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Original Research Article

Features of selected benchmark soils along an elevational transect of the northeastern part of the Moldavian Plateau (Romania)

Geanina Bireescu [a], Carmelo Dazzi [b], Giuseppe Lo Papa [b]

[a] Institute of Biological Research, Department of Experimental and Applied Biology, Iaşi, Romania
[b] Dipartimento Scienze Agrarie Alimentari e Forestali, Università degli Studi di Palermo, Italy

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ABSTRACT

Soil morphological, physical and chemical properties are described at four locations along an elevational transect in the northeastern part of the Moldavian Plateau (Romania). These data contribute to the knowledge of the soils of this area and to their classification according to the USDA-Soil Taxonomy, FAO-WRB and the SRTS-Romanian System. The soils were classified as Inceptisols, Alfisols and Mollisols, according to the USDA-Soil Taxonomy; Gleysol, Chernozem and Luvisol, according to the FAO-WRB and Gleiosol, Cernoziom, Preluvosol, Luvosol, according to the SRTS-Romanian System. The selected soils have a range of properties that represent the soilscape of the Moldavian subcarpathian plateau, characterised by a natural forest with oak as the dominant species. The selected soil parameters decreased with increasing elevation; calcium carbonate and clay leaching and accumulation are the main soil formation processes.

1. Introduction

Soils are non-renewable natural and economic resources producing goods and services that are of paramount importance for human life. Soils produce food, timber, fibre and fuel. They filter and clean large amounts of water and, as a major storehouse for carbon, also help in lowering the emissions of carbon dioxide and other greenhouse gases, which is fundamental for regulating the climate (Blum, 2013; Dazzi, 2008; FAO, 2017). However, evidence recently provided in the Status of the World's Soil Resources (FAO & ITPS, 2015) shows that about 33% of global soils are moderately or highly degraded, which is mainly due to unsustainable management practices.

At the global level, the political momentum to tackle the adverse impacts of land degradation due to unsustainable management practices is particularly favourable due to an increase of the awareness of the importance of the role of the soil in the environmental equilibria (Keesstra et al., 2016). Such awareness is supported by a strong global acknowledgement that land degradation can have a large negative impact not only on the climate and on biodiversity (Reed & Stringer, 2016), but also impacts food security and ecosystem services (Lal, 2003; Richardson, 2010).

The growing concerns about the state of global soils resulted, amongst others, in the establishment of the Global Soil Partnership (GSP Technical Working Group, 2017), in the proclamation of the International Year of Soils by the United Nations General Assembly (Vittori Antisari et al., 2014), in the proclamation of the International Decade of Soils (2015–2024) by the International Union of Soil Sciences (IUSS, 2015) and in the adoption of the revised World Soil Charter by the FAO Conference (FAO, 2015).

The largest political boost for addressing land degradation came from the United Nations General Assembly's adoption of the Sustainable Development Goals (SDGs). In a broader context, the 2030 Agenda for Sustainable Development adopted a number of related targets in 2015, i.e. those aimed at restoring degraded soil, striving to achieve a land degradation-neutral world and implementing resilient agricultural practices that progressively improve soil quality and minimise soil contamination (FAO, 2017). To reach the SDGs and the related targets, it is imperative to have a perfect knowledge of the soils and of their features. Such knowledge allows also for: the sustainable management of the soilscapes (Dazzi, 2007; Schafer & Kirchhof, 2000; Smith, Halvorson, Bolton, & Jr, 2002); updating soil classifications in anthropogenically disturbed areas (Dazzi, Lo Papa, & Palermo, 2009; Vittori Antisari et al., 2014); highlighting the relationship between soil quality and human heath (Goedert et al., 2010); compiling inventories of the soil features and distribution (Dahlgren, Boettinger, Huntington, & Amundson, 1997; Plekhanova, 2017; Poch, Simó, & Boixadera, 2013).

This last case is of paramount importance for those areas where information on soils is scarce, which is the case for the part of the

E-mail address: giuseppe.lopapa@unipa.it (G. Lo Papa).
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Moldavian plateau in northeastern Romania. In such areas, soils along transects allow for the assessment of both the types and rates of change in soil processes and properties (Dahlgren et al., 1997). In this context, the objective of this study was to investigate the main features of selected benchmark soils of a climosequence in the northern part of the Moldavian plateau, with the overall aim to broaden our knowledge of the soils of this area.

2. Study area

The Moldavian Plateau is a geographic area spanning north-eastern and eastern Romania, most of Moldova and parts of the Ukraine (Romanescu, Cotiuga, Asandulesei, & Stoleriu, 2012). In Romania, the Moldavian plateau that lies in between the Prut River (East) and the Nistru Valley (West) accounts for over 2,480,000 ha, with elevations ranging between 5 and 794 m a.s.l. (Mărgărint & Niculiţă, 2017) (Fig. 1).

The relief of the plateau was modelled on a monoclinal sedimentary structure, with a mean inclination of 7–8 m/km from north-west to south-east, contrasting with the crystalline basement of the East-European Platform, which sinks toward west, under the Carpathian Orogene (Ionesi, Ionesi, Roşca, Lungu, & Ionesi, 2005). For the purpose of this survey, we considered four benchmark soils, selected according to an elevational transect that encompasses the Iasi County and the Neamţ County (Fig. 2).

From a geological point of view, the Moldavian plateau belongs to the Moldavian Platform constituted by Precambrian crystalline formations overlaid by Ordovician-Silurian formations. Alternations of consolidated rocks such as sandstones, limestones, tuffs and fewer micro-conglomerates and unconsolidated rocks, such as clays, silts, and sands represent the lithology (Mărgărint & Niculiţă, 2017). These rocks allowed for the genesis of deep soils with low skeleton contents, mainly Luvisols intermixed with Cambisols, Phaeozems and Chernozems. Hills and plateaus characterise the morphology of the landscape, which is undulated for the most part (91%), with an elevation mostly ranging between 100 and 500 m.

The climate is influenced by an air circulation of polar origin, which determines frosts, hoarfrosts and snowfalls at the beginning of the cold season. It is defined humid continental (Dfb according to Köppen, 1936) and is typified by large seasonal temperature differences, with warm and humid summers and cold winters. Rainfall is usually well distributed through the year and ranges between average values of 517 and 650 mm/year. Average annual temperature ranges from 8.2° to 9.8°C. Air temperature ranges from 19° to 20°C in the warm period (July/August) and from −2.5 to −4.0 °C in the cold period (January/February). These climatic features allow for a mesic (border to frigid) soil temperature regime and for an udic soil moisture regime. The dominating lands use type is forest, with oak (*Quercus petraea*) and beech (*Fagus silvatica*) being the main species. There are also a few scattered areas with shrubs and meadows.

3. Material and methods

In the context of our study aims, we considered the four most important forestry ecosystems of the Iasi and Neamt Counties, namely i) the oak forest from Ezăreni; ii) the ash forest from Probota; iii) the oak forest from Barnova; and iv) the mixed forest with beech, ash, hornbeam and oak from Vânători-Neamţ. In each of these forest ecosystems and in a place chosen as being the most representative of the ecological condition of each of them, one soil profile was opened (Table 1).

Soil samples were air-dried and sieved through 2 mm for laboratory analysis. Particle-size distribution was determined by the pipette method; soil pH was measured in a 1:2.5$_{(w/v)}$ soil to water mixture. Total carbonate was measured by the gas volumetric method after HCl treatment. Total organic carbon (TOC) was analysed according to Walkley and Black method (Nelson & Sommers,

Fig. 1. Location of the Moldavian plateau (from Bizbilla.com).