THE CHARACTERISTICS OF FOREST SOILS FROM COVASNA COUNTY

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Abstract

Forest soils represent an important resource for Covasna County, characterized by a large surface of both private and national forests. The forest soils (that differ from agricultural soils) were analysed based on the following chemical characteristics: soil's solution reaction, base saturation degree, humus and total nitrogen content and the total cationic exchange capacity. A total number of 15 soil types were analysed in Covasna County. The most widespread ones are eutric cambisol and dystric cambisol, which cover together 77% of the surface. At the same time, the most acid soils are entic podzols, while the most alkaline are rendzic leptosols. The majority of soils are mezobazic, moderately or intensely humiferous, well and very well supplied with nitrogen. Entic podzol has a very large cationic exchange capacity, while all other soils have high capacities. The chemical characteristics of forests soils from Covasna County are favourable to forest vegetation, a fact that can be observed by the stands' productivity.

Key words: forest soils, eutric cambisol, dystric cambisol, humus, base saturation degree.

Covasna County is located in South-East Transylvania, in the internal part of the Curvature Carpathians (*figure 1*). The County is characterised by a complex geomorphologic structure, with mountain and basin areas, while the climate is moderate, with hot summers and frosty winters. The flora and fauna are very varied (https://ro.wikipedia.org/wiki/Jude%C8%9Bul_Covasna).

Figure 1 **Location of Covasna County** (source: www.pe-harta.ro)

The forests from this county are private forests (144.740 ha) and national forests (28.259 ha), being managed by the National Forest Administration. Their composition is represented by resinous species (40% Norway spruce, 6% fir) and broad-leaved species (34% common beech, 7% oak forests (http://www.rosilva.ro/unitati_silvice/covasna__1_14.htm).

Forests soils have some properties that differentiate them from agricultural soils (Edu *et al*, 2013; Dincă *et al*, 2018; Oneţ *et al*, 2019a; Oneţ *et al*, 2019b). The purpose of this study is to analyse the chemical properties of forest soils located in this county.

MATERIAL AND METHOD

The material for this article was represented by soil analysis present in the database from "*Marin Dracea*" National Institute for Research and Development in Forestry, Brasov. Data regarding eight forest districts during 1992-2017 were extracted from here (***Forest management plans).The large number of soil profiles (489) and pedo-genetic horizons (1502) ensures a good representation of the obtained results.

The soil analyses were realized based on the following national and international recognized methods (Dincă L. *et al*, 2012): the potentiometric method was used for determining soil pH, while a Thermo Orion 3 pH-meter was used for their reading; the humid oxidation method was used for

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establishing the humus and the Walkley-Black-Gogoasa method for the titrimetric dosage; the humid mineralization method was used for determining the total nitrogen, while the Kjeldahl method with automatic analyser was used for the titrimetric dosage.

RESULTS AND DISCUSSION

Covasna County records **15 soil types**: leptosol, fluvisol, rendzic leptosol, phaeozem, preluvisol, luvisol, eutric cambisol, dystric cambisol, andosol, entic podzol, haplic podzol, podzol, humic umbrisol, gleysol, and histosol. Eutric cambisol and dystric cambisol are the most widespread soils, covering 77% of the total surface of forest soils from this area (*figure 2*).

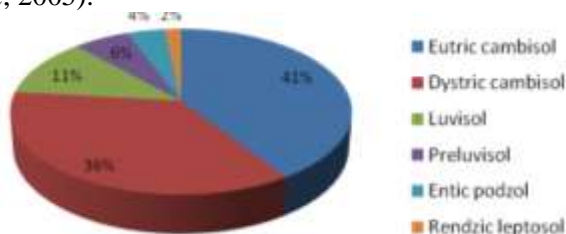Pamic Luvisols are characteristic for Reci, a protected area from Covasna County (Băcăinţan *et al*, 2005).

Figure 2 **Types of forest soils from Covasna County**

Soil solution reaction

pH, or soil solution reaction, was calculated separately for each type of soil and on pedo-genetic horizons (*figure 3*). The lowest pH values were recorded for entic podzols in the surface horizon (Aou, pH= 3.88), while the highest values were registered for rendzic leptosol in the A/Rn horizon (pH=8.26). Rendzic leptosol is weakly alkaline, eutric cambisol, luvisol and preluvisol are moderately acid, while distric cambisol is strongly acid in Ao and moderately acid in Bv, and entic podzol is very acid in Aou and strongly acid in in Bs.

Similar acid values for forest eutric cambisol were also obtained in Timis (Crişan *et al*, 2017), and Cluj counties (Enescu *et al,* 2017).
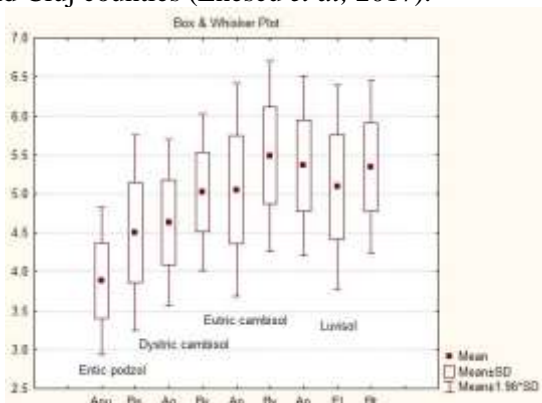

Figure 3 **pH of forest soils from Covasna County**

Base saturation degree

As for pH, the base saturation degree (V) was analysed for each soil type and on pedo-genetic horizons (*figure 4*). The sequencing of soils from this area based on their base saturation degree is the following, from the smallest to the highest: entic podzol (oligobasic), dystric cambisol (oligomesobasic), eutric cambisol (mesobasic), preluvisol (mesobasic), luvisol (mesobasic in Ao and El and eubasic in Bt), rendzic leptosol (eubasic).

The preluvisol from Bihor has the following average V values for dystric cambisol: 35.17 in the Ao horizon and 37.73 in Bv (Dincă *et al,* 2017), while in Bacau the values reach 40.47 in Ao and 40.18 in Bv (Crişan *et al*, 2019).
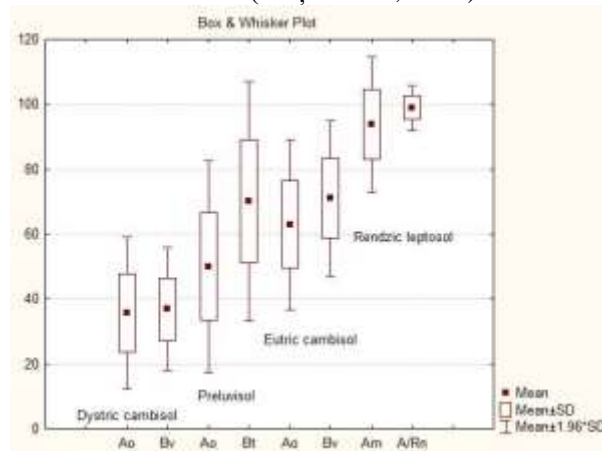

Figure 4 **Base saturation degree for forest soils located in Covasna County**

Humus

Humus is a characteristic that defines numerous forest soils and is generally calculated and interpreted only for the first horizon. In the case of forest soils from Covasna County, we can see that rendzic leptosol and preluvisol are moderately humiferous, while luvisol, eutric cambisol, dystric cambisol and entic podzol are intensely humiferous (*table 1*).

Dystric cambisol from Piatra Craiului National Park are also intensely humiferous (Edu *et al*, 2012), while entic podzol from Brasov are also intensely humiferous (Enescu *et al*, 2019).

Table 1
Average humus and nitrogen contents and the total cationic exchange capacity for forest soils from Covasna County

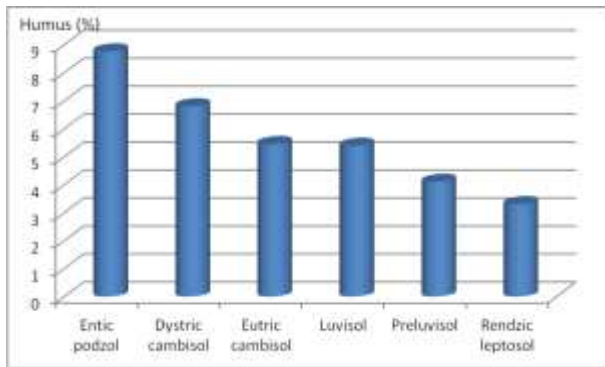| Rendzic leptosol	Dystric cambisol	Eutric cambisol	Preluvisol	Luvisol	Entic podzol
Humus (%)					
3.30	6.80	5.45	4.10	5.39	8.76
Total nitrogen (%)					
0.17	0.33	0.26	0.21	0.44	0.43
Capacitatea total de schimb cationic (T-me 100 g^{-1} sol)					
24.92	20.63	21.3	21.4	19.18	26.28

Figure 5 **Variation of humus quantities for the most widespread forest soils from Covasna County**

The largest humus quantities were found in the first horizon of entic podzol, while the lowest ones were recorded for rendzic leptosol (*figure 5*).

Total nitrogen

The soil's nitrogen content is correlated with humus so that the ordering of soils from Covasna County respect the humus one (*table 1*), with luvisol being the richest soil in total nitrogen and rendzic leptosol the poorest one.

Total cationic exchange capacity (T)

An important soil characteristic, the total cationic exchange capacity was calculated as an average of all recorded values for a certain soil, regardless of their pedo-genetic horizon. As it can be seen (*table 1, figure 6*), entic podzol has a very large cationic exchange capacity, while all soils record a high capacity. Even though significant differences were not recorded between T values, the soils' hierarchy from this point of view is a little changed: entic podzol, rendzic leptosol, preluvisol, eutric cambisol, dystric cambisol, luvisol.

Luvisoils have recorded an average T of 24.51 in the West Plain (Dincă *et al*, 2019) and 24.87 in Dobrogea Plateau (Crișan *et al*, 2020).
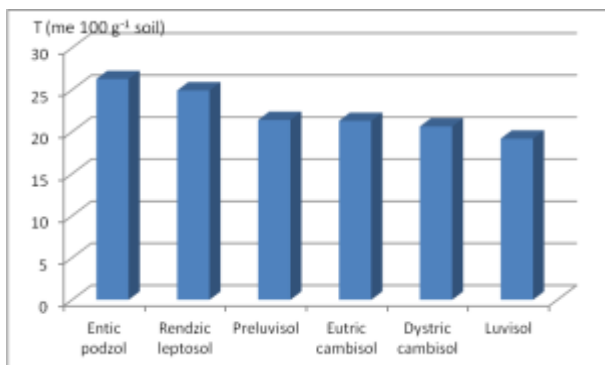

Figure 6 **Variation of total cationic exchange capacity for the most widespread forest soils from Covasna County**

CONCLUSIONS

Forest soils characteristic for Covasna County are eutric cambisol and dystric cambisol, which cover together 77% of the total surface, being followed by luvisol, preluvisol, entic podzol and rendzic leptosol.

Eutric cambisol is a moderately acid soil, mesobasic, intensely humiferous, with a high total cationic exchange capacity and well supplied with nitrogen.

Dystric cambisol is a strongly acid soil in Ao and moderately acid in Bv, oligomesobasic, intensely humiferous and very well supplied with nitrogen.

Luvisol is a moderately acid soil, mesobasic, intensely humiferous, with a high total cationic exchange capacity and very well supplied with nitrogen.

Preluvisol is a moderately acid soil, mesobasic, moderately humiferous, with a high total cationic exchange capacity and well supplied with nitrogen.

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