CLASSIFICATION OF GREAT SOIL GROUPS IN THE EAST BLACK SEA BASIN ACCORDING TO INTERNATIONAL SOIL CLASSIFICATION SYSTEMS

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ABSTRACT

This study was carried out to classify great soil groups in the East Black Sea basin according to international soil classification systems. 13 profiles of 3 great soil groups in this basin have been investigated and classified according to system of FAO/UNESCO (1990), FitzPatrick (1988) and USDA Soil Taxonomy (1998) in this study.

KEY WORDS: east black sea basin, soil genesis, taxonomy

DETAILED ABSTRACT

The aim of this study was to classify great soil groups in the East Black Sea basin according to three different soil classification systems. The basin report was used which prepared by General Directorate of Soil-Water for this purpose. Previously, this basin soils were classified according to Thorp et. al., (1949). Therefore, this system has not been using for a long time in many countries. Nowadays FAO/UNESCO (1990), FitzPatrick (1988) and USDA Soil Taxonomy (1998) systems have been using in many countries. The physical, chemical and morphological properties of the 13 profiles at 3 great soil groups were investigated and evaluated according to FAO/UNESCO (1990), FitzPatrick (1988) and USDA Soil Taxonomy (1998) systems in this study.

INTRODUCTION

The East Black Sea basin comprises 3.0% of Turkey and area situated on the northeastern side of country along the Black Sea coast between 40° 15′ - 41° 34′ N longitudes and 36° 43′ - 41° 35′ E latitudes [1]. The total area is 2.334.820 ha. This basin contains Alluvial, Grey Brown Podzolic, Brown, Brown Forest, Non Calcic Brown Forest, Colluvial, Yellow Red Podzolic and High Mountain Pasture soils, which were classified according to old soil classification system [2]. The distribution area of great soil groups was presented in Table 1. Grey Brown Podzolic, Yellow Red Podzolic and High Mountain Pasture Soils occupy 80.3% of the basin. The annual precipitation and temperature values range from 434.3 to 1196.6 mm and 13.6 to 14.6 °C in the basin. The soil moisture regime is Udic. The soil temperature regimes are thermic and mesic respectively [3]. The basin is under natural vegetation due to hilly topography and high rainfall.

Table 1: The distribution area of great soil groups in the basin [1]

Soil group	Area (ha)	Percentage to basin (%)
Grey Brown Podzolic	1.046.471	47.0
Yellow Red Podzolic	376.651	17.0
High Mountain Pasture	360.512	16.3
Brown Forest	263.976	11.9
Non Calcic Brown Forest	131.804	5.9
Alluvial	32.747	1.5
Brown	4.718	0.2
Colluvial	5.100	0.2

The aim of this study was to classify the main great soil groups in the basin according to three different soil classification systems.

MATERIALS AND METHODS

The East Black Sea basin report was used in this work [1]. This basin report was prepared by General Directorate of Soil-Water. The obtained physical, chemical and morphological results were evaluated and these soils were classified according to the system of FAO/UNESCO [4], FitzPatrick [5], and USDA Soil Taxonomy [6].

The soil samples were analyzed for particle-size distribution [7], pH in a 1:2 soil:water ratio [8], organic carbon [9], total nitrogen [10], calcium carbonate [11], electrical conductivity [12], CEC and exchangeable cations [13].

RESULTS AND DISCUSSION

The some physical, chemical and morphological properties of the soils were presented in Tables 2 and 3.

Profiles from 1 to 6 were classified as Grey Brown Podzolic soil according to Thorp et. al. [2] by General Directorate of Soil-Water. The soil profiles had color of 7.5 and 10 YR hue. The values and chromas of soils ranged from 3 to 8 and 2 to 6 respectively. The sand and silt content of soils varied from 40.4 to 74.0% and 15.0 to 42.0% respectively. The clay content of soils ranged from 8.4 to 36.6%. These soils had high sand values than silt and clay contents of all profiles. pH values of soils varied from 4.5 to 7.0. The organic carbon and total nitrogen values ranged from 0.20 to 5.51% and 0.04 to 0.32% respectively. C/N values varied from 4.4 to 21.8. These soils did not have any CaCO3 content due to non calcareous parent material and high rainfall in the region. Electrical conductivity values ranged from 0.20 to 0.70 dS m^{-1} and the low values were indicated that these profiles were not saline due to good drainage and high rainfall in all the studied soils. The CEC values varied from 10.2 to 43.7 cmol (+) kg^{-1}. The some differences in the studied soil profiles were occurred due to location of the profiles and degree of soil formation process where the soils developed in the research area.

The profile 1 was developed on non calcareous clay stone. The soil has thick profile that was located on 50 m above mean sea level and used as forest. This soil was classified as Haplic Pozdol [4], Podzol [5] and Typic Haplorthod [6].

The profile 2 was formed on andesite. The soil has moderately thick profile, which was located on 850 m above mean sea level and used as forest. This soil was classified as Eutric Podzoluvisol [4], Supragleysol [5] and Typic Hapludult [6].

The profile 3 was developed on shattered andesite material. The soil has thick profile that was located on 400 m above mean sea level and used as forest. This soil

Table 2. The some morphological and physical properties of the East Black. Sea basin soils.

Horizon Old Classification [2]	Depth (cm)	Munsell Color, (moist)	Sand (%)	Silt (%)	Clay (%)	Texture
Grey Brown Podzolic						
Profile 1						
A11	0-15	10 YR 3/2	40.4	28.0	31.6	CL
A12	15-22	10 YR 4/3	50.4	24.0	25.6	SCL
B1	22-34	10 YR 5/4	40.4	25.0	36.6	CL
B2	34-52	7.5 YR 4/4	46.4	24.0	29.6	SCL
C	52-100	10 YR 8/3	45.5	30.0	24.6	L
Grey Brown Podzolic						
Profile 2						
A1	0-13	10 YR 3/3	67.1	24.5	8.4	SL
A2	13-28	10 YR 4/3	54.0	29.7	16.3	SL
B1	28-47	10 YR 5/3	56.0	26.6	17.4	SL
B2	47-69	10 YR 4/4	53.0	29.6	17.4	SL
Grey Brown Podzolic						
Profile 3						
A11	0-15	10 YR 4/2	48.0	41.6	10.4	L
A12	15-32	10 YR 3/3	49.6	42.0	8.4	L
B1	32-48	10 YR 4/4	48.6	36.0	15.4	L
B2	48-73	10 YR 6/4	44.6	32.0	23.4	L
B3	73-95	10 YR 5/6	42.6	36.0	21.4	L
Grey Brown Podzolic						
Profile 4						
A	0-25	10 YR 3/2	56.6	30.0	14.4	SL
B	25-45	10 YR 3/3	45.6	42.0	12.4	L
BC	45-68	10 YR 3/3	51.6	31.0	17.4	L
Grey Brown Podzolic						
Profile 5						
A	0-15	10 YR 6/3	74.0	15.0	11.0	SL
B	15-30	10 YR 6/3	72.0	16.0	12.0	SL
Grey Brown Podzolic						
Profile 6						
A	0-22	10 YR 4/3	48.4	34.0	17.6	L
B1	22-65	10 YR 5/3	48.4	31.0	20.6	L
B2	65-85	10 YR 5/3	48.4	31.0	20.6	L
Yellow Red Podzolic						
Profile 7						
A1	0-27	7.5 YR 5/6	35.5	25.2	39.3	CL
E1	27-55	10 YR 5/6	34.1	34.0	31.9	CL
B1	55-88	5 YR 5/6	27.4	13.2	59.4	C
B2	88-120	2.5 YR 5/6	25.6	23.2	51.2	C
C	120-150	5 YR 4/4	35.0	23.0	42.0	C
Yellow Red Podzolic						
Profile 8						
A1	0-10	10 YR 3/3	36.4	30.0	33.6	CL
E1	10-23	10 YR 3/2	48.4	35.0	16.6	L
E2	23-44	7.5 YR 4/4	46.4	35.0	18.6	L
B1	44-80	5 YR 4/4	38.4	27.0	34.6	CL
B2	80-125	7.5 YR 4/4	38.4	27.0	34.6	CL
Yellow Red Podzolic						
Profile 9						
A1	0-20	5 YR 4/4	42.0	33.0	25.0	L
E1	20-35	7.5 YR 4/4	60.0	22.0	18.0	CL
B1	35-75	7.5 YR 4/4	40.0	32.0	28.0	CL
B2	75-125	5 YR 4/4	38.0	32.0	30.0	CL
B3	125-160	5 YR 4/6	44.0	29.0	27.0	CL
Yellow Red Podzolic						
Profile 10						
A	0-15	10 YR 3/2	66.0	17.0	17.0	SL
E1	15-29	10 YR 3/3	62.0	23.0	15.0	SCL
B	29-60	10 YR 3/4	62.0	17.0	21.0	SCL
Yellow Red Podzolic						
Profile 11						
A1	0-25	10 YR 4/4	48.0	26.0	26.0	SCL
A2	25-60	10 YR 4/3	44.0	25.0	31.0	CL
B1	60-105	7.5 YR 5/4	38.0	24.0	38.0	CL
B2	105-165	7.5 YR 5/4	35.0	19.0	46.0	C
Yellow Red Podzolic						
Profile 12						
A11	0-22	7.5 YR 3/2	44.0	44.0	12.0	L
A12	22-40	7.5 YR 5/4	48.0	38.0	14.0	L
B1	40-73	10 YR 5/3	44.0	34.0	22.0	L
B2	73-103	10 YR 7/3	42.0	38.0	20.0	L
High Mountain						
Pasture Soils						
Profile 13						
A11	0-5	10 YR 4/2	58.0	31.0	11.0	L
A12	5-15	10 YR 4/3	60.0	22.0	18.0	SL
A13	15-45	10 YR 5/6	60.0	23.0	17.0	SL

was classified as Haplic Pozdol [4], Podzol [5] and Typic Haplorthod [6].

The profile 4 was formed on andesite. The soil has moderately thick profile, which was located on 350 m above mean sea level and used as forest. This soil was classified as Eutric Podzoluvisol [4], Supragleysol [5] and Typic Hapludult [6].

The profile 5 was developed on various igneous rock deposits. The soil has thin profile that was located on 950 m above mean sea level and used as forest. This soil was classified as Haplic Pozdol [4], Podzol [5] and Typic Haplorthod [6].

The profile 6 was formed on acid igneous rocks. The soil has thin profile, which was located on 1400 m above mean sea level and used as forest. This soil was classified as Eutric Podzoluvisol [4], Supragleysol [5] and Typic Hapludult [6].

Profiles from 7 to 12 were classified as Yellow Red Podzolic soils according to Thorp et. al. [2] by General Directorate of Soil-Water. The studied soil profiles had color of 2.5, 5, 7.5 and 10 YR hues. The values and chromas of profiles varied from 3 to 7 and 2 to 6 respectively. The sand values ranged from 25.6 to 66.0% and silt values varied from 13.2 to 44.0%. The clay values of profiles ranged from 12.0 to 59.4%. These soil profiles had high sand values than silt and clay values. The similar distribution was observed for Grey Brown Podzolic soils. pH values varied from 5.0 to 5.9. The organic carbon and total nitrogen values ranged from 0.16 to 13.72% and 0.03 to 0.40% respectively. C/N values varied from 4.0 to 34.3. The $CaCO_3$ was absent throughout the studied soil profiles due to non calcareous parent material and high rainfall in the studied region. Electrical conductivity values ranged from 0.10 to 1.35 dS m^{-1}. The CEC values varied from 13.0 to 31.5 cmol (+) kg^{-1}. The differences in the studied soil profiles were indicated that soil formation process was affected these soils.

The profile 7 was developed on clay stone. The soil has very thick profile that was located on 350 m above mean sea level and used as forest. This soil was classified as Eutric Podzoluvisol [4], Supragleysol [5] and Typic Hapludult [6].

The profile 8 was formed on miocene aged sedimentary deposits. The soil has very thick profile, which was located on 450 m above mean sea level and used as forest. This soil was classified as Eutric Podzoluvisol [4], Supragleysol [5] and Typic Hapludult [6].

The profile 9 was developed on clayey and stony old terrace material. The soil has very thick profile that was located on 450 m above mean sea level and used as dry farming field. This soil was classified as Eutric Podzoluvisol [4], Supragleysol [5] and Typic Hapludult [6].

The profile 10 was formed on pliocene aged sand stone. The soil has moderately thick profile, which was located on 180 m above mean sea level and used as forest. This soil was classified as Eutric Podzoluvisol [4], Supragleysol [5] and Typic Hapludult [6].

The profile 11 was developed on clay stone. The soil has very thick profile that was located on 600 m above mean sea level and used as forest. This soil was classified as Eutric Podzoluvisol [4], Supragleysol [5] and Typic Hapludult [6].

The profile 12 was formed on andesite. The soil has thick profile, which was located on 450 m above mean sea level and used as forest. This soil was classified as Eutric Podzoluvisol [4], Supragleysol [5] and Typic Hapludult [6].

The profile 13 was developed on pliocene aged gravel parent material. The soil thin profile that was located on 2036 m above mean sea level under pasture vegetation. This soil was classified as Haplic Kastanozem [4], Kastanozem [5] and Typic Haplustoll [6].

CONCLUSION

Eight great soil groups were determinated according to the fieldwork, which was done by General Directorate of Soil-Water [1] in the basin. Grey Brown Podzolic, Yellow Red Podzolic and High Mountain Pasture soils were investigated in detail and the results of these soils were presented in this basin report. According to obtained results were indicated that the main soil type is podzolic soils due to the current climate, vegetation and related with other soil forming process in the basin. The some differences were occurred in the presented soils where the soils developed. This work was enabled us to compare and evaluate all the obtained data easily, which were classified according to three different soil classification systems in the East Black Sea basin of Turkey.

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Table 3a: The some chemical properties of the East Black Sea basin soils.

Horizon Old Classification [2]	Depth (cm)	pH 1:2 soil:water	Org.C (%)	Total N (%)	C:N	ECx10^3, 25 °C mmhos/cm	$CaCO_3$ (%)	Exchangeable cations Ca	Mg	Na	K	H	CEC	BS (%)
								----------cmol.kg^{-1}----------						
Grey Brown Podzolic Profile 1														
A11	0-15	5.0	3.35	0.28	11.9	0.50	--	28.94	1.06	0.64	2.10	8.30	41.0	79
A12	15-22	4.8	1.93	0.18	10.7	0.35	--	21.00	3.18	0.63	1.80	10.00	36.6	72
B1	22-34	4.8	1.62	0.14	11.6	0.25	--	20.88	2.12	1.20	2.80	12.70	39.7	68
B2	34-52	4.6	0.92	0.12	7.7	0.22	--	23.88	2.12	0.58	2.60	14.50	43.7	66
C	52-100	4.5	0.48	0.07	6.8	0.20	--	17.82	3.18	0.64	1.27	18.80	41.7	55
Grey Brown Podzolic Profile 2														
A1	0-13	6.5	1.30	0.10	13.0	0.60	--	21.03	8.32	0.54	0.31	1.80	32.0	94
A2	13-28	6.6	0.77	0.06	12.8	0.55	--	20.73	7.00	0.64	0.13	2.00	30.5	93
B1	28-47	6.6	0.68	0.06	11.3	0.60	--	18.17	7.56	0.64	0.13	1.50	28.0	94
B2	47-69	6.7	0.65	0.06	10.8	0.60	--	7.18	12.92	0.56	0.14	1.20	22.0	94
Grey Brown Podzolic Profile 3														
A11	0-15	5.5	5.51	0.32	17.2	0.60	--	5.30	3.70	0.35	1.30	9.60	20.2	52
A12	15-32	5.3	3.05	0.14	21.8	0.40	--	2.34	2.88	0.24	0.74	11.80	18.0	34
B1	32-48	5.7	1.21	0.09	13.4	0.50	--	4.18	1.82	0.48	0.62	9.40	16.5	43
B2	48-73	5.2	0.66	0.07	9.4	0.30	--	2.47	6.88	0.36	0.49	6.80	17.0	60
B3	73-95	5.1	0.20	0.04	5.0	0.30	--	2.12	2.88	0.25	0.45	7.30	13.0	43
Grey Brown Podzolic Profile 4														
A	0-25	6.0	1.61	0.12	13.4	0.50	--	16.84	8.16	0.40	0.35	2.80	28.5	90
B	25-45	6.3	0.72	0.06	12.0	0.45	--	13.88	11.30	0.52	0.30	1.80	27.8	93
BC	45-68	6.2	1.49	0.10	14.9	0.50	--	13.78	10.72	0.60	0.19	1.30	26.5	95
Grey Brown Podzolic Profile 5														
A	0-15	5.8	2.11	0.11	19.2	0.70	--	4.80	2.10	0.22	0.40	2.70	10.2	73
B	15-30	5.5	1.01	0.08	12.6	0.45	--	5.30	1.60	0.18	0.34	2.90	10.3	71

Table 3b

Horizon Old Classification [2]	Depth (cm)	pH 1:2 soil:water	Org.C (%)	Total N (%)	C:N	ECx10^3, 25 °C mmhos/cm	$CaCO_3$ (%)	Exchangeable cations Ca	Mg	Na	K	H	CEC	BS (%)
								----------cmol.kg^{-1}----------						
Grey Brown Podzolic Profile 6														
A	0-22	6.6	0.50	0.10	5.0	0.60	--	3.18	10.82	0.30	0.17	1.00	15.5	93
B1	22-65	7.0	0.59	0.11	5.4	0.52	--	2.12	12.00	0.30	0.15	0.40	14.9	97
B2	65-85	6.9	0.48	0.11	4.4	0.47	--	3.18	9.82	4.80	0.19	0.70	18.0	96
Yellow Red Podzolic Profile 7														
A1	0-27	5.1	1.51	0.11	13.7	0.30	--	8.95	4.05	0.38	0.53	4.80	18.7	73
E1	27-55	5.3	0.65	0.07	9.3	0.30	--	6.90	4.23	0.64	0.62	4.30	16.7	72
B1	55-88	5.0	0.40	0.07	5.7	0.30	--	3.10	2.60	0.26	0.16	8.50	14.6	42
B2	88-120	5.1	1.21	0.06	20.2	0.30	--	3.15	2.65	0.33	0.25	9.00	15.4	41
C	120-150	5.2	1.05	0.04	26.2	0.30	--	2.22	1.88	0.18	0.19	8.49	13.0	34
Yellow Red Podzolic Profile 8														
A1	0-10	5.1	1.13	0.13	8.7	0.20	--	8.66	9.64	0.84	0.92	11.40	31.5	63
E1	10-23	5.2	1.98	0.17	11.6	0.25	--	6.30	8.70	0.76	0.89	9.70	26.3	62
E2	23-44	5.2	0.42	0.06	6.0	0.10	--	5.24	7.76	1.18	0.95	9.80	25.0	60
B1	44-80	5.4	0.42	0.07	7.0	0.10	--	5.18	9.82	0.96	1.17	10.90	28.0	61
B2	80-125	5.3	0.16	0.04	4.0	0.10	--	3.18	10.82	0.30	0.75	6.80	21.8	68
Yellow Red Podzolic Profile 9														
A1	0-20	5.1	1.68	0.10	16.8	1.35	--	6.83	3.17	0.74	0.76	7.40	18.9	60
E1	20-35	5.3	1.84	0.09	20.4	0.35	--	8.95	4.05	0.62	0.50	7.00	21.1	66
B1	35-75	5.4	1.37	0.07	19.6	0.45	--	5.24	3.76	0.78	0.71	8.40	18.9	55
B2	75-125	5.4	0.75	0.04	18.7	0.35	--	5.24	4.76	0.84	0.72	8.30	19.9	55
B3	125-160	5.1	0.80	0.03	26.7	0.35	--	5.24	5.76	0.90	0.73	7.10	19.7	64

Table 3c

Horizon Old Classification [2]	Depth (cm)	pH 1:2 soil:water	Org.C (%)	Total N (%)	C:N	ECx10^3, 25 °C mmhos/cm	$CaCO_3$ (%)	Exchangeable cations					CEC	BS (%)
								Ca	Mg	Na	K	H		
								----------cmol.kg^{-1}----------						
Yellow Red Podzolic Profile 10														
A	0-15	5.2	13.72	0.40	34.3	0.40	--	3.12	2.88	0.92	0.81	21.60	29.3	26
E1	15-29	5.3	3.35	0.22	15.2	0.30	--	3.12	1.88	0.78	0.91	18.60	25.3	26
B	29-60	5.5	1.59	0.10	15.9	0.20	--	2.06	2.94	2.84	0.77	14.00	22.6	28
Yellow Red Podzolic Profile 11														
A1	0-25	5.3	2.22	0.15	14.8	0.30	--	4.18	2.82	0.64	0.98	8.50	17.1	50
A2	25-60	5.2	2.25	0.14	16.1	0.35	--	5.77	2.23	0.56	0.79	9.00	18.3	51
B1	60-105	5.0	1.65	0.13	12.7	0.65	--	2.06	1.94	1.70	1.18	8.30	15.2	45
B2	105-165	5.9	1.39	0.09	15.4	0.20	--	3.12	2.38	0.72	0.64	8.70	15.6	44
Yellow Red Podzolic Profile 12														
A11	0-22	5.5	3.34	0.37	9.0	0.40	--	3.12	2.88	0.80	1.13	14.30	22.2	34
A12	22-40	5.3	3.19	0.25	12.8	0.30	--	4.12	2.88	1.26	1.45	14.20	23.9	39
B1	40-73	5.2	1.51	0.11	13.7	0.20	--	3.12	2.88	0.82	0.89	10.50	18.2	40
B2	73-103	5.4	0.87	0.06	14.5	0.25	--	3.12	1.88	0.98	0.87	8.70	15.5	43
High Mountain Pasture Soils Profile 13														
A11	0-5	6.2	3.04	0.24	12.7	0.75	--	5.30	5.70	0.24	0.34	2.00	13.6	84
A12	5-15	5.8	0.45	0.07	6.4	0.25	--	5.30	6.70	2.10	0.23	2.00	16.3	87
A13	15-45	5.2	0.42	0.08	5.2	0.22	--	6.56	3.80	3.00	0.50	4.10	18.0	77