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The predominant forest soils from Timis Forest Administration County

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Abstract The aim of this paper is to realize a description of forest soils from Timis County. The work material is represented by soil analysis data from forest management plans made after 1980. These data are part of a huge national database performed by „Marin Dracea" National Institute for Research and Development in Forestry (INCDS). The analysis material for this study was represented by 395 soils and 1162 soil genetic horizons from Timis County. This area's relief is composed predominantly of plains. The common types of soils from Timis County are preluvisols, luvisols, eutric cambisols and dystric cambisols. These soils are rich in humus, while the reaction is strongly acid to moderately acid and oligomesobasic to eubasic. The first soils (eutric cambisols) are mezobasic to eubasic while the last ones (luvosols) are eubasic. The predominant forest soil types from Timiș County have high and very high values for the total cation exchange capacity.

Key words

Timis county, forest soil description, soil properties

The forest soil is a subject of theoretical research and there is reason to believe that any advance in the fundamental knowledge and description of soils will stimulate phases of soil investigations. The soil is a natural body, with variable depth, differentiated into mineral and organic constituent horizons, which is different in morphology, physical and chemical properties and biological characteristics to the parent material [20, 14, 15, 16].

A great amount of work on soil identification and mapping has been carried out during the last years in the national forestry fund managed by Romsilva.

The total forest area from Timiș Forest Administration County (FAC) contains 103300 ha for the year 2015, according to the National Statistic Institute [27]. The National Forest Administration RNP – Romsilva manages through its afferent forest districts 77521 ha in Timis FAC. The aim of this article is to describe the predominant soils types that were identified in this area.

Place and method of research

Timiș County is situated in the west side of Romania. The relief is represented by plains in the west side of the county, meadows (Mureș meadow) and hills in the center and mountains (Poiana Ruscă Mountains) in the east side. The predominant forests are mixed forests (beech with Norway spruce or silver fir) followed by deciduous forests (beech, sycamore, ash, elm, oak etc.). From the total area of Timis County, 80,17% is agricultural (60,85% arable, 14,33% pasture, 3,4% hayfield, 0,54% vineyards, 1,05% orchards), 12,53% is represented by forests and 7,30% have other utilization [25, 26]. According to Dologa *et al.,* 2013 [10], the agricultural land of Timis area is represented by 20,9% in the hill and mountain area (87% in hills and 13% in mountains).

The present research has determined and monitored the physical-chemical properties of forest soils from Timiș FAC, starting with the year 1980. Thus, the following elements were analyzed: pH, humus content, carbonates content, the base exchange capacity (Sb), hydrogen exchange capacity (Sh), total cationic exchange capacity (T), the degree of base saturation (V) and soil texture. All these analysis are part of an extended national database realized by INCDS „Marin Drăcea", based on forest management plans and are centralized in the analysis bulletins of each forest district.

All the soils analysis were made in the Laboratory from ICAS București (until 1998) and in the Forest soils analysis laboratory from INCDS „Marin Drăcea" Brașov, through accredited national and international methods [6, 7].

The analysis are stored in a database.

From the 395 soil profiles that were realized, a number of 1162 pedo-genetical horizons were analyzed.

Results and Discussions

After soil samples were analyzed, a total number of 9 types of soil were determined on the

surface of FAC Timiș. The following chart regarding the predominance of each encountered type of soil has resulted by taking into account their predominance (Fig. 1).

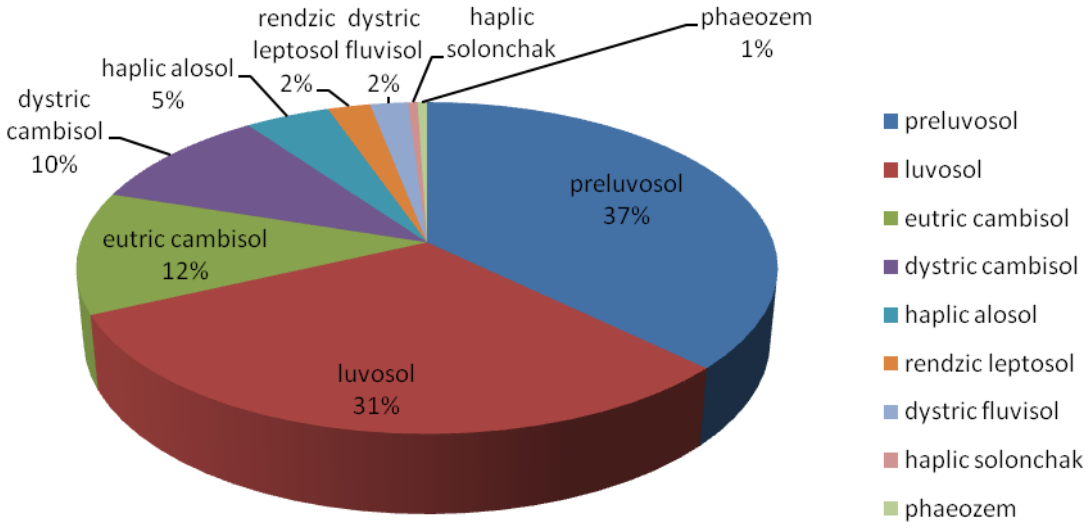

Fig 1. The predominant soils types identified in Timis FAC

As such, the most prevalent soil types are the ones from Luvisols class, occupying over 60% from the county's total forest soils. The first place is occupied by preluvisols (37%), followed by luvisols with 31%. The third and fourth places are occupied by soils from the Cambisols class, namely 12% eutric cambisol and 10% dystric cambisol. Together, Cambisols and Luvisols represent 90% from the total Timis county forest soils. In a smaller percentage (under 10%), soils such as haplic alosols, rendzic leptosols and fluvisols are also present.

At the country's level, eutric cambisol occupies the third place as dispersion in forest soils (with a surface of 869909 ha), dystric cambisol occupies the first place (2292350 ha), preluvisol the fifth place (335050 ha), and luvisol the second place (1440052 ha) [8]. Different types of soils than the forest ones were encountered in Aranca plain from Timis County where the main soil types are: vertisoil (41%), fluvisol (22%) and chernozem (17%) [18]. Concerning the forest soils from Timis area, Țărău *et.al.*2007 [25, 26], obtained similar values: eutric cambisols 32%, dystric cambisols 11%, luvisols 45%, fluvisols 4%. The total agricultural acreage in Timis county is distributed as follows: 30.19 % Kernozems, 23.62 % Luvisoils, 8.78 % Protisoils, 10.14 % Pelisoils, 12.67 % Cambisoils and 6.05 % Salsodisoils [10, 11].

Soil reaction (pH in water) is one of the most important soil chemical parameters, providing optimal nutritive supply for plants [21]. Its values depend on the soil percentage, base saturation and saturation type (predominantly with calcium or sodium). Furthermore, soil pH influences organic matter decomposition while the microbial activity at very low or very high soil pH will influence the rate of organic matter decomposition [22].

For all the soils types differentiated on genetic horizons, the pH variation was analyzed by statistical analysis (Fig. 2).

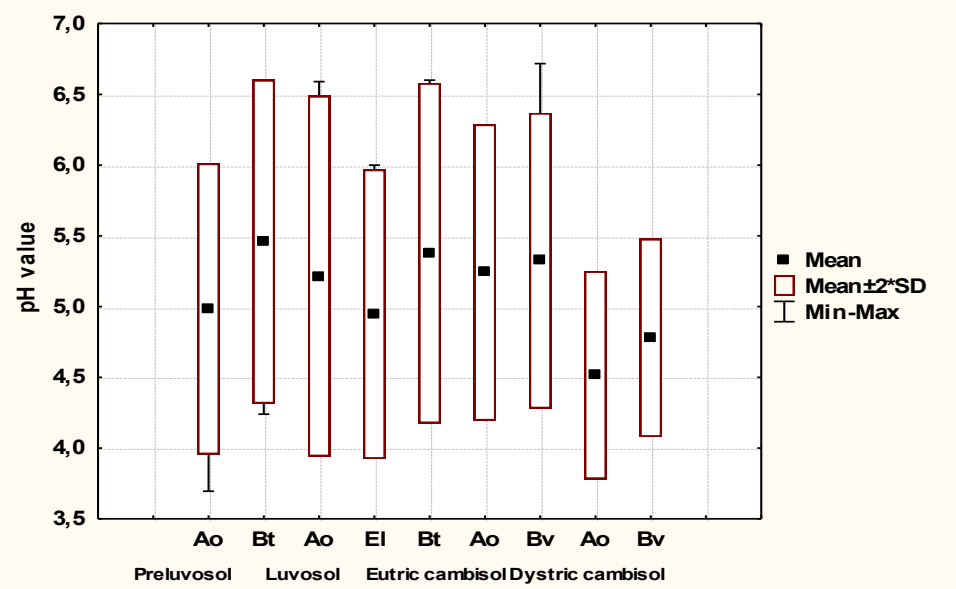

Figure 2. pH variation on genetic horizons for the predominant soils types from Timiş FAC

The lowest pH values are recorded for preluvisols and dystric cambisol, both at the surface of soil, in the A horizon, these values being in the 4-5 interval. pH values closer to 5 are also observed in the luvisol's El and in dystric cambisol's Bv horizons. For eutric cambisol and Bt horizon of preluvisol, the pH is included in the 4,4-6,3 interval. By interpreting the average pH values, the reaction is moderately acid for eutric cambisol, preluvisol and luvisol and strongly acid for dystric cambisol.

Similar pH values in the Ao and El horizons from luvisoil were also observed in Făget area from Timis County [4] and for dystric cambisols from Piatra Craiului [12]. Also, for vesrtic preluvisol from Lugoj area, Timis county, the pH values are of 5,45-5,75 [17]. Borza *et al.* [3], established the main pH values for the soils from Timis county, as follows: highly acid 0,3%, moderately acid 21,4%, low acid 48,7%, neutral 6,9%, low alkaline 19,% and moderately and excessive alkaline 0,8%.

The soil's cation exchange capacity (CEC) is greatly influenced by the level of organic matter [23]. As such, it is well known that a high organic matter soil will have a much higher cation exchange capacity than a low organic matter soil [22].

An average value per profile for each soil type was calculated in order to establish the total cation exchange capacity (Table 1). Fluvisol and rendzic leptosol are the soils with a very large cationic exchange capacity (>25 me 100 g^{-1} sol) while all the other soil types are situated in the large category. Crişan *et al.* [5] 2017, found total exchange capacities values of 17,86 for fluvisols and 24,96 for luvisols in Giurgiu County and 23,13 for dystric luvisols and 25,61 for eutric cambisols in Maramureş County. Enescu *et al.,* [13] 2017, found similar values for CEC in forest soils from Cluj county.

Table 1

Average humus and nitrogen content and total cation exchange capacity for forest soils from Timis County

Medium cationic exchange capacity per soil type (me 100 g^{-1} sol)						
Preluvisol	**Luvisol**	**Eutric cambisol**	**Dystric cambisol**	**Haplic Alosol**	**Rendzic leptosol**	**Fluvisol**
23,30	22,97	20,33	18,74	22,61	32,02	34,50
Medium humus content in the A horizon per soil type (%)						
4,85	6,00	5,43	5,57	1,96	3,46	4,32
Medium nitrogen content in the A horizon per soil type (N %)						
0,227	0,287	0,222	0,345	0,392	0,143	0,226

Humus is the major soil organic matter component [9], making up for 65% to 75% of its total. Humus assumes an important role as a fertility component of all soils, far in excess of the percentage contribution it makes to the total soil mass. When in combination with soil minerals, soil humus can persist in the soil for several hundred years ([2], [1]).

The average content of humus from the A horizon was determined for each identified type of soil (Table 1).

As such, the largest quantity of humus was found for luvisol (6,00%), which is situated thus in the intense humifer soil category. All the other soil types had values of humus content situated in the interval 1,96 – 5,57. It can be observed that luvisols, dystric cambisols and eutric cambisols are intensely humifer soils, while preluvisols, dystric fluvisol, rendzic leptosols are moderately humifer soils and haplic alosols are poor humifer soils.

The humus values from Timis County are situated in the limits of the average humus content for the forest soils in Romania [6, 7]. In Torontal plain from Timis county, Niță *et al.* [18, 19], found similar values for the humus content: 1,24-3,38%.

Nitrogen has a particular importance for plant nutrition among the macronutrients being included in the composition of proteins (about 17%). The nitrogen quantity in soil is generally low, mostly being fixing in soil organic matter (95%), included microorganisms.

Supply of nitrogen varies from value of 0,143% for rendzic leptosol and up to 0,392% for alosols. Nitrogen content in the first horizons has similar values at preluvisols (0,227%), luvisols (0,287%), eutricambisols (0,222%) and fluvisols (0,226%).

The nitrogen quantities in the agricultural soils from the low plain Timis-Bega are situated between 0,104% and 0,260% [24].

One of the most important chemical indicators, closely related to soil reaction and its saturation type in cations Ca, Mg, Na, K, is the soil percentage base saturation.

As such, it can be observed (Fig. 3) that the largest variation amplitude is registered for luvisols, while the lowest is for dystric cambisol. By interpreting the average values of the base saturation degree, this is situated in the interval 60 – 75% for eutric cambisol and preluvisol, which are as such, mezobazic soils. Dystric cambisol is the soil with the lowest average value for the base saturation degree, (under 40%), being situated in the oligomezobazic soil category.

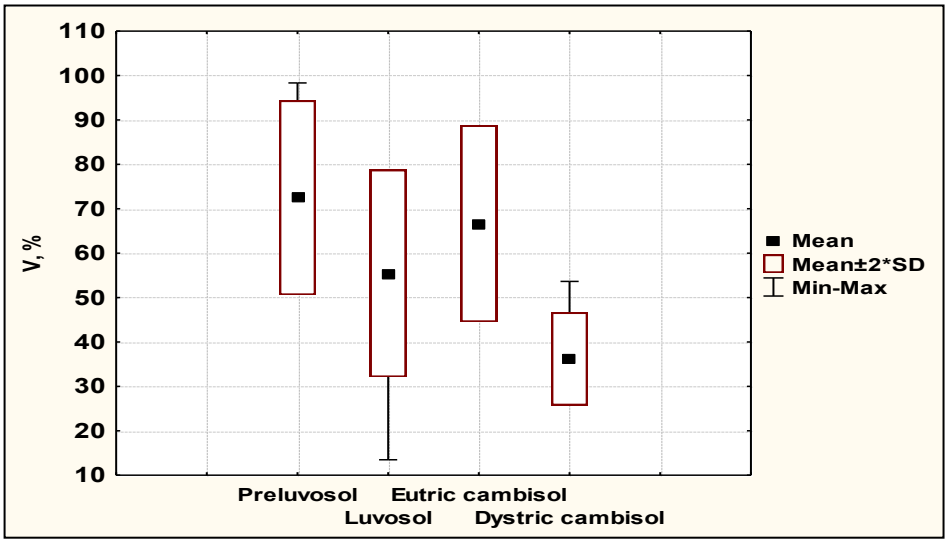

Figure 3. The variation of the percentage base saturation for the most widespread forest soils from Timis County

Conclusions

In conclusion, the most widespread forest soils in Timiș FAC are the soils from Luvisols classes, which hold over 68%. This type of soils are generally formed on flat or gently sloping landscapes.

The most acid soils are dystric cambisols, while the higher pH values are observed at eutric cambisols, respectively luvisols.

In terms of humus content and the soil percentage base saturation, luvisol has the largest content, respectively the largest variation amplitude.

The predominant forest soil types from Timiș FAC have high and very high values for the total cation exchange capacity.

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