THE VEGETATION'S INFLUENCE OVER THE DISTRIBUTION OF THE SOILS IN THE FOREST OF THE HILLS OF ORADEA

Sabau Nicu Cornel*, Morar (Burescu) Adriana**

*University of Oradea, Faculty of Environmental Protection, 26 Gen. Magheru St., 410048 Oradea, Romania, e-mail: nsabau@uoradea.ro
** University of Oradea, Faculty of Science.

Abstract

The main objective of this paper is the study of the existing connections between the vegetation and the type of spatial distribution of the soils in the Hills of Oradea.

The Hills of Oradea, located between the basins of Barcău, at North, and the basins of Crisul Repede, at South, represents the western extension of the Apuseni Mountains, respectively of the Plopis Mountains towards the Crisurilor Plain.

The predominant vegetation in the Hills of Oradea is holm (cvercinee) forests alternating with meadows and hay, the particular one for the agricultural land, used mainly for wine-growing and fructiferous plantations.

The main classes of soils in the forest of the Hills of Oradea are the Luvisoils on 84,7% (2093,9 ha) and the Cambisoils on 14,3 % (354,5 ha), the remain of 1 % (24,7 ha) are the Protisoils. The cernic eutricambosoils (13,2 %), the typical (62,4 %) and the stagnic (24,4 %) are making the connection between Cernisoils, which are specific for the plain areas, with steppe vegetation and Luvisoils, which are specific for the hill areas, occupied by forest vegetation.

Key words: forest soils, forest vegetation, cvercinee forest

INTRODUCTION

The Hills of Oradea represent the Western extension of the Apuseni Mountains, respectively of the Plopis Mountains towards the Crisurilor Plain. These are making the tie between the basins of Barcau, at North, where these end in terraces and the basins of Crisul Repede, at South, being delimitated at East by the Hills of Derna and Plopis, and at the West by the Crisurilor Plain.

The Hills of Oradea are separated from the Hills of Derna by the Hay Valley (Ghepisului), which appears like a wide corridor, of connection between the valley of Crisul Repede and the valley of Barcau.

The main heights have altitudes around 300m, the Hill of Demen 304 m, the Hill Miresul Mic 293 m and the Hill La Grinda 289 m.

The term of "forest soil" is a general naming, used in some soil classifications, especially in European literature, for a special class of soil, formed in the temperate climate, under forest vegetation, natural or planted. (Rogobete Gh., 2009)

The specialty literature in our country denotes by "forest soil" the soils that deal with the forestry funds of the country, including both the

areas planted with forest and those with a forest destination, such as nurseries, glades, lands destined for constructions etc. (Chiriţă C. D., 1974; Sabău N. C., et al, 1999; Sabău N. C., 2008; Moţiu P. T., 2008)

The pedogenesis of forest soils is also influenced, besides the forest vegetation, that is types of trees and grassy vegetation, by relief conditions, by climate and geological conditions, by hydrological and anthropic conditions of the area, usually referring to soils with a low depth positioned in a certain altitudinal sequence. (Geambaşu N., et al, 1997; Târziu D. R., 2006.)

Katai J. et al., 2007 and Motiu P. et al., 2008, mention the fact that the influence of forest vegetation, represented by Douglas (*Pseudotsuga menziesii*) and Sessile Oak (*Quercus petraea*), on the physical and chemical properties of a luvisoil take place through the quantity and quality of the hummus formed on the profile surface.

THE NATURAL CONDITIONS AND THE RESEARCH METHOD

Geographically speaking, the hills of Oradea are located in the European Province (I), Western Piedmonts Subprovince, The Middle Section (Crisana Piedmont).

Geomorphologically speaking, the area is located in the Geosynclinal Alp-Carpathian Province, the area of Western Piemonds (VI) very much like the Banat-Crisana type, characterized by low hills, minimum height 150 m and maximum height 360 m. (Podoleanu Doina, 2008)

The predominant landform is that of low to minimum sloped mounds, bent toward North and steep slopes toward South, in the drainage basin of Crisul Repede.

Geologically speaking, the lithological substratum in the area is part of the tectonic unity called Pannonian Hollow. This took form through the submerge of a part of the Western Carpathians during the Neozoic Era. The gradual clogging of this hollow during Pliocene and Pleistocene led to the development of the Tisa Plains, whose Eastern extension is limited by the Hills of Oradea.

In the Northern part of the hills of Oradea, the lithological substrate consists of gravel, sand belonging to the lower terrace of Barcau river and Bolin red clays formed in Neogene, Miocene-Pliocene series, Pannonian level.

In the Southern part of the area, scarcely there can be found alternations of sandy clay and grey or yellow clayey marls with sands and sandstones. In the area of the Uileacului Valley, close to the deposits of sandy clay, sands and marly sandstone, can also be found deposits of loessoide formed in Neogene, Pilocenian series, Pannonian level.

Modeled in pontic formations, (sandy clay, sands) the slopes present a big availability for land falling, as it happened in February 1999 at Burzuc, Chiorag, Almasul Mic. (Josan N. and Sabau N.C., 2004)

The Hydrographical Network is formed by a series of valleys and affluents of Barcau and Crisul Repede rivers.

The main affluents of Barcau river are: Valea Fanațelor (Hay Valley / Ghepis), Almas, Fertisag, Valea Vițeilor (Calves Valley), Canalul Vechi (The Old Channal) and Faneața Mare (The Big Hay).

Barcau's affluents advanced regressively "pushing" the water shed/balance between Barcau and Crisul Repede basins, very close to the level of the afore mentioned last river.

Crisul Repede's affluents, of less importance, because of the smaller hydrographical basins, excepting that of Crisul Mort (Dead Cris) are: Valea Sustorogi (Sustorogi Valley), Valea Rosie (Red Valley), Valea Rea (Bad Valley), Valea Husasau (Husasau Valley), Valea Seaca (Dry Valley), Valea Balaii (Fair's Valley), Valea Uileacului (Uileac Valley) and Poposeala brook.

All these valleys and brooks have both a pluvial and a nivala supplying regime, being part of the I type of the hydrological regime, which is characterized by abundant waters during spring time, and after pouring rains even with freshets during summer, even if in the periods with no precipitation they are dry.

Because of the land's fragmentations, the groundwater of the interfluves can be found at great depths except for the meadows.

From a ***climatical*** point of view the Oradea Hills are characterized by a temperate-continental climate with oceanic influences.

Taking into account that the analyzed area makes the separation between hydrographical basin of Barcau and that of Crisul Repede, the climate can be analysed with the help of the data recorded at the Oradea and Sacuieni Bihor meteorological stations. (Serban Eugenia, 2010)

Being positioned front of the humid masses of air from the West of the continent, the habitat which is taken into the account knows a large climatical space-time variability, also determined by the local geographical conditions, by the disposal of the relief and by the hydrographical network. (Dumiter Aurelia, 2007)

The annual average quantity of the precipitations in the Hills of Oradea is around 600 mm, in Oradea being registered 585,4 mm, while at Sacuieni Bihor 625,6 mm. The multiannual average temperature, registered in Oradea is of 10,4 ºC, temperature which goes at Sacuieni-Bihor as low as 10.3 ºC.

The general characterisation of the ***vegetation*** in the Hills of Oradea is given by the presence of Holm (cvercinee) forests in alternation with the meadows and agricultural lands. (Morar Adriana, 2011)

The forests occupy more than 60 % of the territory, and their plant formations are subordinated to the associations: *Carpino-Făgetum* Paucă 1941, *Querco robori-Carpinetum* Borza 1937, *Querco petreae-Carpinetum* Soó et Pócs 1938, *Carpino-Quercetum cerris* Klika 1938, *Tilio tomentosae-Quercetum dalechampii* Sârbu 1979, *Querco roburi-petraeae* Borza (1928) 1959, *Petraeo-Fagetum* Scamoni (1956) 1959, *Quercetum petraeae-cerris* Soó 1963, *Tilio argenteae-Quercetum petraeae-cerris* Soó 1957, *Poligono latifolio-Quercetum roboris* (Hargitai 1940) Borhidi 1966 in Borhidi et Kevey 1996, *Quercetum frainetto-dalechampii* Bârcă 1984 Chifu et al., 2006.

The meadows occupy around 15% of the territory, the following associations being identified: *Anthoxantho-Agrostietum capillaris* Sillinger 1933, *Festuco rubrae-Agrostetum capillaris* Horvat 1951, *Thymo comosi-Festucetum rupicolae* Pop et Hodişan 1985, *Agrostio-Festucetum valesiacae* Borisavljevic şi colab. 1955, *Poterio-Festucetum valesicae* Danon 1964, *Festuco valesiae-Danthonietum calycinae* Boşcaiu 1972, *Filagini-Vulpietum* Oberdorfer 1938, *Vulpio-Airetum capillaris* Paucă 1941, *Xeranthemetum cylindracei-Brometum arvensis* Popescu 1992, *Bromo squarrosi-Xeranthemetum annui* Coroi 2001, *Clinopodio-Pteridietum aquilini* Dihoru 1975.

The agricultural lands are mainly used for wine and fruit growing, especially on the southern slopes and less for field crops, these being located primary on plateaus and slight slopes from the North-Western areas.

The mapping of the soils from the forest content of the Hills of Oradea was accomplished by the Institute of Research for Forest Arrangements Bucharest (ICAS), Oradea branch. The physical and chemical proprieties of the analysed sections were determined in agreement with the methodology recommended by the Institute of Pedological and Agrochemical Research (ICAP) Bucharest. (Florea N. et al, 1987)

RESULTS AND DISSCUSIONS

For the conditions of the Hills of Oradea, where a large range of pedogenetic factors are manifested (relief, hydrography, hydrology, climate, vegetation, parental material, anthropography), the forming process of the soils led to the forming of a very large diversity (a real mosaic) of soils. (Fig. 1)

Besides the listed factors, the particular conditions of microclimate and microrelief helped the formation of soil. Therefore, for a difference of altitude of 200 meters as it represents the difference between Crişurilor

Plaine's share and the highest share of Oradea's Hills, we have soils from Cernisoils (Faeoziom) classes, Cambisoils (Eutricambosol), Luvisoils (Preluvosoil, Luvosoil, albic Luvosoil) and Protisoils (Regosoil and Aluviosoil).

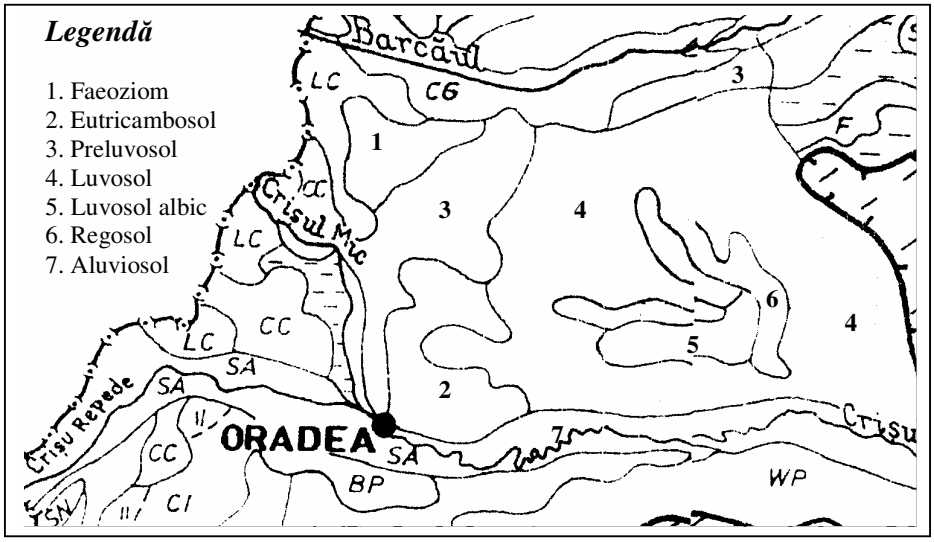

Fig. 1 The sketch of the main soil types of Oradea's hills.
(after Asvadurov, cited by Burescu P., 2003)

The Faeozioms (SRTS), former cernoziomoide soils (SCSR) were reported in Oradea's Hills, on small surfaces, by N. Barbu, 1993 in the luvisoils area of hardwood forests, this is given by the fact that they occupy areas with slopes, from plain to hilly, on former meadows or forested areas from woodland meadows current exploited.

According to the forest management plans of the production units UP I Şiştirea, UP II Husasău and UP III Ineu de Criş, administered by Oradea Forest, the forest from Oradea's Hills has an area of 2473,1 ha. (Table 1)

If in the Highlands, the main classes of forest soils encountered in our country are Cambisoils, Luvisoils and Spodisoils (Rogobete Gh., 2009), in the foothills of Oradea we meet only two classes of soils: Cambisoils and Luvisoils.

The Luvisoils being specific for the area of forest soils of Holm oak and oak and hilly relief are prevalent, occupying 84,7 % (2093,9 ha) from the area of forest fund while Cambisoils-specific to the forest steppe zone takes 14,3 % (354,5 ha) and the rest of 1 % (24,7 ha) remains to Protisoils, young soils whose evolution is not influenced by climate conditions.

Table 1

Classes, types and sub-types of forest soils of the hills of Oradea (original)

Nr. crt.	Class of Soils	Type of Soil	Sub type of Soil	Surface	
				Ha	%
I.	Cambisoluri	Eutricambosol	typical	221,3	62,4
		Eutricambosol	cernical	46,8	13,2
		Eutricambosol	stagnical	86,4	24,4
			Total	354,5	14,3
II.	Luvisoluri	Preluvosol	typical	496,7	23,7
		Preluvosol	cernical	479,5	22,9
		Luvosol	typical	164,3	7,8
		Luvosol	stagnical	752,9	36,0
		Luvosol	vertical	7,3	0,3
		Luvosol	albical	39,0	1,9
		Luvosol	albic-stagnical	6,3	0,3
		Alosol	typical	147,9	7,1
			Total	2093,9	84,7
III	Protisoluri	Aluviosol	cernical	19,3	78,1
		Regosol	typical	5,4	21,9
			Total	24,7	1,0
			TOTAL	2473,1	100

Among **Cambisoils**, the Typical Eutricambosoil has the largest spreading (62,4 %) followed by Stagnical Soil (24,4%) and Cernical Soil (13,2 %).

The ***Eutricambosoils*** are making the transition from the Plains, with specific vegetation of steppe (Agrostio-*Festucetum valesiacae; Anthoxantho-Agrostietum capillaries)* to the area of hills, with specific vegetation of forest (Querco *robori-Carpinetum; Poligono latifolio-Quercetum roboris)* occupying the Western and South-Western part of the analyzed area.

The cernical Eutricambosoils generally occupy areas close to plain or herbaceous vegetation enclaves forests, being the most fertile in this category. The typical Eutricambosoils occupy steeper slopes, while the Stagnical soils occupy plateau areas, with poor natural drainage, from steppe area.

The analyzed Eutricambosoils have on surface an acid reaction (pH = 5,8) which passes from the profile base (basis) into a neutral reaction (pH = 7,0), being formed on rocks with a basic character, chalks, dolomites and limestone conglomerates, which makes the degree of saturation in bases to be more than 55 %. The humus content is between 7,2 % on surface, reducing the lower horizons, reason why they are well supplied with a total nitrogen on surface (0,35 %) and very poor supplied in depth (0,003 – 0,07 %).

The most representative **Luvisoils** of the studied area are: Preluvosoils and Luvosoils (each occupies half of the surface: 46,6 %-46,3 %) and the rest (7,1 %) is taken by Alosoil. For these types of soil, the following plant associations are specific: *Quercetum petreae-cerris, Tilio argenteae-Quercetum petraeae-cerris, Querco petreae-Carpinetum, Petraeo-Fagetum and Carpino-Fagetum.*

The **Typical Preluvosoil** found in the North-West side of Oradea Hills, on terraces and slopes slightly inclined, on clayey parental materials presents a medium texture on the surface, which passes from clayey to the profile basis. (Table 2).

Table 2

Some chemical properties of typical Preluvosoil from Oradea's Hills (after Oradea's Forest management plans U.P I Şiştirea , U.P II Husasău and U.P III Ineu de Criş)

Nr. crt.	Hori-zon	Depth (cm)	pH (H_2O)	Humus (%)	Base amount (me/100g)	Exchange capacity	Base saturation V (%)	Total Nitrogen (%)
1.	Ao	0-3	4,89	8,95	34,00	49,00	39,39	0,459
2.	Ao/Bt	3-15	4,72	3,64	18,60	36,98	50,30	0,187
3.	Bt	15-75	5,35	0,91	20,00	26,90	74,35	0,047
4.	C	75-105	5,59	0,11	26,00	31,25	83,20	0,005

The moderately weak acid reaction (pH = 4,72 - 5,59), the high humus content on the profile's surface (8,95 %) and the weak in depth (0,11 %) and the degree of saturation in base (50 – 83 %), except for the Ao horizon the good supply with nutritive elements (nutrients) indicate a soil with medium to high trophicity.

The ***Cernical Preluvosoil*** occupies the same areals as the typical preluvosoil, but evolves predominantly under the influence of herbaceous vegetation, specific to pastures and hayfields, reason why on the profile surface it presents an A molic horizon (Am) gray - black in color, because of the accumulated humus, of mull type saturated with calcium ions, qualitatively superior.

The ***Luvosoil*** occupies the forested areas, with gentler slopes than those from the area of preluvosoils or from the higher plateau areas in the Eastern hills of Oradea.

The ***Typical Luvosoil*** is formed of various parental materials: clays, clays alternating with sandstone, sericite shales, usually basic, on slopes with frequently shaded exhibitions and very low slopes that tend toward plateaus.

The reaction is neutral on the surface and slightly acid on the basis of the profile (pH = 7,26 - 6,42) with an extra - acidity in the El luvic eluvial horizon, where it is moderately acid. (Table 3.) The humus content on the surface, of 4,74 %, indicates a moderate humifer soil, reducing its depth,

reaching levels of 0,56 % parent material. Total nitrogen, with a maximum in the Ao bioaccumulation horizon of 0,243 %, is reduced in the parental material to 0,029 %.

Table 3

Some chemical properties of typical luvosoil from Oradea's Hills (after Oradea's Forest management plans U.P I Şiştirea, U.P II Husasău and U.P III Ineu de Criş)

Nr. crt.	Horizon	Depth (cm)	pH	Humus (%)	Base amount (me/100g)	Exchange capacity	Base saturation V (%)	Total Nitrogen (%)
1.	Ao	0-10	7,26	4,74	26,60	29,98	88,74	0,243
2.	El	10-25	5,13	2,63	14,00	25,03	55,94	0,135
3.	Bt	25-50	6,61	1,90	17,60	22,63	77,79	0,097
4.	C	50-90	6,42	0,56	16,60	21,85	75,97	0,029

Compared with the typical luvosoil, the stagnical luvosoil occupies the high plateau areas, where the precipitation accumulation stagnates over the accumulation horizon of Bt argic clay, the vertic luvosoil presents an inflatable clay in this horizon and the albic luvosoil is characterized by a higher intensity of the iluviation process of the clay because of their formation on clay deposits poor in basic elements.

The ***typical and stagnant alosoil*** is a type of soil newly introduced by the Taxonomic system of the Romanian Soils, in 2002 (STTS), which occupies the highest areas of the forest, having acid properties, imprinted by the aluminum ions from the foils of the layered clay minerals.

The ***Protisoils***, an underrepresented class, includes soils (Aluviosoil and Regosoil) whose evolution is not directly influenced by the pedoclimatic conditions of the area considered, being young soils whose development of bioaccumulation of organic matter horizon is prevented for some reasons.

The **alluvial soil** is a young soil, formed on fluviatile deposits, whose evolution is obstructed by the repeated floods, which frequently bring to the profile's surface fresh alluvia.

The **alluvial cernic soil** has been identified on 49 acres in the alluvial plain areas of the major valleys and creeks, being covered by grasslands and meadows.

The **regosol** has its A bioaccumulation horizon weakly developed, due to the fact that its evolution is being obstructed by the hydric erosion of the versants. The regosoil and the eroded soils can be found in patches, especially on the versants with high cliffs, on the watersides with landslides, like in the case of the versants with southern exposure in the Crisul Repede river basin, especially in the areas without forestial vegetation, on a 13 acres area.

Due to the natural environment where it is situated, it has weakly represented vegetation by xeromesophyle species *Poterio-Festucetum valesicae, Filagini-Vulpietum, Vulpio-Airetum cappilaris, Xeranthemetum cylindracei-Brometum arvensis* and *Bromo squarrosi-Xeranthemetum annui*, or are practically without any vegetation.

CONCLUSIONS

The specific vegetation of Oradea's Hills is given by the presence of Holm (cvercinee) forests (*Querco robori-Carpinetum, Querco petreae-Carpinetum, Quercetum petraeae-cerris, Petraeo-Fagetum, Tilio argenteae-Quercetum petraeae-cerris* and *Carpino- Fagetum*) alternating with grasslands (*Agrostio-Festucetum valesiacae, Anthoxantho-Agrostietum capillaris* and *Thymo comosi-Festucetum rupicolae*), furthermore meadows and lands used in agricultural purposes, especially vineyards and orchards.

The main soil classes in Oradea's Hills' growing stock are Luvisoil on 84,7 % (5174 acres) and Cambisoil on 14,3 % (875 acres), the rest of 1 % (60 acres) is Protisoil; these are young types of soil, whose evolutions is not being influenced by the pedoclimatic conditions.

Among the Cambisoils, the soft (13,2 %), the typical (62,4 %) and the stagnic (24,4 %) Eutricambosoil make the connection between different types of Cernisoil, specific to the plain area, with steppe vegetation and Luvisoil, specific to the hill area, covered with forest vegetation.

The Regosol from the class of Protosoil, even though it expands only on small areas of the growing stock, about 13 acres, spread in spots, due to the manifestations of the hydric erosion phenomena requires anti-erosion works, ultimately afforestation being recommended.

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