CHEMICAL PROPERTIES OF FOREST SOILS FROM BIHOR COUNTY

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Abstract

The aim of this paper is to realize a description of forest soils from Bihor County, on the basis of the soil analysis data from forest management plans made in the period 1988-2015: 474 soil profiles and 1240 pedo-genetic horizons. The common types of forest soils from this area are luvisols (moderately acid soil, with a high total cationic exchange capacity, well supplied with nitrogen and intensely humiferous), eutric cambisols (moderately acid, mesobasic, with a very high total cationic exchange capacity, well supplied with nitrogen and moderately humiferous), dystric cambisols (strongly acid, oligomesobasic, with a high total cationic exchange capacity, very well supplied with nitrogen and intensely humiferous) and preluvisols (moderately acid, mesobasic, with a high cationic exchange capacity, well supplied with nitrogen and moderately humiferous).

Key words: forest soils, dystric cambisol, eutric cambisol, luvisol, humus

INTRODUCTION

There are numerous definitions for the term "soil", but not one that is generally accepted. As such, Hilgard (1914), defines soil as a more or less mellow and friable material from which plants, through their roots, are extracting food and which ensures growth conditions for plants. This definition is only one from the many definitions that consider soil as a mean of vegetal production.

From another point of view, the soil represents a fundamental natural resource that is essential for economy, human wealth and especially for the environment. As such, in order to have a lasting economy, while improving at the same time the environment's quality, is necessary to study very well soils, so that they can be better understood in regard with their properties, functions, ecological roles and their management (Brady, Weil, 2016).

Knowing the characteristics of forest soils is a necessity for their well management and in order to identify the site conditions in which forests from a certain area are developing (Târziu et al., 2004; Spârchez et al., 2011). The purpose of the present paper is to describe and present the characteristics of soil types identified in Bihor Forest County.

MATERIAL AND METHOD

Bihor County is situated in the North-West part of Romania, having all the types of relief units: fields (West Plain), hills (West Hills) and mountains (Plopișului Mountains, Pădurea Craiului, Bihor and partially Vlădeasa Mountains). The altitude ranges from 90 m (Ateaș – Cefa area) to 1849 m in Bihorului Mountains.

The total area of Bihor County's forest fund is of 208.730 ha. Bihor County Forest Administration currently (the situation for 31 December 2015) manages an area of 115.120 ha forest fund, from which 61.660 ha are public state forests, and 53.460 ha belong to different private owners (local councils, associations, learning and cultural institutions, physical persons).

The forest fund (public state property) of Bihor County Forest Administration is composed of forests with special protection functions in a percentage of approximately 47% and forests with protection and production function in a percentage of 53%. (www.rosilva.ro).

The present paper has analyzed the soil samples gathered in the period 1988-2015 from 10 Forest Districts from Bihor County Forest Administration. A silvicultural management plan is realized for each forest district once every 10 years. During this plan, among other actions, soil samples from certain characteristic parcels are gathered and the soil type is determined based on its physical-chemical properties. These analyses are realized based on renowned national and international methodologies (Dincă et al., 2012). The present paper is based on the analyses realized for 474 soil profiles and 1240 pedo-genetical horizons.

RESULTS AND DISCUSSION

Types of soil from Bihor County

The most widespread types of soils are the ones from Cambisoil and Luvisoil classes, which occupy each 42% from the total county's soils surface. As type of soils, the most widespread is luvisol (25%), followed by eutric cambisol (22%), dystric cambisol (20%), preluvisol (17%) and entic podzol (5%), (Fig. 1). Other type of soils (alosols, fluvisols, phaeozems, gleyosols, arenosols, dystric leptosols, rendzic leptosols) represent 11% from the region's total forest soils.

At the country's level, dystric cambisol occupies the 1st place as spread in forest soils (2.292.35 ha, meaning 35%), luvisol the 2nd place (1.440.052 ha, meaning 22%), eutric cambisol occupies the 3^{d} place (with a total area of 869.909 ha, meaning 13%), and preluvisol the 5th place (335.050 ha, meaning 5%), (Dincă et al., 2014).

In the agricultural area of Bihor County, Venig and Rusu (2008) are mentioning the result of a large population of soils (10 types of soils), in

close relation with the variety of geomorphologic and geolitic factors which lead to a great diversity of parental materials, as well as of the various anthropic interventions. The most important soils amongst these 10 types are: luvisols 31,8%, preluvisols 11,1%, eutric cambisols 10,9%, fluvisols 7,6%, chernozems 6,8%.

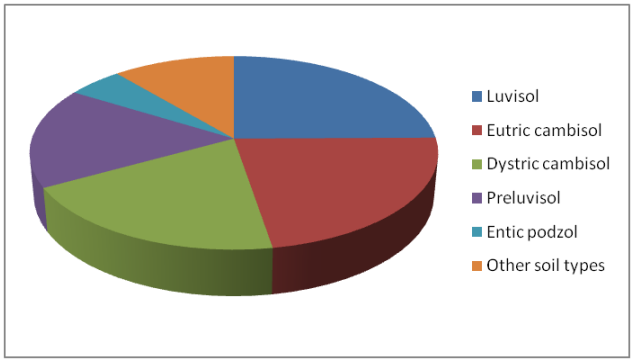

Fig. 1. The percentage of forest soils identified in Bihor County

Furthermore, the County's agricultural area (Borza et al., 2007) shows that the most widespread soils are: luvisols (28.8%), chernozems (17.58%), fluvisols (10.63%), phaeozems (5,47%).

Soil solution reaction

In general, it is admitted that the soil's pH plays a central role in determining the soil's general microbial community composition. As such, in the case of a low pH, mushrooms are favored to the detriment of bacteria, while in the case of a high pH, the bacteria is favored to the detriment of mushrooms (Alexander, 1977). The soil's reaction (pH) presents an extremely importance both for the soils characterization as well as for the agricultural practice.

The soil's solution reaction (pH) was calculated differentially on pedogenetic horizons for the most widespread types of soils (Fig. 2). Dystric cambisol has an average pH of 4.33 in the Ao horizon and 4.62 in Bv, being a strongly acid soil, while eutric cambisol registers 5.48 in Ao and 5.69 in Bv, being a moderately acid soil. Preluvisol has an average pH in the Ao horizon of 4.88 (strongly acid) and 5.32 in Bt horizon, while luvisol registers 5.12 in Ao, 4.96 in El and 5.38 in Bt - moderately acid. However, entic podzol is a very strongly acid soil in the Aou horizon (pH=3.76) and strongly acid in Bs (pH=4.45).

Crișan et al. (2017) have identified for forest soils from Giurgiu district a pH of 5.53 in the A ocric horizon, 5.33 in the E luvic horizon and 5.68 in B argic for luvisols and 5.62 in Ao and 5.85 in Bt for preluvisols.

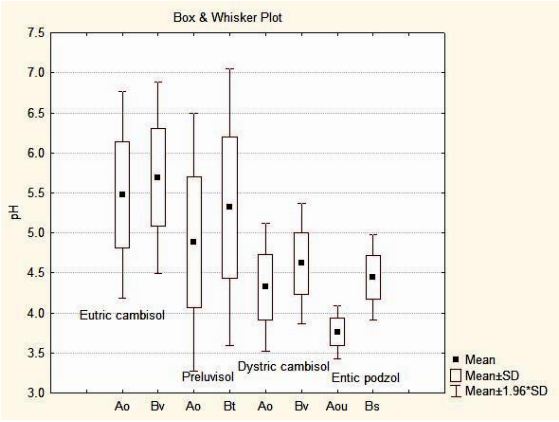

Fig. 2. pH variation of genetic horizons for the most widespread forest soils from Bihor county

Tirpe Gh. and Tirpe O.P. (2008) have found some modifications of the physical and chemical preluvisols indices from Oradea, affected by the secondary compaction.

Degree of base saturation

The degree of base saturation is one of the soil's most important chemical indicators, which is strongly correlated with the soil's reaction. The values of this indicator are determined either by calculation in the case of acid soils - as a percentage report between the content of exchangeable basis (SB, me/100g sol, determined through the Kappen method) and the total cationic exchange capacity ($T_{8.3}$ = SB + $A_{8.3}$) - , either by determining T_{Na} (Bower method), in the case of alkaline soils.

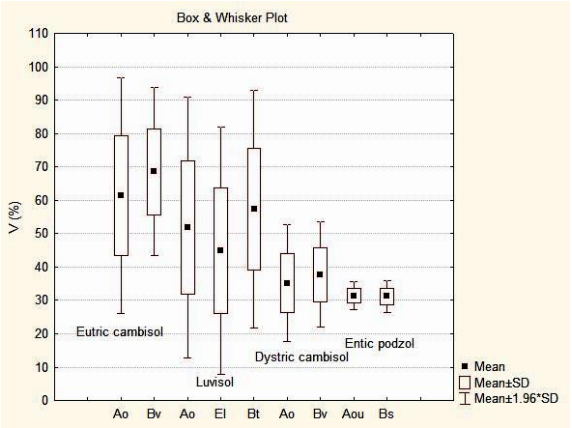

Fig. 3. Base saturation degree variation for the most widespread soils from Bihor County

Based on these parameter, dystric cambisol and entic podzol are oligomesobasic, luvisol is oligomesobasic in Ao and El and mesobasic in

Bt, preluvisol is oligomesobasic in Ao and mesobasic in Bt, while eutric cambisol is mesobasic (Fig. 3). The largest variation of this parameter is registered for luvisol, while the lowest is for oligomesobasic soils.

Luvisols were formed in a late glacial era and include soils with a well differentiated profile, characterized by the presence of an argic B horizon (Bt), with the exception of those soils that are belonging to Molisoils and which have a relatively weakly expressed Bt horizon. Luvisols can or cannot have eluvial B horizon (Bullock, Murphy, 1979; Van Vliet-Lanoe, 1998).

Total cationic exchange capacity

The total cationic exchange capacity (T) was determined through the Bower method and was calculated for each type of soil as an average profile value (Table 1).

Table 1

Total cationic exchange capacity and average humus and nitrogen content for forest soils from Bihor County

Eutric cambisol	Dystric cambisol	Preluvisol	Luvisol	Entic podzol
Total cationic exchange capacity per type of soil (T-me 100 g^{-1} sol)				
25.46	17.13	20.83	24.22	16.70
Average humus content in the A horizon (H-%)				
4.23	7.07	4.55	5.26	8.52
Average nitrogen content in the A horizon (%)				
0.25	0.36	0.26	0.29	0.44

Eutric cambisol has a very large cationic exchange capacity, while all the other soils have a large exchange capacity (Fig. 4). Dincă. and Cântar (2017), have identified a cationic capacity of 20.23 for the forest entic podzol from Caraș County.

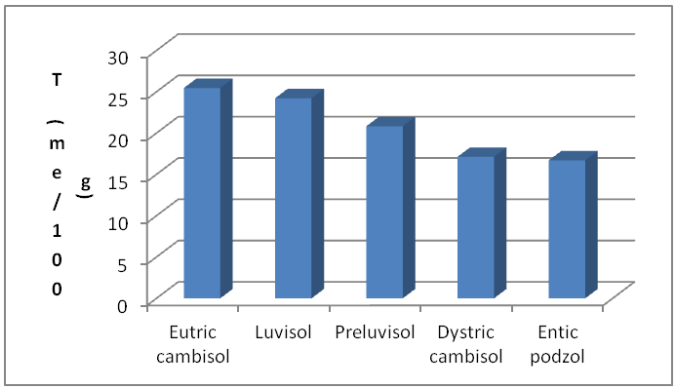

Fig. 4. The variation of total cationic exchange capacity for the most widespread forest soils from Bihor County

Humus

Humus is a soil's specific fundamental constituent representing an important soil ecological determinant and executing physical, chemical and trophic functions (Chiriță, 1974). In aerobiosis conditions, different forms of humus are formed (calcic mull, acid mull, moder mull, moder, raw humus), while in an anaerobic environment, turf and anmoor are formed (Duchaufour, 1970, quoted by Chiriță, 1974).

The humus content (H, %) was determined through humid oxidation (the Walkley – Black method) for each type of identified soil from the A horizon (Table 1, Fig. 5). Eutric cambisol and preluvisol are moderately humiferous soils, while luvisol, dystric cambisol and entic podzol are intensely humiferous soils. The quantities of humus from this county are similar with the average values calculated for forest soils for the entire country (Dincă et al., 2012).

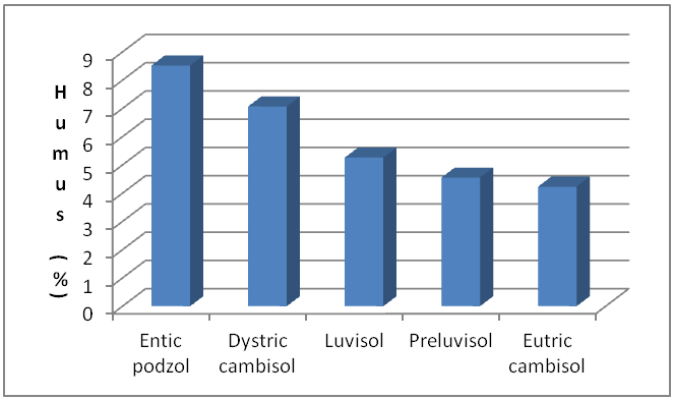

Fig. 5. The variation of humus content for the most widespread forest soils from Bihor County

Nitrogen

Amongst nutritive macro elements, nitrogen has a special importance for the plant's nutrition, being a basic constituent for vegetal mass and being part of the protein's composition (approximately 17%). In accessible forms, it is exposed to loss by fixing as NH_4 in clay minerals, through immobilization in micro-organisms and through emission in atmosphere and especially through elutriation as nitrates.

Like the humus, the nitrogen was also calculated only for the first horizon, the two elements accumulating by the decomposition of the organic matter at the surface and in the first centimeters of the soil's profile. The largest quantity of nitrogen is accumulated for entic podzol, followed by dystric cambisol. The two types of soils are very well supplied with nitrogen, while the other soils are well supplied with this element. Dincă

and Cadar (2017), have found in the first horizon an average nitrogen quantity of 0.21% at preluvisoils and 0.19% at forest luvisols from Vaslui County.

CONCLUSIONS

Bihor County has a territory widespread both in the field area, as well as the hill and mountain ones, having as such specific forest soils for these three relief forms: phaeozems and preluvisols in the field area, luvisols and eutric cambisols at the hill area and dystric cambisols and entic podzols for the mountain area. Soils specific to certain conditions can also be found in this county: arenosols on sandy fields, fluvisols in the river's meadow, rendzic leptosols on calcium substrates. Four type of soils have an almost equal spreading in the forests of this county: luvisols, eutric cambisols, dystric cambisols and preluvisols.

Eutric cambisols from Bihor County is moderately acid, mesobasic, with a very high total cationic exchange capacity, well supplied with nitrogen and moderately humiferous. Dystric cambisols are strongly acid, oligomesobasic, with a high total cationic exchange capacity, very well supplied with nitrogen and intensely humiferous. Preluvisols are moderately acid soils, mesobasic, with a high total cationic exchange capacity, well supplied with nitrogen and moderately humiferous. Luvisols are moderately acid soils, with a high total cationic exchange capacity, well supplied with nitrogen and intensely humiferous. Entic podzols are very strongly acid, oligomesobasic, with a high total cationic exchange capacity, very well supplied with nitrogen and intensely humiferous. Generally speaking, the dominant soils from Bihor County Forest Administration are moderately acid, with a high and very high total cationic exchange capacity, are moderately and intensely humiferous and are well supplied with nitrogen.

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