CHARACTERISTICS OF THE PEDOPLASMA OF SOME SOILS FROM PĂDUREA CRAIULUI MOUNTAINS

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Abstract

The paper emphasized the characteristics of the pedoplasma of two soils from Pădurea Craiului Mountain, in relations with the soil fertility and biodiversity of the two pasture ecosystems. Plasma is one of the most important and mobile component of the soil which show the dynamic of soil profile. The researchers were performed in the northern part of Pădurea Craiului Mountain, on a Luvisol located in "Dâmbul Tânăr Hill", and a Red Soil located in "Glimeii Hill". The studied soils were characterized on the basis of micromorphological, physical and chemical analysis. The data showed that the organic component of the pedoplasma is very low in Luvisol and higher in Red Soil. The clayey component of the pedoplasma is low in the upper part and high in the lower part of both soil profiles, as a result the Idt in Luvisol is 1.53 and 1.6 in the Red Soil. The clay mineralogy showed high differences between the two soils: smectite is dominant in the Luvisol, while caolinite is prevailing in Red Soil. The Fe component of the pedoplasma is presents in high quantity in both studied soils. However in Luvisol, Fe has been accumulated in hydromorphic conditions and appears as redoximorphic features, while in Red Soil Fe accumulation is the result of a previous evolution in a Mediterranean climate and appears as matrix pigmentation. The high mobility of the pedoplasma in Luvisol induced high acidity, very low soil fertility and low biodiversity of the pasture ecosystem, while the very low mobility of the pedoplasma in Red Soil favor high fertility and high biodiversity.

Key words: micromorphology, pedoplasma, Luvisol, Red Soil, Pădurea Craiului Mountains

INTRODUCTION

Plasma translocation is one of the most important processes which lead the genesis and evolution of a soil. Soil plasma, or pedoplasma, consists of the most mobile organic and mineral soil constituents (under 0.002 μm) and easy translocated in soils.

The Luvisols and Red Soils are very different soils. Beside a common feature as the presence of Bt horizons, their genesis, evolution and characteristics are very different. According to the high differences of parent materials and local pedoclimatic conditions, their pedogenesis leaded to the formation of two very different soils.

The paper emphasized the characteristics of the pedoplasma of two soils from Pădurea Craiului Mountain, in relations with the soil fertility and biodiversity of the two pasture ecosystems.

MATERIAL AND METHOD

The researchers were performed in the northern part of Pădurea Craiului Mountain, in "Dâmbul Tânăr Hill" with an absolute altitude of 500m and in "Glimeii Hill" with an absolute altitude of 480m. The absolute altitude of the Pădurea Craiului Mountain being low, the mountain summits are named "Hills".

The mean annual temperature is 6 - 8^{o}C and the mean annual precipitation is 680 mm. The land use is pasture.

The soils are a Luvisol (Luvosol Albic Clinogleic - SRTS-2012; Stagni-albic Luvisol - WRB-SR) located in "Dâmbul Tânăr Hill", and a Red Soil (Preluvosol Rodic Litic - SRTS-2012; Luvisol Rhodic - WRB-SR) located in "Glimeii Hill".

The soil profiles had been described in the field and sampled for physical, chemical and micromorphological analyses in accordance with Munteanu M. et Florea N. (2009) and ICPA Methodology (1987).

For the micromorphological research, undisturbed soil samples were air drayed and impregnated with epoxidic resins and prepared oriented thin sections (25 - 30 μm), which were studied with the Documator (20 X) and the optical microscope (50 - 500 X) in PPL and XPL. The terminology used was from Bullock et al. (1985).

The soils were analyzed according to the ICPA Methodology (1987).

RESULTS AND DISSCUSIONS

Pădurea Craiului Mountain was formed in limestones with karst topography, while "Dâmbul Tânăr Hill" is composed of sandstone which drives the soil formation throughout acid soils.

In "Glimeii Hill" the parent material is composed of limestone and bauxite, leading the pedogenesis throughout Red Soils formation.

The organic components of the pedoplasma depend quantitatively and qualitatively on the bioaccumulation process.

In the studied Luvisol, the organic plasma is in the small quantity and appears as matrix pigmentations. In the Luvisol, the bioaccumulation process presents a peculiarity due to the temporary moisture excess, which slows down the organic matter mineralization (Fig. 1 a). The high acidity of the soil favors the accumulation of mull acid humus. The data showed the small values of the organic matter content: 2.00% in Ao horizon, 1.30% in Ea and 0.70% in E/Bw. The surface Aț horizon has a higher content of organic matter (4.80%), due to the maximum accumulation of vegetal remains.

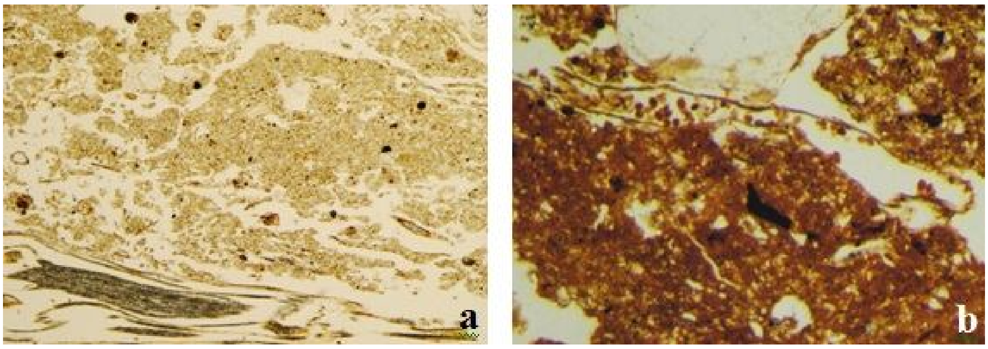

Fig. 1. Luvisol (a): vegetal remains, N II. Red Soil (b): a vegetal fragment partially consumed by the soil mezofauna, N II.

In the studied Red Soil the organic matter content is higher (than in Luvisol), the values ranging from 2.10 to 3.60%. The accumulated humus is mull calcic. The organic matter is present in the higher horizons either as humons (pigmentations of the soil matrix) or as vegetal remains in different degrees of decomposition. Many organic residues have been partially consumed by soil mezofauna and replaced with the small reddish organic coprolites (Fig. 1 b). In Bt horizon also appears melanized organic matter (showing an old decomposition process in hydromorphic conditions).

The clayey component of the pedoplasma (< 0.002 μm) in Luvisol is 27.4 - 35.1% in the Bt horizons, comparing with 18.6 - 20.0% in the upper part of the soil profile. The index of the textural differentiation (Idt = clay in Bt/clay in Ao) is 1.53, pointing out a high textural differentiation due manly to a coarser texture of the upper horizons, than to a high accumulation of the clay in Bt horizon.

From the quantitatively point of view, the clay (< 0.002 μm) values in Red Soil is very high, increasing from the Bt_1 (39.4%) to Bt_2 (48.1%) and respectively Bt_3 (52.7%) horizon, and strongly contrasting with the values of clay content (18.8 - 29.5%) in the upper part of the soil profile. The high differences between the clay values of Bt and Ao horizons, induce a vary high value of Idt (1.6).

From the qualitatively point of view, the clay mineralogy of the two soil profiles showed high differences: in Luvisol the smectite increased from the surface throughout the Bt horizon where became dominant. In Red Soil, the caolinite is prevailing in all the soil horizons.

The Fe component of the pedoplasma is presents in high quantity in both studied soils, however the differences between the processes generating the accumulation and the behavior of Fe in the two profiles, are very high.

The Luvisol have aquic conditions created by the perched water table flowing into the soil profile on the impermeable clayey Bt horizon. Hydrogenesis, together with the acidity of parent material leaded the soil pedogenesis through an acid and hydromorphic soil with a low and specific biodiversity (Răducu D. et al., 2012).

The aquic conditions are emphasized by the redoximorphic features. When reduce, Fe and Mn are mobilized and leached from the peds, thus redox depletions appeared to the ped surfaces (Fig. 2). Redox concentrations are Fe±Mn±organic matter accumulations inside the peds (Fig. 2), as masses, pore linings, nodules and concentrations. Many types of nodules have been observed into the ped core: typical nodules (with an undifferentiated fabric) and concentric nodules (with concentric fabric) are frequent; nucleic nodules (with a distinctive core) are rare. Thus, Luvisol is riche in Fe, but as the redoximorphic features due to the periodically saturation of soil with water.

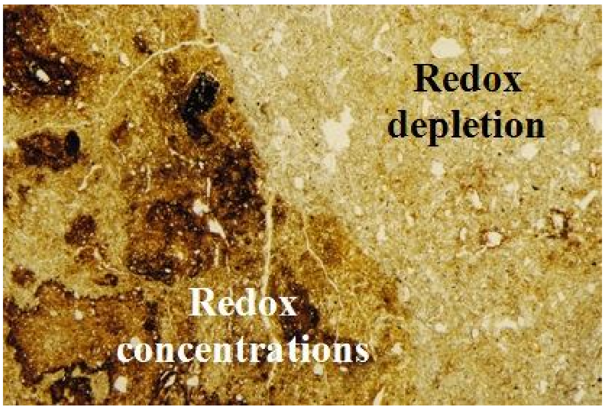

Fig. 2. Redoximorphic features in Luvisol: redox concentrations inside the ped; redox depletion to the ped surfaces. N II.

Red Soil is very rich in Fe which appears as strongly pigmentation of the soil matrix, as a result of an old evolution in a Mediterranean climate. As for example, driving forces of Terra Rossa formation are the Mediterranean climate, the good internal drainage conditions, and the supply of bases, provided by the underlying rock or sediment (Boero and Schwertmann, 1989; Levine et al., 1989; Costantini et al., 2006; Priori et al., 2008). The nodules observed in the Red Soil are lithorelicts (resulting from the bauxite fragments).

The Al component of the pedoplasma is presents only in Luvisol, in low quantity (1.01 - 2.11 me/100 g soil) as a result of a high acidity of the soil. The Al content depends always by the very low pH values. In the acid soils, a low humus content induce Al toxicity, while a higher quantity of humus decrease the Al fitotoxicity, tying it into the Al-humic components.

The mobility of the soil plasma is emphasized by the presence, in soil thin sections, of the textural pedofeatures. The colloid leaching was an important process in the studied Luvisol and generated either an eluvial (Ea) horizon or many types of textural pedofeatures. In the BtW horizon of the Luvisol many textural pedofeatures have been observed: reddish illuvial clay±Fe coatings are very frequent either on pore walls, or integrated in soil matrix (in different degrees of fragmentation). Yellowish and colorless clay coatings have been also observed in depleted areas.

In the Red Soil the pedoplasma is very stabile, no mobilization or coatings were observed.

The high mobility of the pedoplasma in Luvisol drastically influences the soil fertility and the grass species of the pasture (which is dominated by the acidophilic species). The low mobility of the Red Soil plasma induces a higher fertility of the soil which is mesotrophic and favors a high biodiversity in the pasture.

CONCLUSIONS

The micromorphological researchers of the pedoplasma from a Luvisol and a Red Soil located in Pădurea Craiului Mountain draw the following conclusions:

The organic component of the pedoplasma is very low in Luvisol (0.70 - 2.00%) and higher in Red Soil (ranging from 2.10 – 3.60%).

The clayey component of the pedoplasma is low in the upper part, and high in the lower part of both studied profiles, as a result the Idt in Luvisol is 1.53 and 1.6 in the Red Soil.

The clay mineralogy showed high differences between the two soils: smectite is dominant in Luvisol and caolinite in Red Soil.

Fe component of the pedoplasma has been accumulated in high quantity in both soils: under hydromorphic conditions in Luvisol and appears as redoximorphic features; during a previous phase of evolution in a Mediterranean climate, and strongly pigmenting the Red Soil matrix.

The Al component of the pedoplasma is presents only in Luvisol, in low quantity.

The mobility of the soil plasma, emphasized by the textural pedofeatures, is very high in Luvisol, many types of illuvial clay±Fe coatings have been observed, while in Red Soil the pedoplasma is very stabile, no mobilization or coatings were present.

The high mobility of the pedoplasma in Luvisol induced high acidity, very low soil fertility and low biodiversity of the pasture; very low mobility of the pedoplasma in Red Soil favor high fertility and high biodiversity.

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