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MAIN CHARACTERISTICS OF FOREST SOILS ACROSS GETIC PIEDMONT (SOUTH-WESTERN ROMANIA)

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Abstract

In recent years, the importance of the forest soils started to gain an increasing attention both among forest specialists, policy makers and other stakeholders. This is mainly due to their importance for humanity, being the base for assuring several forest products and services. Since the 1980s, the Romanian soil specialists developed several soil taxonomy systems, based on the developments and data acquired at a certain moment. Knowing the type of the soil and its characteristics is crucial also for the foresters, for a sustainable forest management point of view. The aim of this study was to highlight the main characteristics of the forest soils across Getic Piedmont. Data from the forest management plans of twelve forest district that are responsible for managing the forests across the region were taken into account. The main representatives of Luvisols Class accounted for three quarters of the forest soils. In general, the characteristics of the forest soils are favorable for mixed-oak forest stands. In the future, special attention should be given to preserving the forests composed by autochthonous species, in order to maintain the fertility of the forest soils.

***Key words**: base saturation, forest soils, Getic Piedmont, humus, pH.*

INTRODUCTION

Soils are vital for mankind, providing several products and services, such as food and fresh water (Abrahams, 2002; Huang et al., 2018), mitigating the effects of the contemporary climate change (Lal, 2004) and conserving the biodiversity of the ecosystems (Crișan et al., 2017). In this context, it is mandatory to maintain their physical, chemical and microbiological characteristics to optimal levels (Morariu et al., 2018).
In the last decades, increasing attention was given to the impact of different human activities, such as agriculture or different forest operations, on soil characteristics (Worrell and Hampson, 1997; McFero Grace et al., 2006; Samuel et al., 2017). In particular, many foresters started to take into account the relation between the forest soils, the tree layer composition and the silvicultural measures in order to highlight the best combination from a sustainable development point of view (Enescu et al., 2018).
Moreover, the role of the forest soils as carbon sinks (Dixon et al., 1994; Lal, 2005; Edu et al., 2013; Chen et al., 2018), which, in general, recorded higher carbon concentrations in comparison with the agricultural soils, is gaining an increased interest among experts (Baritz et al., 2010).
Almost three decades ago, the European Commission started creating a soil database called LUCAS (Land Use and Land Cover Area Frame Survey), which is managed by the Eurostat (Montanarella et al., 2011). LUCAS is an in-situ survey (Panagos et al., 2012) aimed at assessing in a harmonized way the characteristics of the topsoil layer of the non-forest lands (Blujdea et al., 2016).
The database comprises more than 45,000 soil samples originating the EU Member States, which were analyzed (Tóth et al., 2013; Orgiazzi et al., 2018). In 2012, Romania added

to the database 1,384 soil samples (Tóth et al., 2016).
In Romania, starting from 1980s, three soil classification systems were developed, 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 (Enescu & Dincă, 2018).
The most common forest soils from Romania are represented by the dystric cambisols, haplic luvisols and eutric cambisols (Dincă et al., 2014) and the value of the organic C stock ranges between 70 and 360 t/ha (Dincă et al., 2015).
As regards the soil pH (soil reaction), at national scale, it was found that in the mineral horizon the pH values are slightly smaller in the coniferous forests in comparisons with the hardwood stands. Moreover, if we take into consideration the three historical provinces from Romania, it was reported that the pH values from the mineral horizon is 3.98 in Transylvania, 4.66 in Muntenia and 4.98 in Moldova, in the case of the soils with hardwood species, these values being higher than in the case of the coniferous-dominated sites (*i.e.* 3.50 in Transylvania, 3.44 in Muntenia and 4.04 in Moldova), respectively (Geambașu et al., 2004). High amplitude of the pH values was also recorded on limited area, such as the one from Poiana Stampei Peat Bog, where the values ranged between 4.09 and 5.89 (Cazacu et al., 2018).
The aim of this study was to highlight the main characteristics of the forest soils from Getic Piedmont.

MATERIALS AND METHODS

Getic Piedmont, the largest piedmont of Romania (Bălteanu et al., 2010) and a relict geomorphologic relief unit (Stănilă et al., 2010), is located in the southern-western part of Romania (Figure 1), between the Danube (in the west and south) and Dâmbovița River (in the east). It is a region characterized by intense human activities that generated several land-use changes (*e.g.* deforestation, fish fauna destructuring, exploitation of minerals) which occurred in the last two centuries (Tomescu, 2005; Spârchez et al., 2009; Bănăduc et al., 2013; Cărăboiu & Niță, 2013; Anghelache & Burea, 2018).
One of the most visible effects of the deforestation is represented by the relief fragmentation (Ionuș et al., 2011).
The above-mentioned land-use changes were mainly generated by the favorable conditions for living, the number of the localities, according to the census made two decades ago, being more than one and a half thousand (Dumitrescu, 2003). Nowadays, most of the areas that were deforested, especially in the southern part (Popescu, 2009) are cultivated with several cereals, wheat and corn being the most common ones, but also large areas were reforested with fast-growing species, such as black locust (Enescu & Dănescu, 2013).
Getic Piedmont is part of Getic Depression, an area where the sedimentation process started in Triasic and continued until Cuaternary (Tomescu et al., 2008).
The area is characterized by a high variability in terms of precipitation (Pleniceanu & Alina, 2003), several hydrological hazards being reported in the last years especially in the eastern part of the region (Tanislav & Alexe, 2012). Getic Piedmont is also characterized by a dense gully system (Boengiu et al., 2012) and a significant percentage of its area is susceptible to landslides (Bălteanu et al., 2010).

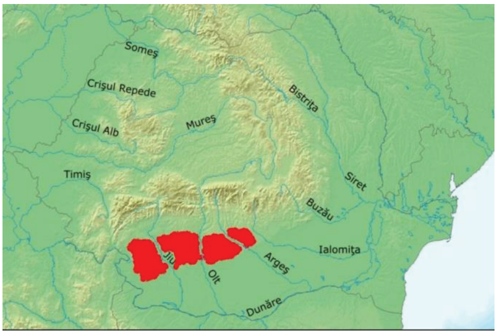

Figure 1. Location of Getic Piedmont
(Source: ro.wikipedia.org)

Data regarding the forest soils characteristics were gathered from the "Marin Drăcea" National Institute for Research and Development in Forestry. The database included the information available for the timeframe 1986-2014 for the twelve forest districts across Getic Piedmont, namely

Cotmeana and Poiana Lacului (Argeş Forestry Directorate), Cărbuneşti, Hurezani, Motru, Peşteana and Târgu Jiu (Gorj Forestry Directorate), Corcova and Topolniţa (Mehedinţi Forestry Directorate) and Băbeni, Horezu and Stoiceni (Vâlcea Forestry Directorate), respectively.
The main chemical characteristics were recorded for each pedogenetic horizon.
Afterwards, the data were centralized by the aid of Microsoft Office package, and the variation of the soil reaction (pH) and the base saturation degree (V%) was highlighted by using a Box and Wisker Plot model.

RESULTS AND DISCUSSIONS

A total of 566 soil profiles and 1796 pedogenetic horizons were analyzed. According to the centralized data, Luvisol and Preluvisol were the most common forest soils, accounting for three quarters out of the total forest soils across Getic Piedmont (Figure 2). The less common forest soils were the Fluvisol type.

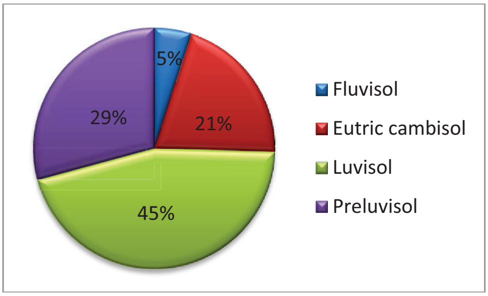

Figure 2. Main forest soil types from Getic Piedmont

A high variation was recorded for soil reaction (pH), as follows:
In the case of fluvisols, the minimum pH values were 4.20 and 4.41 in Ao and C horizons, respectively, while the maximum values recorded in the same horizons were 7.98 and 8.23, respectively (Figure 3).
As regards eutric cambisols, the minimum pH values were 3.67 and 4.11 in Ao and Bv horizons, respectively, and the maximum recorded value was 7.90 for both horizons (Figure 3).
In the case of luvisols, the minimum pH values were 4.03 in Ao horizon, 3.55 in El horizon 3.82 in Bt horizon, respectively. The average value for soil reaction ranged between 5.00 and 5.30 (Figure 3).
The minimum pH values for preluvisols were 3.52 and 4.17 in Ao and Bt horizons, while the maximum values recorded in the same horizons were 8.60 and 8.03, respectively (Figure 3).
In general, by taking into account the average values of the soil reaction, the soils are acid and weakly acid, being suitable for many hardwoods including the autochthonous oak species, such as Turkey oak (*Quercus cerris* L.), Hungarian oak (*Q. frainetto* Ten.), pedunculate oak (*Q. robur* L.) and sessile oak [*Q. petraea* (Matt.) Liebl.].
As regards the humus content (H, %), the highest values for A horizon were recorded in the case of luvisols, followed by eutric cambisols and preluvisols (Table 1).
In general, the forest soils across Getic Piedmont are moderately humiferous to intensely humiferous, being favorable for the main tree species from the region, especially for the oaks.

Table 1. Average humus content

Soil type (horizon)	Humus content (%)
Fluvisol (Ao)	3.33
Fluvisol (C)	1.05
Eutric cambisol (Ao)	4.94
Eutric cambisol (Bv)	1.59
Luvisol (Ao)	6.2
Luvisol (El)	2.21
Luvisol (Bt)	0.99
Preluvisol (Ao)	4.8
Preluvisol (Bt)	1.43

The variation of the base saturation degree is given in Figure 4. The highest values were recorded in the case of fluvisol, while the lowest values were recorded for luvisol.

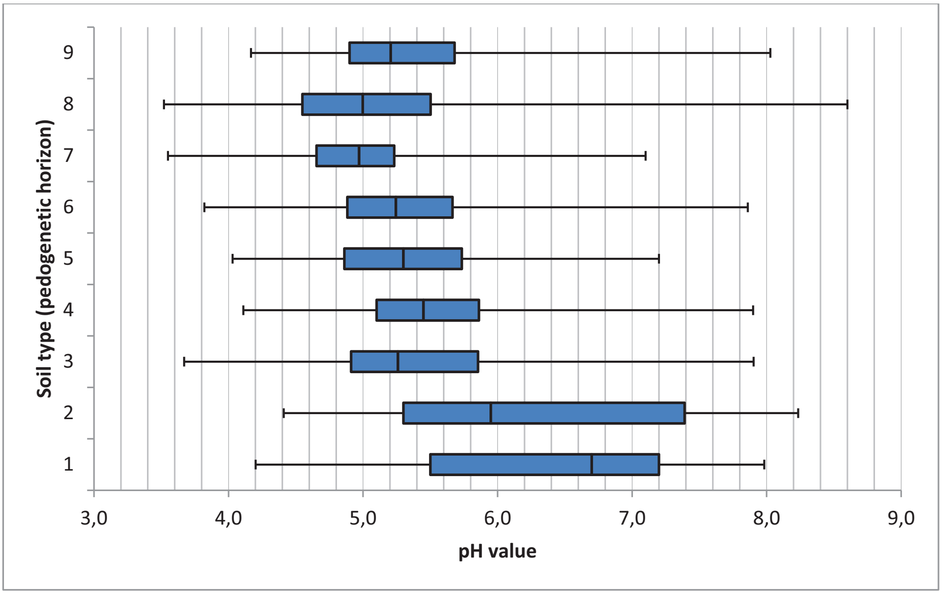

Figure 3. Box and Wisker Plot of the pH variation of genetic horizons for the most widespread forest soils from the Getic Piedmont: 1-Fluvisol (Ao), 2-Fluvisol (C), 3-Eutric cambisol (Ao), 4-Eutric cambisol (Bv), 5-Luvisol (Ao), 6-Luvisol (Bt), 7-Luvisol (El), 8-Preluvisol (Ao), 9-Preluvisol (Bt)

In the case of the fluvisols, the average value of the base saturation degree (V) was 74.30% in Ao horizon and 79.00% in C horizon, respectively, meaning that these soils were mesobasic-eubasic. Eutric cambisols had a value of 65.20% in Ao horizon and 75.80% in Bv horizon, respectively, being mesobasic soils. In general, luvisols and preluvisols were mesobasic soils (Figure 4).

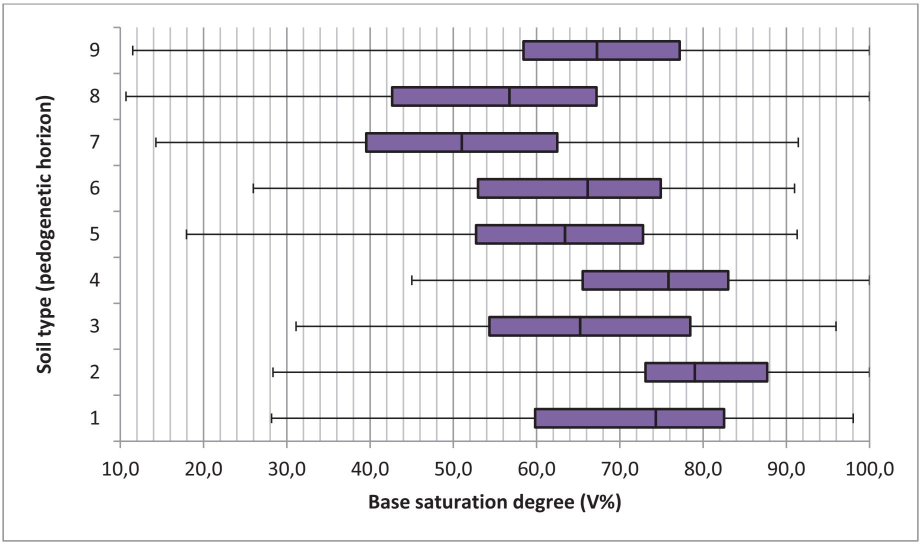

Figure 4. Box and Wisker Plot of the Base Saturation degree (V) variation of genetic horizons for the most widespread forest soils from the Getic Piedmont: 1-Fluvisol (Ao), 2-Fluvisol (C), 3-Eutric cambisol (Ao), 4-Eutric cambisol (Bv), 5-Luvisol (Ao), 6-Luvisol (Bt), 7-Luvisol (El), 8-Preluvisol (Ao), 9-Preluvisol (Bt)

CONCLUSIONS

Three quarters of the forest soils across Getic Piedmont belong to Luvisols class, being soils characterized by a high fertility for mixed forest stands dominated by oak species. In order to preserve their characteristics and fertility, future silvicultural measures should be focused on maintaining and/or increasing the area of oak-dominated stands, even if several challenges exist.

This study represents an overview of the main forest soils across Getic Piedmont and, in our opinion, its results should be interested both for practitioners, but especially for the policy makers who are responsible of maintaining and promoting a sustainable forest management, including preserving current forest ecosystems, composed by valuable autochthonous species. It is well known that in case of the forest soils were the forest was eliminated and land-use changes occurred (*i.e.* deforestation), their acidity increased, meaning that in the next couple of years those soils will be degraded and only a very limited species will be able to grow. This is what happened in the region in the last two hundred years, and as a result, nowadays the lands that were covered by mixed oak species are either degraded, either planted with black locust or other allochthonous fast growing tree species.

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