adsorbed phosphorus constitute the major portion of total phosphorus and a correlation between the adsorbed and the available phosphorus may be forthcoming.

Distribution of Different Forms of Potassium.—The distribution pattern of available, adsorbed and fixed forms of potassium has been presented in Table 7.

TABLE 7.—DISTRIBUTION OF THE DIFFERENT FORMS OF POTASSIUM IN SOILS AND CLAYS.

Soil type and horizon	Total K_2O in soil	Available K_2O in soil	Adsorbed K_2O in soil		Fixed K_2O in soil		Fixed K_2O in clay	Fixed K_2O in non-colloid.	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Salia SI			★		★		★		
A_{1A}	3.23	0.008	0.26	0.040	1.24	3.18	98.45	2.44	2.95
A_{1B}	2.77	0.007	0.25	0.045	1.62	2.72	98.19	2.31	2.34
A_2(?)	2.22	0.007	0.31	0.035	1.58	2.18	98.20	1.94	2.19
B	3.04	0.008	0.26	0.039	1.28	2.99	98.35	2.44	3.05
—	2.17	0.006	0.28	0.049	2.26	2.12	97.46	1.92	2.13
Mughlipara FSL									
A_1	2.27	0.012	0.53	0.032	1.41	2.22	97.80	3.88	1.78
—	2.87	0.020	0.70	0.039	1.36	2.81	97.91	3.60	2.50
—	3.22	0.009	0.28	0.040	1.24	3.17	98.45	4.64	2.84
B_1	4.37	0.008	0.18	0.067	1.53	4.29	98.29	3.76	5.09
BC	2.58	0.011	0.43	0.062	2.40	2.51	97.17	3.34	2.41
Nacksapara SCL									
A_{1A}	4.67	0.007	0.15	0.067	1.43	4.59	98.42	3.65	5.04
A_{1B}	5.39	0.009	0.17	0.095	1.76	5.28	98.07	4.47	5.70
AB(?)	5.39	0.008	0.15	0.040	0.74	5.34	99.11	3.31	6.19
B_1	5.37	0.011	0.20	0.067	1.25	5.29	98.55	4.49	5.65
B_2	5.31	0.008	0.15	0.065	1.22	5.23	98.63	4.80	5.42
Salehpur SL									
A_{1A}	3.72	0.012	0.32	0.037	0.99	3.67	98.69	2.03	3.99
A_{1B}	4.37	0.008	0.18	0.032	0.73	4.33	99.09	2.25	5.25
A_2(?)	3.55	0.010	0.28	0.022	0.62	3.51	99.10	2.01	3.69
B_1	4.45	0.011	0.25	0.044	0.92	4.41	98.76	3.55	4.66
B_2	4.39	0.007	0.16	0.055	1.30	4.32	98.54	3.73	4.50

(*Table 7 continued*)

(*Table 7 continued*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Lackatoorah LS									
A_{1A}	2.73	0.009	0.23	0.029	1.06	2.69	98.61	2.43	2.73
A_{1B}	4.57	0.011	0.24	0.035	0.77	4.52	98.99	2.40	4.78
A_2(?)	4.06	0.008	0.20	0.055	1.35	3.99	98.45	1.62	4.17
—	3.29	0.010	0.30	0.064	1.95	3.21	97.75	1.48	3.29
C(?)	3.64	0.007	0.19	0.062	1.70	3.57	98.11	1.81	3.69
Khakurpara SC									
A_1	4.76	0.008	0.17	0.086	1.81	4.66	98.02	3.14	5.73
A_2	2.72	0.009	0.26	0.059	2.17	2.65	97.57	3.33	2.54
B_1	4.47	0.012	0.27	0.077	1.72	4.38	98.01	3.41	4.72
B_2	4.63	0.010	0.22	0.092	1.99	4.53	97.79	3.81	4.69

*Expressed as percentage of total potassium. + On oven dry basis.

Available Potassium.—Available potassium does not show any tendency to impoverishment in the surface horizon. This is probably due to the fact that the soils are under the native vegetation cover, with the exception of Salehpur SL and hence no appreciable loss of this element is possible.

Available potassium, on the other hand, when expressed as percentage of total potassium, assumes only a microscopic fraction.

Adsorbed Potassium.—Jenney and Overstreet [15] demonstrated that adsorbed potassium remains in the exchange complex of clays wherein the reaction between the plant roots and the soil colloids takes place. In the soils of Sylhet foothills there, however, exists no general correlation between exchangeable and adsorbed potassium, indicating thereby that a major portion of adsorbed potassium is in a relatively unavailable state. This form of potassium also does not follow any definite system in their distribution pattern down the profiles (Table 7).

Fixed Potassium in Colloid and Non-colloid Fractions.—As more than 97 percent of the total potassium is in the fixed form, it is clear that very little amount of this element is in the available state. Fixed potassium occurs both in the colloidal and non-colloidal fractions (Table 7).

The fixed potassium content of non-colloid fraction is more than that in the clay fraction. According to Polynov [17] this is an indication of the fluviatile origin of the parent material of soils which is perhaps the case in the present investigation.

A considerable amount of fixed potassium is found in the colloid fraction of the soils which hints at the possible presence of "Illite" in the clay minerals. Following the findings of Karim,[18] and Karim and Khan,[11] it may be stated that illite comprises a small fraction (probably not more than 15-20 percent) of the total clay minerals of the soils. It may be assumed, therefore, that the major clay mineral in the present soils will be kaolinitic.

References

1. R. Lang, Versuch einer Exakten Klassifikation der Boden in Klimatischen und Geologischen Hinsicht. Int. Mitt. Bodenk, 5:312-346 (1915).
2. C.S. Piper, *Soil and Plant Analysis* (Adelaide University, Australia, 1950).
3. E. Truog, J. Am. Soc. Agron., **22,** 874 (1930).
4. P.B., Lynch, *et al.*, *Methods of Assessing the Adequacy of Plant Nutrition with Special Reference to Permanent Texture.* Proc., Brit. Commonwealth Sci. Conf., 169 (1950).
5. S. Mattson, *et al.*, Ann. Roy. Agr. Coll, Sweden, **17,** 107 (1950).
6. B. Dyer, Trans. Chem. Soc. **65,** 115 (1894).
7. S.M. Sircar and N.K. Sen, Indian J. Agr. Sci., **11**, 193 (1941).
8. E.J. Russell, *Soil Condition and Plant Growth*, (Longmans, Green Co., London, 1942).
9. C.J., Schollenberger, Soil Sci., **10,** 127 (1920).
10. A. Kaila, Soil Sci., **68,** 279 (1949).
11. A. Karim, and D.H. Khan, Soil Sci., **81**, 47 (1956).
12. M.O. Ghani and S.A., Aleem, Indian Agr. Sci. **13,** 283 (1943).
13. P.R. Stout, Soil Sci. Soc. Proc., **4,** 177 (1939).
14. C.A. Black, Soil Sci. Soc. Am. Proc., **6,** 157 (1941).
15. H. Jenny, and R. Overstreet, Soil Sci., **47,** 257 (1939).
16. H.F. Birch, Proc. 1st Commonwealth Conf. Tropical and Sub-Tropical Soils, 225 (1949).
17. B.B. Polynov., *The Cycle of Weathering* (Thomas Murby and Co., London, 1937).
18. A. Karim, J. Soil Sci **1,** 1 (1954).