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FOREST SOILS FROM ARGEŞ COUNTY

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Abstract
Forest soils are regarded as the main element of the forest sites, being a strong correlation between the types of the forests and their productivity with the types of the soils. In the last four decades, three soil classification systems were developed in Romania, namely SRCS-1980 (valid for the timeframe 1980-2002), SRTS-2003 (used in the period 2003-2012) and SRTS-2012, in use starting from 2013. The aim of this paper was to realize a description of forest soils from Argeş County. The data for the timeframe 1985-2015 from the forest management plans of the state-owned forest districts within Argeş Forestry Directorate were taken into account. The most spread forest soils across Argeş County were the eutric cambisol and the dystric cambisol, followed by the luvisol, preluvisol and entic podzol. The soils vary from moderately humiferous (preluvisols) to intensely humiferous (eutric cambisols, dystric cambisols and luvisols) and very intensely humiferous (entic podzols).

Keywords: Argeş, dystric cambisol, eutric cambisol, forest soils, luvisol.

1. INTRODUCTION

Forest soils play an important role in hydrological, nutrient and carbon cycles (Bauhus et al., 2002). In the last decades, special attention was given to the role of the forest soils in mitigating climate change worldwide, being well known that the forest soils represent one of the most important carbon sinks (Lal, 2005; Zhou et al., 2006; Dincă et al., 2015). For example, in Europe, it was reported that the forest soils store 1.5 times more carbon than the trees (Baritz et al., 2010). The amount of the carbon stored in the soils varies depending on the type of the forests, more carbon being stored in the soils from the boreal forests in comparison with the soils from the tropical forests (Pan et al., 2011).

According to several studies (Johnson and Curtis, 2001; Liski et al., 2002; Jandl et al., 2007; Nave et al., 2010; Bragă and Spârchez, 2015), it resulted that the forest management techniques have a strong influence on soil carbon sequestration. In order to increase the capacity of the forest soils in terms of carbon sequestration, forest management should include, among others measures, site preparation, afforestation, species selection, use of fertilizers and soil amendments (Lal, 2005). All these aspects should be taken into consideration by the forest managers together with the physical-chemical properties of the soils in order to adopt the adequate silvicultural measures in certain cases (Târziu et al., 2004; Spârchez et al., 2011).

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Forest soils are regarded as the main element of the forest sites, being a strong correlation between the types of the forests and their productivity with the types of the soils. In this regard, the concept of the zonality of the soils was introduced one century ago in Romania by Gheorghe Murgoci (Stănilă and Dumitru, 2016).
Moreover, in order to have a clear classification of the soils across Romania, in the last four decades, three soil classification systems were developed in our country, namely SRCS-1980 (valid for the timeframe 1980-2002), SRTS-2003 (used in the timeframe 2003-2012) and SRTS-2012, in use starting from 2013 (Țărău et al., 2012; Vlad et al., 2015).
The aim of this paper was to realize a description of forest soils from Argeş County.

2. MATERIALS AND METHODS

Data regarding the soil types were collected from the forest management plans (FMPs) of the 13 forest districts within Argeş Forestry Directorate, namely Aninoasa, Domneşti, Câmpulung, Costeşti, Cotmeana, Curtea de Argeş, Mihăeşti, Muşăteşti, Piteşti, Poiana Lacului, Topoloveni, Şuici and Vidraru (Anonymous, 1985-2015). The FMPs were updated every ten years, and during every update amongst other aspects, soil samples were collected and the physical-chemical properties analysis of soil samples were realized based on renowned national and international methodologies (Dincă et al., 2012a). In this study, the soil samples collected in the timeframe 1985-2015 were taken into account (*i.e.* 898 soil profiles and 2.492 pedogenetic horizons).

3. RESULTS AND DISCUSSIONS

Forest soil types from Argeş County

The most widespread soil types across the forest lands managed by Argeş Forestry Directorate were the eutric cambisol and dystric cambisol, each of them with a share of 28%, followed by luvisol (16%), preluvisol (14%) and entic podzol (10%) (Figure 1). Other identified soil types across the county that accounted 4% of the total area were the alosols, fluvisols, phaeozems, podzols and rendzic leptosols.

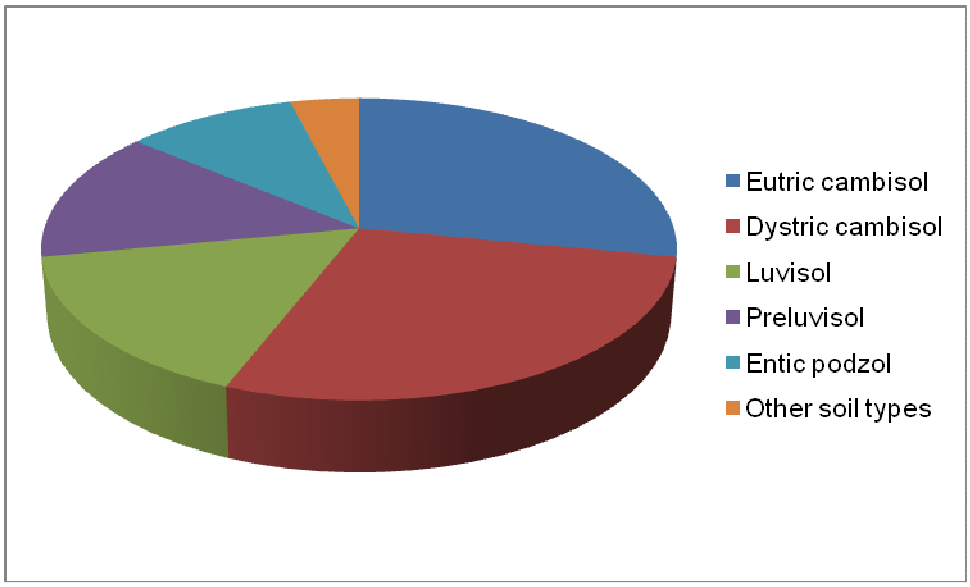

Figure 1. The percentage of forest soils identified in Argeş County

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These results are similar with the statistics at national level, according to which the dystric cambisol is placed on the first place in terms of occupied area, *i.e.* 2.292.35 ha (35%), luvisol on the second place, *i.e.* 1.440.052 ha (22%), eutric cambisol on the third place, *i.e.* 869.909 ha (13%), while preluvisol occupy the fifth place, *i.e.* 335.050 ha (5%) (Dincă et al., 2014).
The luvisols were also among the most widespread soils in Câmpulung Muscel Depression (Demeter et al., 2005) and also among the agricultural soils across Argeş County, with a share of almost 23% (Creangă et al., 2009).

Soil pH

The soil pH was differentially calculated on pedogenetic horizons for the most widespread soil types. Dystric cambisol had an average pH value of 4.44 in the Ao horizon and of 4.86 in Bv horizon, respectively, being a strongly acid soil. Eutric cambisol had an average pH value of 5.19 in Ao horizon and 5.46 in Bv horizon, respectively, the values being similar with the ones reported at national level (Spârchez et al., 2017). Preluvisols had an average pH value of 4.9 in Ao horizon (strongly acid) and of 5.23 in Bt horizon, respectively, being moderately acid soils, while in the case of the luvisols the pH value was 5.17 in Ao horizon, 4.89 in El horizon and 5.22 in Bt horizon, respectively. On the other hand, the entic podzol was a very strong acid soil in the Aou horizon (pH=4.03) and strongly acid in Bs (pH=4.48) (Figure 2).
In the case of the agricultural soils across Argeş County, based on the pH values, the following results were obtained in a recent study: very acid soils (13%), moderately acid soils (40%), weakly acid soils (33%), neutral soils (6%) and weak alkaline soils (8%), respectively (Creangă et al., 2009). Similar values were also reported in the case of the luvisols in a study conducted for Iaşi County (Dincă and Dincă, 2017).

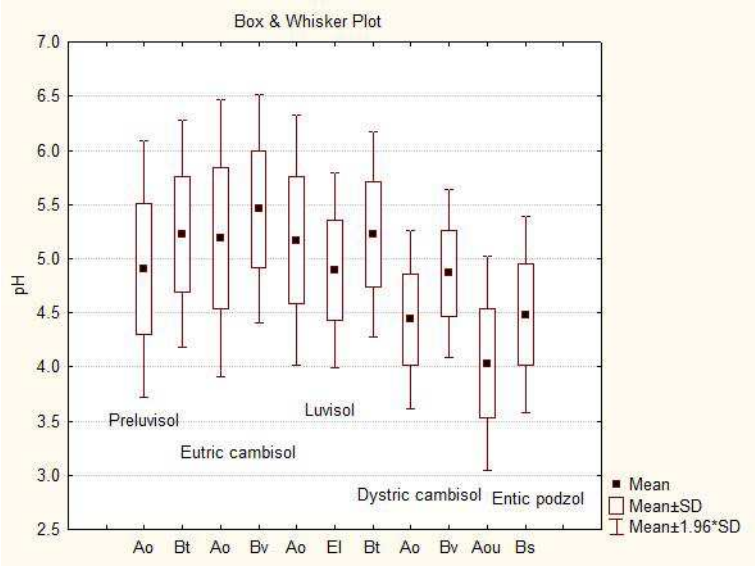

Figure 2. pH variation of genetic horizons for the most widespread forest soils from Argeş County

Soil base saturation

In the case of the dystric cambisols, the average value of the base saturation degree (V) was 34.75% in Ao horizon and 36.94% in Bv horizon, respectively, meaning that these soils were oligomesobasic. Eutric cambisols had a V value of 60.62% in Ao horizon and 69.51% in Bv horizon, respectively, being mesobasic soils. Luvisols had a V value of 57.55% in Ao horizon,

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47.44% in El horizon and 61.77% in Bt horizon, respectively, while the preluvisols had a V value of 49.87% in Ao horizon and 65.24% in Bt horizon, respectively. The entic podzols had a V value of 26.84% in Aou horizon and 27.66% in Bs horizon, respectively. The largest variation of this parameter was recorded in the case of the preluvisol, while the smallest in the case of the dystric cambisol (Figure 3).

As a comparison, the soils from Maramureş County were also characterized by the fact that they were oligobasic (entic podzols), oligomesobasic (dystric cambisols), or mesobasic (eutric cambisols), respectively (Crişan et al., 2017). Similar results were also obtained for luvisols in Cluj County (Enescu et al., 2017) and preluvisols in Bihor County, respectively (Dincă et al., 2017).

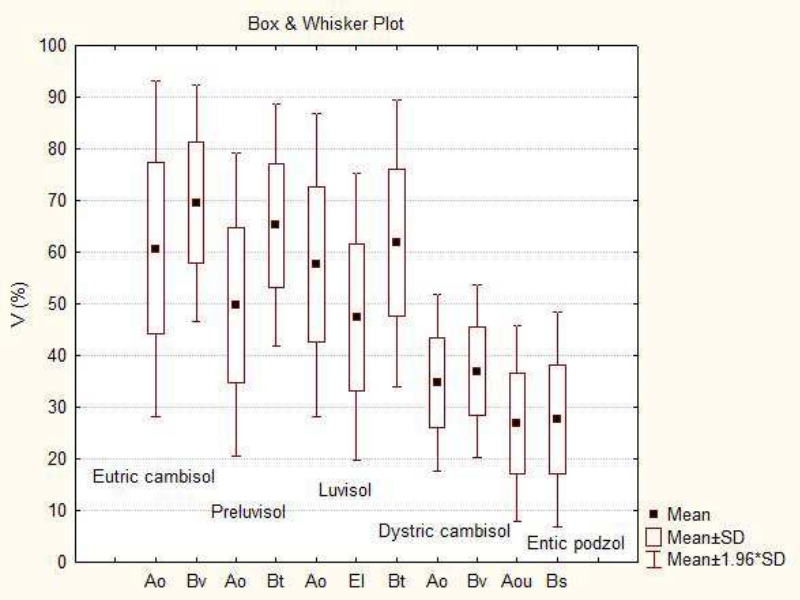

Figure 3. Base saturation variation for the most widespread soils from Argeş County

Total cationic exchange capacity

The total cationic exchange capacity (T) was calculated for each soil type as an average profile (Table 1).

Table 1. Total cationic exchange capacity and average humus content for forest soils from Argeş County

Eutric cambisol	Dystric cambisol	Preluvisol	Luvisol	Entic podzol
Average total cationic exchange capacity on soil types (T-me 100 g^{-1} soil)				
23.30	28.84	21.90	23.10	25.27
Average humus content in the A horizon (H-%)				
5.86	8.93	4.99	6.74	10.74
Average nitrogen content in the A horizon (%)				
0.34	0.46	0.21	0.35	0.55

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Eutric cambisol, preluvisol and luvisol have a large cationic exchange capacity, while dystric cambisol and entic podzol have a very high total exchange capacity (Figure 4). A high total cationic exchange capacity was also identified for the luvisols from Giurgiu County and a very high one for the entic podzols from Maramureş County (Crişan et al., 2017) and Timiş County (Crişan and Dincă, 2017), respectively.

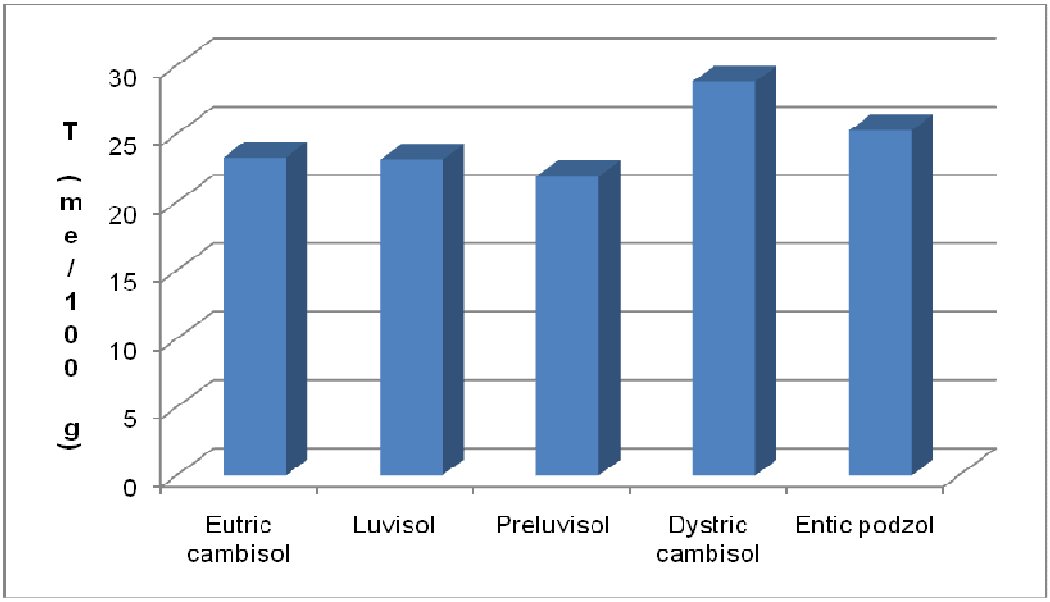

Figure 4. The variation of total cationic exchange capacity for the most widespread forest soils from Argeş County

Humus

Due to the fact that the highest quantity of humus is accumulated in the first horizon of the soils, the average content of humus was calculated only for this horizon (Table 1, Figure 5). Thus, the preluvisols were moderately humiferous, the eutric cambisols, dystric cambisols and luvisols were intensely humiferous, and the entic podzols were highly intensely humiferous.

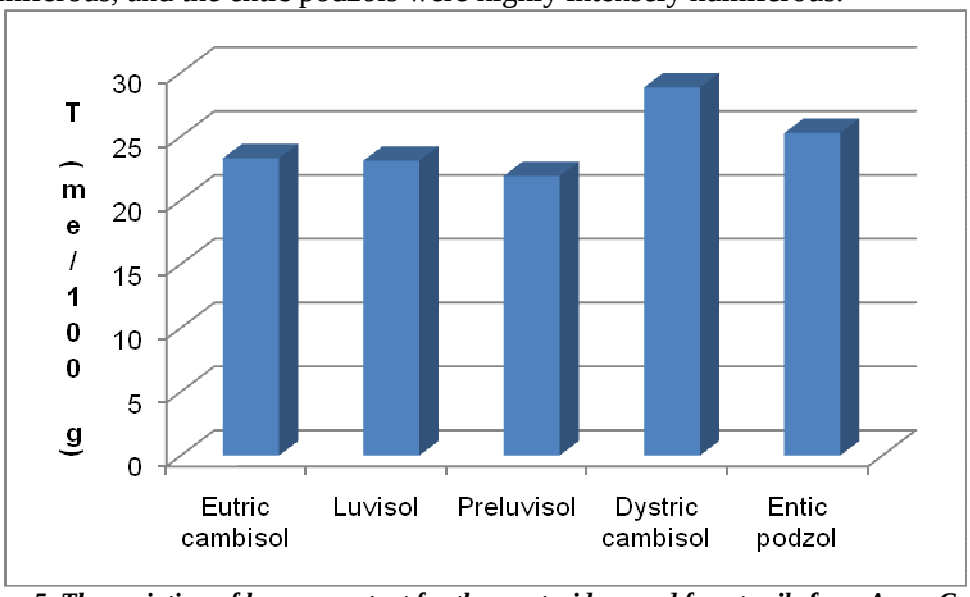

Figure 5. The variation of humus content for the most widespread forest soils from Argeş County

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The humus quantities of the forest soils across Argeş County are similar with the average values calculated for forest soils from the entire country (Dincă et al., 2012b). Based on the humus content from the first 20 cm in the case of the agricultural soils from this county, the following results were found: very weak (5%), weak (54%), moderately (28%), large (9%) and very (large 4%) (Creangă et al., 2009).

Nitrogen

As in the case of the humus content, the nitrogen was also calculated only for the first horizon as both elements are accumulated through the decomposition of organic matter at the surface and in the first centimeters of the soil's profile. The lowest quantity of nitrogen was found for luvisols, which is a well-supplied soil with nitrogen, while all the other soil types were very well supplied with nitrogen.

4. CONCLUSIONS

The majority of the forest soils across Argeş County belong to Cambisoil and Luvisoil classes. The most representative forest soils were the eutric cambisols and dystric cambisols, followed by the luvisols, preluvisols and entic podzols.

The forest soils from this county are acid, from the ones that registered a very low pH value (entic podzols and dystric cambisols), to the moderately acid ones (eutric cambisols and luvisols).

As regards the base saturation values, the forest soils were oligobasic (entic podzols), oligomesobasic (dystric cambisols), and mesobasic soils (eutric cambisols, luvisols and preluvisols), respectively.

The soils vary from moderately humiferous (preluvisols) to intensely humiferous (eutric cambisols, dystric cambisols and luvisols) and very intensely humiferous (entic podzols), being favorable for the main tree stands across the county (beech, sessile oak and Norway spruce).

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