ORIGINAL ARTICLE

SOME IMPORTANT PROPERTIES AND CLASSIFICATION OF MOLLISOLS IN NORTHWESTERN TURKEY

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ABSTRACT

Mollisols have developed under xeric moisture and thermic temperature regimes in northwestern Turkey. Six soil profiles were studied in this research. The morphological, physical and chemical properties of the soils were investigated and classified according to USDA Soil Taxonomy. The examined soils were showed some variations in their morphological, physical and chemical properties as a result of differences in mean annual precipitation, parent material, topography and vegetation.

KEYWORDS: Mollisols, soil properties and classification

DETAILED ABSTRACT

Mollisols are generally non-cultivated soils in northwestern Turkey. These are under natural vegetation due to their presence on higher latitude in the region. The most common land use is forestry and various types of vegetation occurring in the research area. This research was carried out to determine some important properties of Mollisols and to classy them according to USDA Soil Taxonomy. This work was provided useful information for their proper land management. Mollisols were well developed in the 600-800 mm precipitation zone. Also, they are confined to areas of concave and convex slope. These areas are under forest vegetation and characterized by Mediterranean type of climate. The soils had high clay content and values increased with depth in all studied soils. pH of the soils is alkaline due to calcareous parent material. The soils had high CEC with the high clay content and organic matter. Profiles 1, 2 and 3 were classified as Lithic Haploxerolls and others were classified as Typic Calcixerolls according to USDA Soil Taxonomy.

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INTRODUCTION

Mollisols are mineral soils that have a mollic epipedon (dark coloured surface horizon) with a greater than 50% base saturation, or have a surface horizon that after mixing to a depth of 18 cm meets all requirements for a mollic epipedon except thickness ([9]). Mollisols have formed mostly in Quaternary materials on gentle or moderate slopes. These soils occur in a wide range of landscapes ranging from flat alluvial plains to undulating plains and mountains. These soils occur in frigid, mesic, thermic, or hyperthermic soil temperature regimes and under aquic, udic, ustic, or xeric soil moisture regimes ([2]). The formation of Mollisols is favored by semiarid to subhumid climates ([1]).

Mollisols had a grass vegetation at some time. It is generally agreed that the total amount of organic matter produced, its distribution in the soil, and relative rates of decomposition are important differences among different vegetation types and environments. The mollic epipedon is favored by grass roots in the soil of lignin content, abundant calcium and a subhumid or semiarid climate ([1]).

The accumulation of Ca-rich organic matter is the principle process in Mollisols formation. The mollic epipedon may occur in soils of other orders in addition to Mollisols. Vertisols may have mollic epipedons. Some Inceptisols also have mollic epipedons ([9]).

Mollisols are generally under natural vegetation in northwestern Turkey due to their presence on higher latitude in the region. The main objectives of this research were to characterize the soils of the area, to classify the soils according to the USDA Soil Taxonomy ([12]) and to provide information for their proper land management.

MATERIALS AND METHODS

Profiles 1, 2 and 3 have developed on hard limestone and located on convex slope between 40° 17′ - 40° 19′ N latitudes and 29° 18′ - 29° 20′ E longitudes under 600 mm precipitation zone. Profiles 4, 5 and 6 have developed on from Quaternary deposits derived from limestone and located on concave slope between 40° 07′ - 40° 10′ N latitudes and 29° 02′ - 29° 04′ E longitudes under 800 mm precipitation zone. The soil moisture and temperature regimes are xeric and thermic in the research area.

Six profiles were selected in this study. The profiles were described according to Soil Survey Manual ([10]) before taking the samples. The soil samples were analyzed for particle-size distribution by the hydrometer method ([3]), pH in a 1:2 soil:water ratio ([4]), organic matter ([5]), EC ([8]), calcium carbonate ([6]), CEC ([7]), exchangeable cations ([11]), and free iron oxides ([8]).

RESULTS AND DISCUSSION

The selected physical and chemical properties of Mollisols were presented in Table 1. The colour of all studied profiles have Munsell colour of 7.5 YR hue with value 3 to 4 and chroma 2 to 3 when moist. Clay increases with depth in all studied soils indicating active illuviation processes. The difference in clay content between the surface and the subsurface horizons in all soils account for the presence of an argillic horizon. The clay values ranged from 31.4 to 51.3% and increased with depth. The texture varied at each profile expects the profiles 2 and 3. These profiles showed same texture. Silt content decreases with depth. This is attributed to eolian accretion. pH of all the studied profiles is alkaline throughout the profiles with the highest values in the lowest horizons. The values of pH ranged from 7.9 to 8.3. The organic matter content of the soils varied from 0.73 to 2.35%. The highest values were occurred in the profiles 4, 5 and 6. These profiles developed on concave slope and under dense forest vegetation. These features enhanced the accumulation of organic matter and slowed its oxidation process, giving rise to the development of a mollic epipedon. The $CaCO_3$ values ranged from 7.2 to 25.9% and values increased with depth. The calcic horizons were occurred in the profiles 4, 5 and 6 due to accumulation of $CaCO_3$ in these profiles. EC values occurred that highest value was 0.93 dS m^{-1} at 55 cm depth in profile 2 and values ranged from 0.32 to 0.93 dS m^{-1}. This indicates that these soils are not saline. The free iron oxides varied from 0.48 to 0.84% and values decreased with depth.

Table 1: The some physical and chemical properties of Mollisols

Horizon	Depth (cm)	Sand (%)	Silt (%)	Clay (%)	Texture	pH soil: water (1:2)	O.M (%)	$CaCO_3$ (%)	EC dS m^{-1}	Free Fe_2O_3 (%)	CEC	Exchangeable cations			
												Ca	Mg	K	Na
											cmol (+) kg^{-1}				
Profile 1															
A	0-25	14.2	49.5	35.8	SiCL	8.0	1.82	12.4	0.74	0.65	33.2	25.4	5.8	1.31	0.42
Bt	25-50	13.0	38.6	48.2	C	8.2	0.90	14.1	0.86	0.52	37.4	29.6	6.1	0.89	0.45
R	50+	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Profile2															
A	0-20	11.4	56.4	31.4	SiCL	7.9	1.44	9.3	0.81	0.59	30.1	20.1	7.0	1.52	0.50
Bt	20-55	10.1	48.3	41.2	SiC	8.0	0.82	10.2	0.93	0.48	34.3	25.9	7.8	0.94	0.58
R	55+	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Profile 3															
A	0-28	19.9	45.7	32.5	SiCL	8.1	1.17	16.7	0.68	0.72	31.2	25.3	4.2	1.10	0.31
Bt	28-62	14.5	41.8	43.1	SiC	8.2	0.78	18.0	0.79	0.61	35.0	28.4	5.3	0.75	0.42
R	62+	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Horizon	Depth (cm)	Sand (%)	Silt (%)	Clay (%)	Texture	pH soil: water (1:2)	O.M (%)	$CaCO_3$ (%)	EC dS m^{-1}	Free Fe_2O_3 (%)	CEC	Exchangeable cations			
												Ca	Mg	K	Na
											cmol (+) kg^{-1}				
Profile 4															
A	0-18	25.8	41.4	31.8	CL	8.0	2.19	9.0	0.32	0.78	30.8	18.9	8.1	1.58	0.25
Btk	18-40	20.2	35.6	43.4	C	8.2	0.90	19.8	0.38	0.70	36.4	23.9	9.8	1.50	0.28
Btk1	40-62	22.7	31.3	45.2	C	8.2	---	22.4	0.42	0.65	37.0	24.3	10.5	0.82	0.30
Bk2	62-90	21.3	30.1	48.1	C	8.3	---	25.9	0.51	0.61	39.3	25.4	11.9	0.80	0.37
Profile 5															
A	0-24	16.2	44.5	38.5	SiCL	7.9	1.97	7.2	0.35	0.84	32.5	22.1	7.5	1.72	0.22
Btk	24-72	9.7	40.1	49.7	SiC	8.1	1.12	16.5	0.40	0.80	38.7	27.3	8.9	1.15	0.26
Bk1	72-95	10.6	37.6	51.3	C	8.1	---	18.8	0.47	0.72	39.9	27.9	9.7	0.92	0.31
Profile 6															
A	0-15	18.7	45.8	34.9	SiCL	8.1	2.35	10.1	0.41	0.81	31.4	20.3	7.9	1.93	0.30
Btk	15-45	11.8	41.1	46.8	SiC	8.2	0.73	19.7	0.44	0.74	36.8	24.9	10.3	1.02	0.33
Bk1	45-80	15.6	35.4	48.7	C	8.2	---	23.4	0.56	0.67	37.5	25.1	10.5	0.75	0.40

The CEC ranged from 30.1 to 39.9 cmol (+) kg^{-1} and values increased with depth. The high CEC values are associated with the clay and organic matter contents. Calcium was the most dominant extractable cation followed by magnesium. Calcium was lowest at the surface horizons and increased with depth. Magnesium is also increased with depth. Exchangeable Ca and Mg values varied from 18.9 to 29.6 cmol (+) kg^{-1} and from 4.2 to 11.9 cmol (+) kg^{-1}. K and Na values ranged from 0.75 to 1.93 cmol (+) kg^{-1} and from 0.22 to 0.58 cmol (+) kg^{-1}. Sodium increased with depth in all the studied profiles while potassium decreased with depth. The free Fe_2O_3 values varied from 0.48 to 0.84% and decreased with depth. The highest values occurred in the profiles of 4, 5 and 6. The obtained results indicated that these profiles had higher degree of development due to differences in mean annual precipitation, parent material, topography and vegetation. The profiles of 1, 2 and 3 were in low development stage. These soils developed on convex slope and under Macchie vegetation. These soils were classified according to their morphological, physical and chemical properties. The clay illuviation and calcification are the prominent process in the studied soils. Profiles 1, 2 and 3 were classified as Lithic Haploxerolls and others were classified as Typic Calcixerolls according to USDA Soil Taxonomy ([12]).

CONCLUSIONS

Mollisols were developed under xeric moisture regime and confined to areas of convex and concave slopes. These areas are natural vegetation because of the difficulty of cultivating these soils. Mollisols are non-saline and alkaline throughout the studied profiles. The high clay contents of the soils, which are attributed the high CEC with the organic matter. The some variations in their properties were occurred due to differences in mean annual precipitation, parent material, topography and vegetation.

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