A SENSITIVE SANDY SOIL UNDER PASTURE AS MICROORGANISM HABITAT PROVIDER

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Abstract
The sandy soils are sensitive ecosystems, being in a precarious equilibrium with the pedolandscape conditions, any changes could bring drastically modifications into the soil environment. The researches had been performed in Suceava Tableland, in Stephan the Great area, on a Luvosol albic-psamic, lamelar. The researches in the paper focused on the upper part of the argic horizon, on Bt_1 sub-horizon characteristics at macro- and microscopic scale. In this respect, at the macro-morphological level, the Bt_1 sub-horizon is composed of a sequence of thick lamellae (3–5 cm) separated by the inter-lamellar spaces. The granulometric analysis showed that the lamellae had a medium loamy texture, while the inter-lamellar spaces had coarse granulometric composition. At micromorphological level, the image emphasized, in the lamellae, the presence of the clayey±Fe±humic coating the mineral grains and clogging part of the inter-granular spaces. The results of the microbiological investigation showed a concentration of the microorganisms into the lamellae, while in the inter-lamellar spaces, their development has been scarce. The total counts of ***bacteria*** and fungi registered low number (16.81 x 10^6 viable cells x g^{-1} d.s. and 1.026 x 10^3 cfus x g^{-1} d.s., respectively). Despite of these results, the data of the global indicator of the soil microbiological activity, the ***soil respiration*** respectively, attend high level of activity (31.357 mg CO_2 x g^{-1} d.s.). The researches pointed out that the sandy soil is a very sensitive environment for the soil life, but the presence of the clayey±Fe lamellae proved to be a hospitable habitat.

Key words*:* sandy soil, pasture, microorganism habitat, microbiology, micromorphology.

INTRODUCTION

The sandy soils are sensitive ecosystems, being in a precarious equilibrium with the pedolandscape conditions, any changes could bring drastically modifications into the soil environment.
The lamellae in the sandy soils are, for soil life, like the oasis in the deserts (Raducu, 2009).
The objectives of the paper focused on the evaluation of the characteristics of a sensitive sandy soil under the pasture as a provider of the habitat for the soil life at microscopic scale.

MATERIALS AND METHODS

The researches had been performed in Suceava Tableland, in Stephan the Great area, in bioclimatic zone of the forests (oak and beech). The vegetation is secondary pasture of *Festuca rubra, Agrostis tenuis, Antoxanthum odoratum, Setaria glauca, Trifolium arvense*.
The soil was Luvosol albic-psamic, lamelar (according to SRTS-2012; and Lamellic

Luvisol – according to WRB-SR-2014) formed in parent materials consist of sands with intercalations of gravels, clay with intercalations of sands and gray clays.

The soil had been sampled from each pedogenetic horizon of the profile and analyzed according to RISSA Methodology-1987, as follow: the disturbed samples had been used for the physical, chemical and microbiological analysis; and the undisturbed samples for the micromorphological study.

The microbiological indicators used to analyze the microbiological characteristics were: the number of bacteria; the number of fungi; and the soil respiration.

The number of heterotrophic bacteria was determined using the method of dilutions – soil suspensions by dispersion on Topping nutrient medium. The results are expressed in x 10^6 viable cells x g^{-1} dry soil.

The total number of fungi was determined by dispersing soil dilutions-suspensions on the Czapek-Dox nutrient medium. The calculation takes into account the number of colonies that resulted from inoculation, dilution and soil moisture. The results are expressed in x 10^3 cfus x g^{-1} dry soil.

Taxonomic identifications were made on the basis of cultural, morphological and/or physiological characteristics, according to the manual of determinative bacteriology (Bergey, 1994) and fungi in agricultural soils (Domsch et Gams, 1972).

Soil respiration as a global indicator of soil microbial activity was determined by the Ştefanic method. The results are expressed in mg CO_2 x g^{-1} dry soil.

The undisturbed soil had been air drayed and impregnated with epoxidic resins. After hardening, oriented thin sections (25 - 30 µm) have been made from each sample and studied by the aim of microscopic tools in plain polarized light (PPL) and cross-polarized light (XPL), using for their description Bullock et al. (1985) terminology.

both coated the mineral grains and clogged part of the inter-granular spaces.

The lamellae had a complex composition, with: (a) areas where the skeleton grains are trapped in a dark gray clayey – loamy-clayey mass; and (b) areas where the inter-granular material is exclusively illuvial (consisting of clayey±Fe±humic illuvial plasma, brown and reddish-brown).

The illuvial coatings in the first type of areas (a) are darker (due to a higher content of the loamy size impurities) and are partially laminated. In these areas, several generations of coatings (with different compositions) stratified deposited were also noticed. In the second type of areas (b), the illuvial coatings had lighter colour (brownish-yellow) and are very rarely laminated.

RESULTS AND DISCUSSIONS

The results pointed out that on the general background of a soil with coarse sandy texture, the pedogenetic processes generated a deep Bt horizon composed of lamellae randomly distributed into the sandy matrix.

The researches in the paper focused on the upper part of the argic horizon, on Bt_1 sub-horizon characteristics at macro- and microscopic level.

In this respect, at the macro-morphological level, the Bt_1 sub-horizon is composed of a sequence of thick lamellae (3 – 5 cm) distributed into the horizon and separated by the inter-lamellar spaces.

At micromorphological level, the images (fig. 1 B and C) emphasized, ***in the lamellae***, the presence of the clayey±Fe±humic plasmic material that

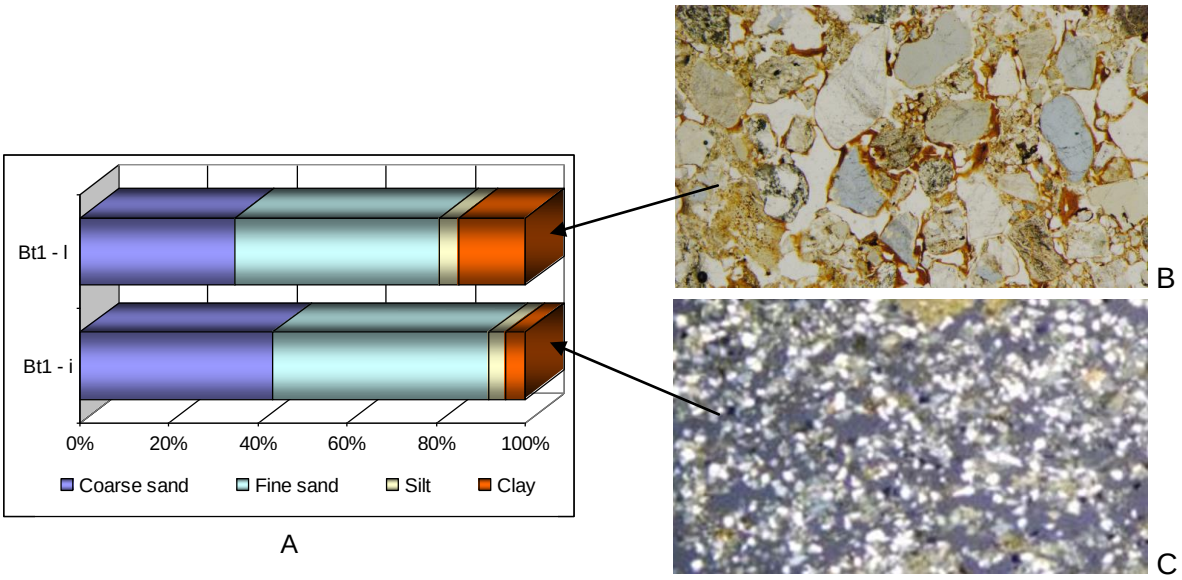

Figure 1. The Bt1 horizon matrix:
A) the granulometric composition of the lamellae (Bt1 – l); and the inter-lamellae (Bt1 – i) ; B) in the lamellae the clay±Fe±humic plasma both coating the mineral grains and clogging part of the voids; C) inter-lamellar space composed of mineral grains (dominantly) of coarse sand sizes.

Locally *in the lamellae*, opaque ferric concentrations also appear. They had rough surfaces and were in an advanced stage of destruction, showed by the locally removed of the Fe oxyhydroxides, and leaving visible the illuvial clay previously deposited under Fe oxi-hydroxide films.

These characteristics highlighted the polyphasic evolution of the soil, evolution during which the wetter periods (that favour the deposition of the clay illuvial coatings), alternated with less humid periods and more aerated (which favoured the segregation and the deposition of the Fe±Mn oxi-hydroxides).

Through the soil pedogenesis, under the influence of the pedogenetic processes, many types of *textural* and *amorphous pedofeatures* formed into the lamellae.

The textural pedofeatures formed in the lamellae had been: 1) yellowish brown clayey illuvial coatings with small amounts of iron, part of them fragmented or in different degrees of fragmentation (the oldest ones); 2) blackish-brown illuvial coatings (composed of clay with a significant amount of iron), mostly laminated; 3) black illuvial coatings, opaque predominantly ferric; 4) brown illuvial impure clay coatings (the contemporary ones).

Consequently, the (clayey±Fe±humic) plasmic material is higher (according also to the micromorphological images – fig. 1 B), creating an environment rich in nutrients and favorable for soil living development.

The amorphous pedofeatures are represented by the black nodules of Fe±Mn that appear sporadically within the lamellae, but are lithorelicts (derived from strongly weathered small fragments of sandstones with ferruginous cement).

The matrix of *the inter-lamellar spaces* is composed of the mineral grains mainly of coarse sand size (similar in size to those within the lamellae). The skeleton mineral grains had a relatively dense spatial arrangement (fig. 1 C), that generated a porous space with more or less packing voids.

The amorphous pedofeatures had been also formed into the inter-lamellar spaces of the horizon, as amorphous black

nodules (of Fe±Mn), derived also from lithorelicts.

The results of the microbiological analysis showed a concentration of the microorganisms into the lamellae, while in the inter-lamellar spaces, their development has been scarce.

In this respect, the total counts of *bacteria* registered low number (16.81 x 10^6 viable cells x g^{-1} d.s.), as well as the *fungi* (1.026 x 10^3 cfus x g^{-1} d.s.).

Despite of these results, the data of the global indicator of the soil microbiological activity, the *soil respiration* respectively, attended high level of activity (31.357 mg CO_2 x g^{-1} d.s.).

The researches emphasized that the sandy soil is a very sensitive environment for the soil life, but the presence of the clayey±Fe±humic lamellae proved to be a hospitable habitat.

CONCLUSIONS

The research results pointed out that under the influence of the pedogenetic processes in the Bt horizon a succession of lamellae and inter-lamellar spaces had been formed.

According to the granulometric analysis the texture had been medium loamy in the lamellae and coarse, sandy in the inter-lamellar spaces.

Consequently, the (clayey±Fe±humic) plasmic material is higher (according also to the micromorphological images), creating an environment rich in nutrients and favourable for soil living development.

The results of the microbiological analysis showed the concentration of the microorganisms into the lamellae, while in the inter-lamellar spaces, their development has been scarce.

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