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A CALCARIC ALLUVIAL SOIL CHARACTERISTICS AT SUBMICROSCOPIC SCALE USING SEM

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INTRODUCTION

Soil is the most important resource of organic farmers. The attempt of performing in organic crops on calcaric alluvial soils, which are almost like sandy soils, requires high knowledge of crop technologies (Stefan et al., 2018), as usually these soils have less nutrients and low water holding capacity leading to frequent irrigation and fertilizations to meet crop requirements (Alshankiti and Gill, 2016). In studies on soil microbial activity of sandy soils it was found that overall activity was low, due to low organic matter and low rainfall (Unkovich, 2014). Due to lower organic fertility and fewer microsites to protect soil biota, sandy soils have also a lower capacity to suppress pathogens and other pests (Coventry, 1998). Eftene et al. (2014) showed that physical and chemical properties of a soil with sandy texture and low soil organic matter content (due to intense mineralization of organic residues) create conditions for a reduced activity of microflora. The physical characteristics of the soils, mainly of the young soils (as Aluviosols) are important for the further evolution of the soils, for the structural and the adjacent poral space genesis that strongly influence the air and soil solution circulation and the biochemical processes. The role and transformations of agricultural inputs, as fertilisers, microbial inoculants, pesticides, etc are highly dependent on soil characteristics.

For a deeper understanding of these characteristics and its interrelations with biotic factors, natural or applied during crop technologies, analysis using Scanning Electron Microscopy (SEM) proved their utility over time. Early SEM observations have been conducted by Barden in 1973 and Grabowska-Olszewska in 1975 on European loess from Belgium and Poland (Delage et al., 2005) and become currently widely used for micromorphological studies. Răducu (2018) showed that soil biota initiated and controlled the important pedogenetic processes, thus soil fauna activity had a major influence on the illuvial process of pedobioplasma, while the activity of microorganisms had a major influence on coatings evolution.

The aim of the present study was to emphasize the main characteristics of an Aluviosol Molic Calcaric from an organic agroecosystem, before the treatment with microbial bioinoculants, using scanning electron microscope (SEM), in order to better understand the changes that occur in the soil (open field) after application of such microbial inoculants.

MATERIALS AND METHODS

The experiment was conducted in the organic research plot from Vegetable Research and Development Station Buzău, România

Three soil surveys were taken up to a depth of 125 cm, with soil samples collected in plastic bags, than dried in the laboratory and carefully stored.

Analysis with FEI Inspect S50 model, in the Laboratory of Microscopy and Plant Anatomy, of the Research Center for Study of Food and Agricultural Products Quality, inside the USAMV Bucharest

RESULTS AND DISCUSSIONS

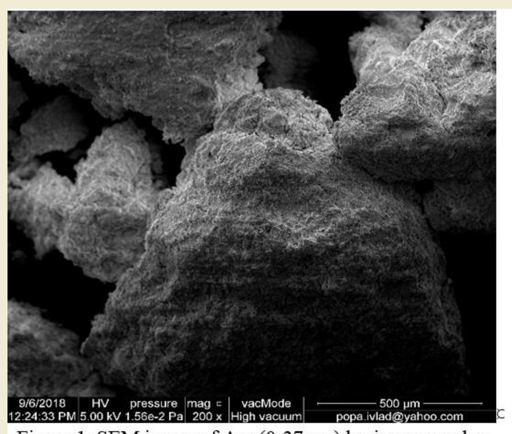

Figure 1. SEM image of Am (0-37 cm) horizon: crumby structure with interconnected pores (200 X)

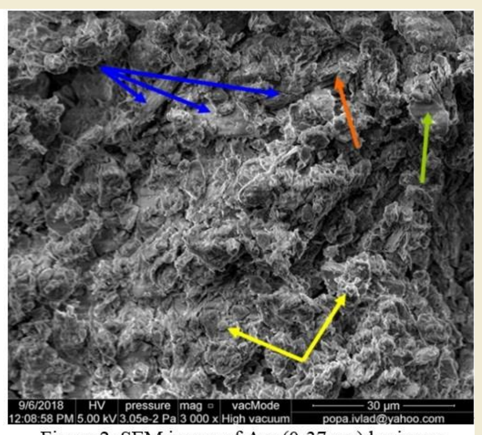

Figure 2. SEM image of Am (0-37 cm) horizon: mineral skeleton grains (→); microorganisms (→); plagioclase feldspars (→); mica flakes (→) (3000 X)

Am (0-37 cm)	Ck_1 (37-96 cm)	Ck_2 (96-124 cm)
Medium sandy-loam; crumb structure weak developed; moderate biological activity; frequent fine pores; weak-moderate effervescence (locally); very frequent thin roots from cultivated vegetation.	Fine sandy-loam; massive; frequent thick pores; frequent fine roots; moderate-strong effervescence.	Coarse sandy-loam; massive; very friable; coarse mineral grains (visible by the necked eye); frequent $CaCO_3$ pseudomycelium; strong effervescence.

Morphological characteristics of the Aluviosol Molic Calcaric

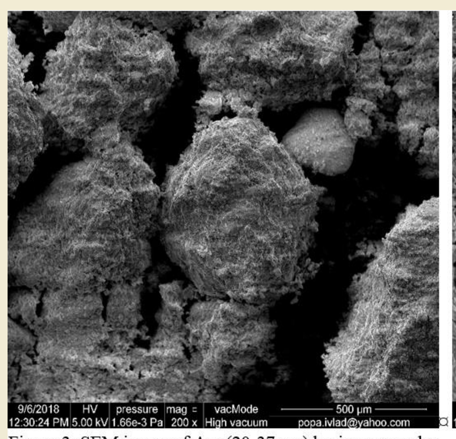

Figure 3. SEM image of Am (20-37 cm) horizon: crumby structure with interconnected pores (200 X)

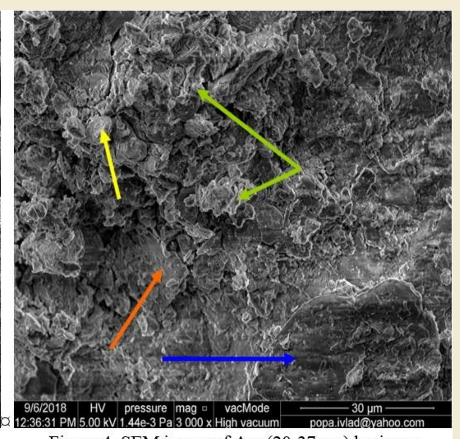

Figure 4. SEM image of Am (20-37 cm) horizon: mineral skeleton grains (→); calcite (→); clay particles binding together (→); mica flakes (→) (3000 X)

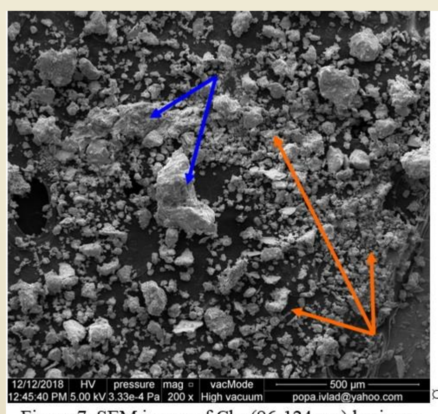

Figure 7. SEM image of Ck_2 (96-124 cm) horizon: poorly developed and non-durable structural elements (→) by the side of un-aggregated coarse material (→) (200 X)

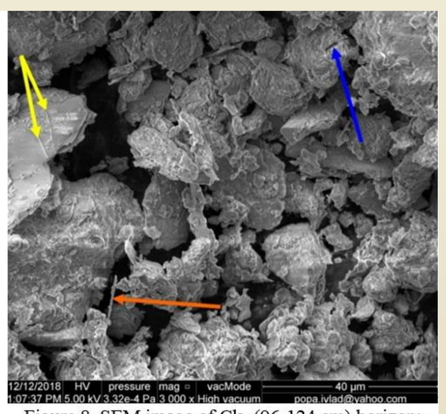

Figure 8. SEM image of Ck_2 (96-124 cm) horizon: acicular calcite crystal (→); fungi mycelium on a platy mica grain (→); fissured calcite and with local recrystallizations (→) (3000 X)

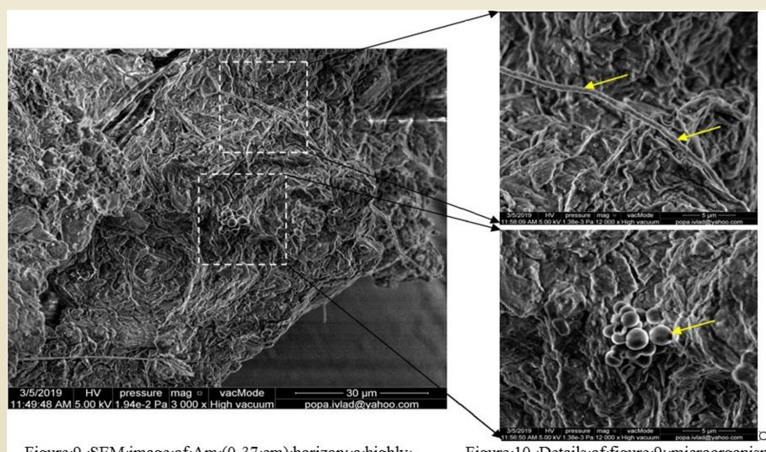

Figure 9. SEM image of Am (0-37 cm) horizon: a highly decomposed vegetal residue (3000 X)

Figure 10. Details of figure 9: microorganisms (→) on the decomposed vegetal residue (12000 X)

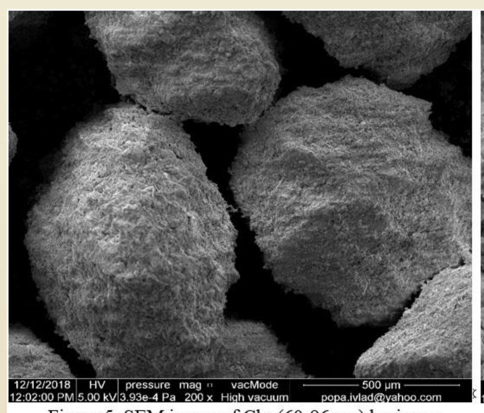

Figure 5. SEM image of Ck_1 (60-96 cm) horizon: crumby structure with interconnected pores (200 X)

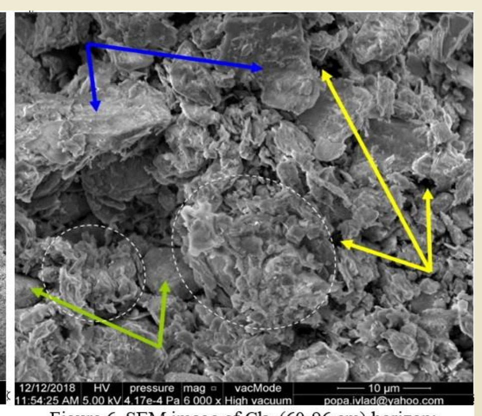

Figure 6. SEM image of Ck_1 (60-96 cm) horizon: mineral skeleton grains (→); silt-size micro-aggregates (◌); intrapedal packed pores (→); calcit crystals (→) (6000 X)

CONCLUSIONS

*** The results obtained with the help of the scanning electron microscope (SEM) following the study of an Aluviosol Molic Calcaric from an organic agroecosystems before the treatment with microbial bioinoculants revealed detailed aspects related to the spatial organization of the soil at sub-microscale.**

*** The high magnification (until 6000 X) allowed the visualization of the soil elementary fabric into the peds. Even if the SEM images are in the greyscale, the skeleton grains were detected according their specific characteristics (type of twinning, foliated texture etc.).**

*** Many skeleton grains are weathered and partially covered with secondary alteration products (clay, Fe etc.), whose presence favours the development of microorganisms on the faces of the mineral grains.**

*** The study of the behaviour of $CaCO_3$ in the soil pedological horizons showed the presence of the different types of calcite crystals: crypto-crystals (embedded into the soil matrix), acicular crystals (on the pore walls) etc.**

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