ASSESSMENT OF SOIL QUALITY IN CONSERVATIVE AGRICULTURE SYSTEMS VERSUS CONVENTIONAL AGRICULTURE

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Abstract

The paper presents the results of the researches carried out in the SCDA Drăgănești Vlașca experimental field, in two agriculture systems, conservative and conventional. Soil samples, taken in two phases, were analyzed in the laboratory to determine physical and chemical parameters: organic matter content, soil structure, bulk density, soil reaction, nutrients (N, P, K, and S) contents, total porosity, and resistance to penetration. Micro biological analyses were also performed: total number of bacteria (TNB×10^6/g dry soil), total number of micro fungi (TNF×10^3/g soil), and soil respiration (mg CO_2/100 g sol).
Soil arrangement state assessed through BD, TP, and RP is more favorable in the case of the conservative system as compared to the conventional one. The analyzed indicators highlight a soil looser arrangement in the conservative system and a certain improvement of the air condition. The slightly positive effects determined by the conservative system application reflect upon the soil hydric and physical state, and a little better conditions are present for water accumulation in soil. Diminished surface traffic permitted the so-called `soil rest` resulting in a natural soil aggregates re-arrangement and a slight improvement of the air-water system. From the chemical point of view, the soil in both agriculture systems presented characteristics relatively favorable for growth and evolution of cultivated plants. From the micro biological point of view an increase of the TNF values was noticed at the spring harvest 2017 in two of the three probes made in the soil worked in conservative system as compared both to the autumn harvest and the conventional system, due to the nutrients abundance proceeded from the vegetal biomass left at the soil surface after harvest. Soil respiration as a soil biologic activity indicator closely modelled the TNB and TNF values obtained in both agriculture systems and in both harvest periods, proving that the soil microorganisms' populations are really active and develop their metabolic and ecologic functions in the soil.

Key words: agriculture systems, soil, heterotroph microorganisms, soil respiration

The fact is recognized in conventional agriculture that causing, accelerating, and intensifying soil degradation is mostly determined by anthropic activities and less by some natural limiting factors. Anthropic activities carried out in conventional agriculture along with natural factors determine: physical degradation, water and wind erosion, water logging, chemical degradation, and biologic degradation (Dumitru E., 2005). The organic matter natural level rapidly decreases, immediately after beginning soil cultivation, but the rate of this decline depends on agricultural management practices, respective inputs, rotation of crops, vegetal leftovers management, and organic amendments application. As concerns the nutritive substances soil contents it varies very much. The variation is determined by the microorganism's activity, soil chemical reactions, plants consumption, and soil and climatic conditions. The variation has different intensities also depending on the cultivated plant species or the used agro technical methods (Onisie T., *et al*, 2000). The minimum works system or no-till accelerates organic matter oxidation by the soil microorganisms through aeration, temperature, and nutritive medium (Doran J.W. *et.al,* 1987, cited by Thomas G.A *et al*, 2007). Bacteria are active in all the soil degradation reactions and have a crucial role in organic matter and vegetal leftovers decomposing processes (Voiculescu A.R. *et al,* 2005). In the conservative systems with direct sowing the lack of soil works allows the accumulation of vegetal leftovers at soil surface and supplies food and better protection against erosion and creates a more favorable micro habitat for all the soil microorganisms.

The soil microbial mass reacts differently in relation to works manner and aeration. The more intense the works, the strongest the negative effects (Young I. M. *et al,* 2000). No-till (NT) is an

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agriculture management practice which reduces soil physical disturbance which could affect the organism's habitat. No-till can modify soil humidity, the temperature condition (McConkey B. G., *et al*, 1996), aggregation (Alvarez R., 2009), nutrients cycle (Cookson W. R. *et al*, 2008; Triplett G. B., *et al*, 2008, cited by Helgason B. L., *et al*, 2010), and eventually plants growth. In the no-till system a soil is obtained with a series of biologic, chemical, and physical characteristics opposite to those of a ploughed soil, by leaving vegetal leftovers on soil surface and blending them during works. A comparison between no-till and conventional systems will include the difference as regards the microbial medium, the soil microorganisms' number and activity, the effect of works upon micro fauna, organic matter decomposition, nitrogen concentration, chemical properties, influence upon mulch, effects of works upon bulk density and porosity (Phillips R. E. *et al*, 1983). The arable layer physical properties, which are modified by soil works, include bulk density and soil structure.

Soil works cause changes as regards different size aggregates as well as their distribution. Crust formation is avoided, soil physical and chemical properties are improved and a better water infiltration takes place through conservative systems like minimum soil works and no-till.

MATERIAL AND METHODS

Researches were carried out in the SCDA Drăgănești Vlașca, Teleorman County, experimental field, where agrochemical probes were made in the area of soil profiles characteristic to the studied region on a 4 ha surface. Soil samples were taken for physical, chemical, and micro biological analyses in two agriculture systems, conservative and conventional, in two sampling phases (autumn 2016 and spring 2017). The soil, of the Haplic Phaeoziom[2] type, had the following characteristics: baticalcaric (moderately leached), loamy clay, clayey loam, formed on clayey loam, loess carbonatic deposits with clayey shale deposits substratum, villafranchian, arable, battered; Humus content: 3,0-3,6%; clay content (0-45 cm): 45-48%; total nitrogen: 186 ppm; available phosphorus (soluble in ammonium lactate-acetate): 76 ppm; available potassium (soluble in ammonium lactate-acetate): 250 ppm; pH (in H_2O): 6,3; medium fine loamy clay structure. The micro biologic samples were taken from soil surface on the 0-20 cm depth, after removing vegetal debris. The physical samples were taken in undisturbed structure and the agrochemical ones on pedogenetic horizons in the case of probes on the 5-10, 25-30, and 45-50 cm depths.

Physical and chemical analyses were carried out in the laboratory: organic matter, soil structure, bulk density, pH, N, P, K, S, total porosity and resistance to penetration, and for the micro biological samples: TNB$\times 10^6$/g dry soil, TNF$\times 10^3$/g dry soil, and soil respiration, mg CO_2/100 g sol. All analytical methods are standardized in STAS and ISO systems.

RESULTS AND DISCUSSIONS

The influence of working systems upon soil physical and chemical properties

In the conservative works system, in the first phase of sampling for physical analyses, the fact is noticed that bulk density is high on the 5-10 cm depth and average on the 25-30 cm and 45-50 cm depths; total porosity is small on the 5-10 cm depth and average on the 25-30 cm and 45-50 cm depths and the compaction degree is moderate on the 5-10 cm depth and small on the 25-30 and 45-50 cm depths which leads to a less favorable soil arrangement state for growth and development of plants, especially at soil surface. Soil aeration works are needed for improving the air-water condition. From the chemical point of view, the soil from the researched area presents relatively favorable characteristics for cultivated plants growth and development.

In conventional works system, in the first phase of soil sampling for physical analyses, the fact is noticed that average bulk density and total porosity in all probes and on all depths and the small compaction degree lead to a less favorable soil arrangement state for plants growth and development on all three depths. Soil aeration works are needed to improve the air-water condition.

In the second sampling phase for physical analyses in conservative system the dynamics study of the soil arrangement state reveals an improvement determined by the conservative works application.

The diminished traffic at the surface allowed the so-called `soil rest` which favors a natural soil aggregates re-arrangement, a slight improvement of the porous system and implicitly of the whole arrangement state. Thus, the values of the determined hydro-physical indicators highlight a certain improvement of the soil water condition, effect of the presence of a better distributed porous system. It is noticed that the soil tends to have a better water retention and accumulation capacity.

From the hydro-physical characteristics point of view the soil of the conventional system presents a less good state as compared to the soil of

[2] WRB 2014

the conservative system. The situation is due to the presence of a less favorable porous system for soil water accumulation.

The influence of the works systems upon soil micro biological activity

The quantitative heterotrophe bacteria microflora analyses expressed in values of the total bacteria number (TNB×10^6/g dry soil) show differences between the soil works systems especially at the autumn 2016 sampling after seedbed preparation (Figure 1). Tus, in the samples taken in the conventional system, the TNB values are noticeably higher as compared to those obtained in the conservative system as a consequence of the higher oxygen concentration in the ploughed soil. The differences are though not significant, they don′t exceed one order of magnitude.

At the spring 2017 harvest in both soil works variants the TNB values are much lower as compared to those of the autumn harvest, normal fact caused by passing through the cold winter period when, generally, the bacteria species majority go into resistance forms (Figure 2). On the other hand the bacteria communities restart activity at the same time with soil temperature rising and at harvest time no technologic elements existed which generate differences between the soil works systems.

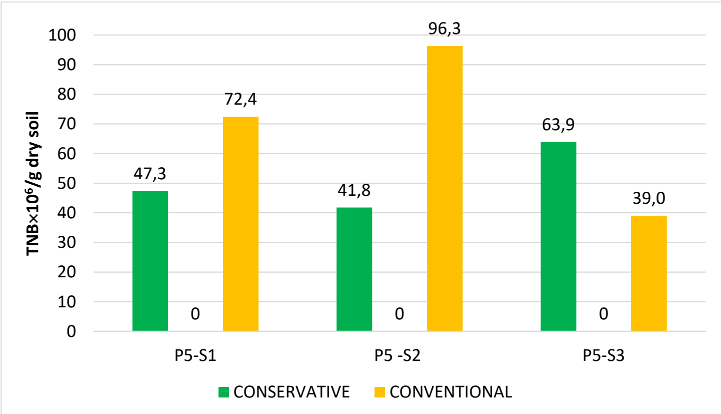

Figure 1 **The dimensions of the edaphic bacteria communities in the two soil works systems in the autumn of 2016**

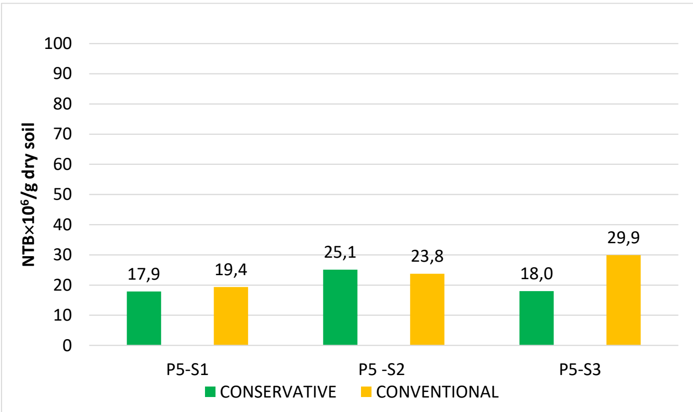

Figure 2 **The dimensions of the edaphic bacteria communities in the two soil works systems in the spring of 2017**

The fungi micro flora quantitatve analyses, expressed in values of the total micro fungi number (TNF×10^3/g dry soil), show minor differences between the soil works systems at the autumn 2016 harvest, i.e. slightly higher values in the conventional system variants. The most probable cause is the oxygen input in soil, as in the case of bacteria, determined by the seedbed preparation works (ploughing) (Figure 3).

At the spring 2017 harvest an TNF values increase was noticed in two of the three probes of the soil worked in conservative system as compared to both the autumn harvest and the conventional system.

Soil respiration as an indicator of the soil biologic activity closely models the TNB and TNF values obtained in both agriculture systems and in both harvest phases, which shows that the microorganisms populations determined through laboratory analyses are really active and unfold their metabolic and ecologic functions in soil (Figures 5 and 6).

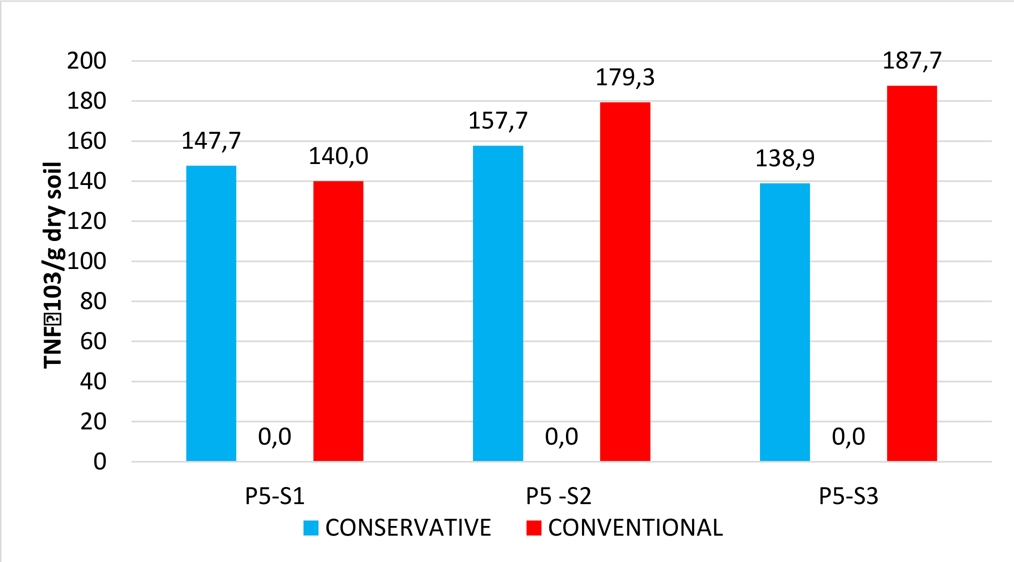

Figure 3 **The dimension of the edaphic micro fungi communities in the two soil works systems in autumn 2016**

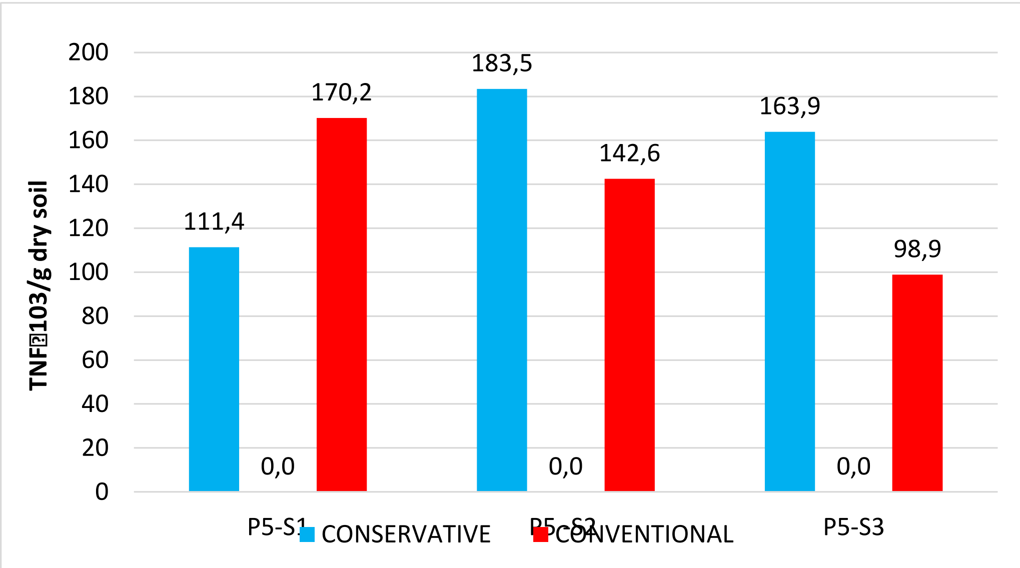

Figure 4 **The dimension of the edaphic micro fungi communities in the two soil works systems in spring 2017**

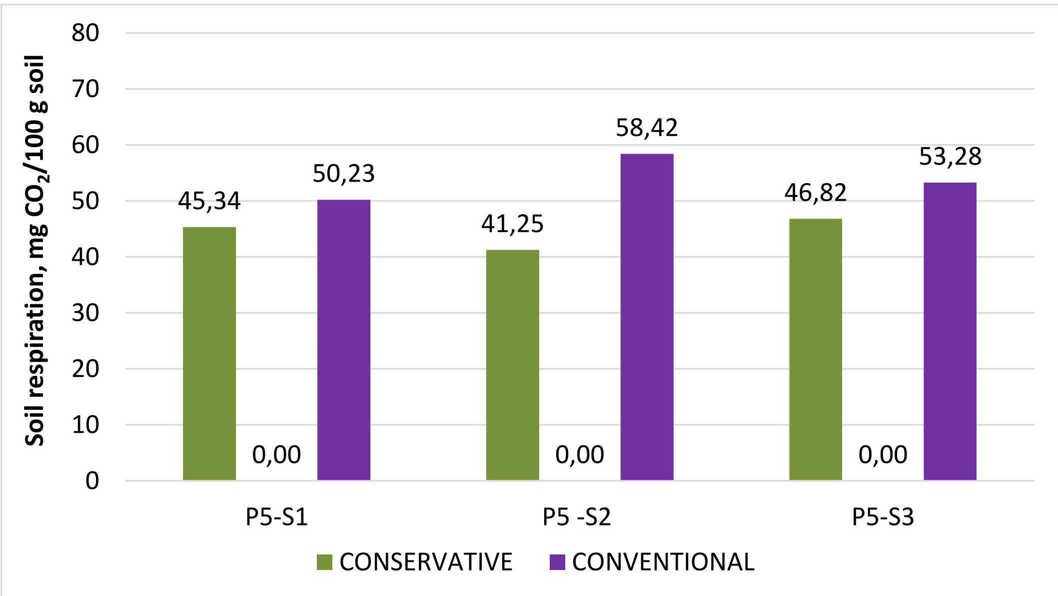

Figure 5 **Soil respiration in the two soil works systems in autumn 2016**

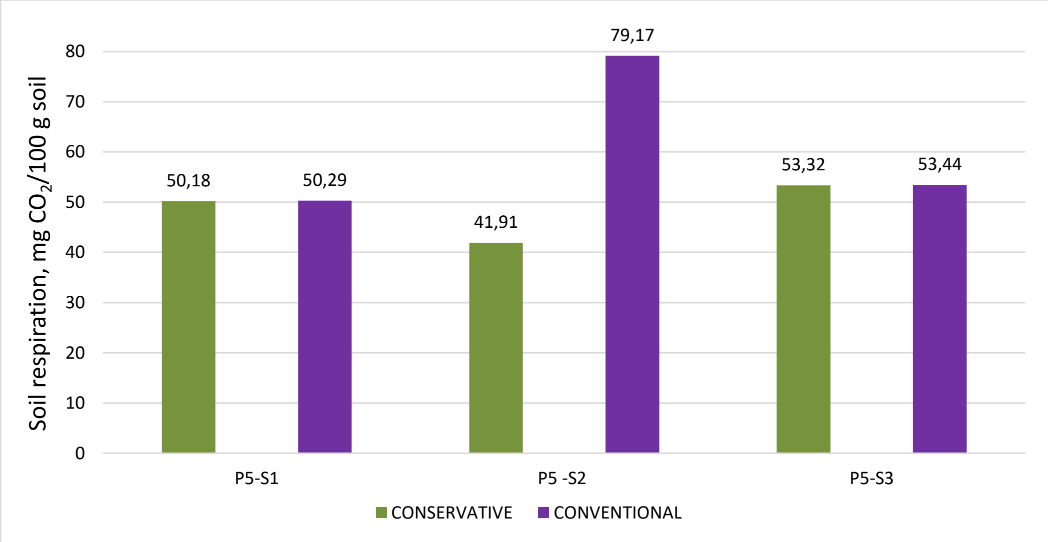

Figure 6 **Soil respiration in the two soil works systems in spring 2017**

CONCLUSIONS

From the physical state point of view the soil in the conservative system presented more favorable characteristics as compared to the one in the conventional system. The soil arrangement state assessed by determining BD, TP, and RP is more favorable in the case of the soil in the conservative system as compared to the one in the conventional system.

The analyzed indicators values highlight a looser soil arrangement in the conservative system and a certain improvement of the air condition. The slightly positive effects determined by the conservative system application also reflect upon the soil hydriphysic state and a little better conditions are present for water accumulation in soil. The soil resistance to penetration in the conservative system registered lower values as compared to those of the conventional system soil.

From the dynamic analysis of the soil state one can say that a certain improvement of the soil physical and hydro physical state is noticed in the conservative system.

The low surface traffic allowed the so-called `soil rest` which resulted in a soil aggregates natural re-arrangement and a slight improvement of the air and water condition. Keeping the vegetal leftovers at the surface protects the soil against the destructive natural factors action. The soil of the region is susceptible to physical degradation processes through dusting, pores filling, and crust formation.

From the chemical point of view, the soil from the areas in the conservative and conventional systems presented characteristics relatively favorable to cultivated plants growth and development.

From the micro biological point of view it was noticed that at the spring 2017 harvest two of the three probes stood out in the soil worked in conservative system with a TNF values increase as compared to both the autumn harvest and the conventional system.

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