COMPARATIVE DESCRIPTION EFFECTS OF THE SOIL HORIZON AND CROP TYPE ON THE MICROORGANISMS VARIATION IN AGRICULTURAL SOILS FROM CRISURILOR PLAIN

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Abstract

Abundance of the microorganisms in the soil in relation to soil horizon and crop type was evaluated. The soil samples were collected from an experimental plot located in Cauaceu, Bihor County, in the spring and autumn of the years 2014-2015. The quantitative variation of three ecophysiological microbial groups was studied: aerobic mesophilic heterotrophic bacteria, fungi and Actinomycetes. The plate count method was used to estimate the total number of the studied microorganisms. The two-way analysis of variance ANOVA was used to determine the significance of mean differences between the microbiological parameters for the soil horizon and crop type factors. The results showed that the crop type factor is the dominant factor with effects on the variation of the bacteria population while the fungi population is influenced by the both horizon and crop type factors that shows high variation amplitude.

Keywords: microorganisms, abundance, soil depth, crop type.

INTRODUCTION

Large diversity of microflora is found in the soil horizons. Factors that influence the microorganisms abundance are of unique interest (Bhattarai, 2015). The distribution of microorganisms in a typical soil profile has been described by Alexander (1971). Although extensive information has been generated on plant and animal biodiversity, little is known on microbial diversity and our knowledge on soil biodiversity is still a miniscule. Two parameters become important while evaluating the significance of microorganisms in soil i.e., abundance and diversity. While abundance may increase or decrease over short periods of time in response to management practices and inputs, diversity is a more complex and stable attribute and reflects a state of near equilibrium (Hawksworth, 1991).

High variation can be found for abundance between different soil types, seasons and land uses. In view of the large fluctuations and the undependability of numbers, microbial biomass is often used as a more reliable parameter to assess the abundance (Tilak, 2000). Soil profiles are many meter deep and soil varies from place to place. The microorganisms population also varies with the depth (Bhattarai, 2015). Cultivation alters the distribution of organisms throughout the soil profile. Thus, the physical effect of cultivation has a profound direct effect on the habitat of soil

organisms. Cultivation has a wide range of influences on soil organisms. A difficulty in trying to determine the impact of cultivation on a soil organism is that more than one factor is usually altered simultaneously (Duah-Tentumi and Johnson 1986). To a better understanding of the microorganisms variations in response to common conditions of agricultural practice the paper present the comparative description of the effects generated by the soil horizon and crop type on the microorganisms abundance.

MATERIAL AND METHODS

The experimental field is located in Bihor County, in Cauaceu locality area. The study was made on the haplic luvisol cultivated in three variant: maize crop, orchard and meadow. The soil samples were collected from the experimental plots in spring and autumn of the years 2014-2015. The plate count method was used to estimate the total number of aerobic mesophilic heterotrophic (AMH) bacteria on a sterile solid nutrient medium containing meat extract (pH 7.5, incubation at 37^0C, 3 days) (Atlas, 2004), the total number of fungi (FNG) on Sabouraud dextrose medium (pH 5.4-5.6, incubation at 25^0C, 4-5 days) and total number of *Actinomycetes* (ACT) on casein-starch agar (Williams and Davis, 1965). The statistical method used to determine the significance of mean differences between the microbiological parameters for the soil horizon and crop type factors was the two-way analysis of variance (ANOVA) (P=0.05). Analysis of variance helped to emphasise the dominant factor (soil horizon/crop type) effect in terms of the variability of soil microbiological properties. The ANOVA results were generated using the software GraphPad Prism version 5.5 (GraphPad Software, San Diego, CA) (Quinn, 2002; Abdi, 2010).

RESULTS AND DISCUSSION

In the table 1 are presented the results of the studied soil parameters as mean ± standard deviation (SD) to reflect the statistically significant differences between the mean values according to the two-way ANOVA (P=0.05, N=3) analysis with the crop type factor (with the levels CROP-cropland, MEAD-meadow and ORCH-orchard) and soil horizon factor (h_1:0-20 cm and h2:20-40 cm). The significance of differences between the averages of each parameter (for the soil horizon factor and crop type factor) is marked with letters after each mean value. Different letters designate statistically significant differences between the corresponding means. The multiple comparison was made with the *post-hoc* Tukey's test with Bonferroni corrections (P=0.05), within the two-way ANOVA test.

Table 1

The results of the *post- hoc* Tukey's test of multiple comparisons within the two-way ANOVA analysis for the interaction Horizon*Crop Type.

Variable	Factor: Crop type	Factor: Horizon, h_1 (mean ±SD)	Factor: Horizon, h_2 (mean ±SD)
AMH (CFU/g soil)	CROP	7.406a ±0.017	7.263b ±0.023
	MEAD	7.439a ±0.023	7.025c ±0.010
	ORCH	7.039c ±0.055	6.899d ±0.077
ACT (CFU/g soil)	CROP	8.114b ±0.007	7.748c ±0.014
	MEAD	8.146b ±0.005	8.833a ±0.003
	ORCH	6.277d ±0.047	4.299e ±0.046
FNG (CFU/g soil)	CROP	5.846b ±0.025	4.039f ±0.061
	MEAD	5.279d ±0.013	4.531e ±0.034
	ORCH	6.491a ±0.019	5.531c ±0.028

Note: different letters near the means describe statistical significant differences.

The plots shown below (fig. 1, 2, 3) represent the two-way ANOVA factorial analysis for the soil horizon factor on 2 levels (h_1: 0-20 cm and h_2: 20-40 cm) and crop type factor on 3 levels: meadow (MEAD) cropland (CROP) and orchard (ORCH).

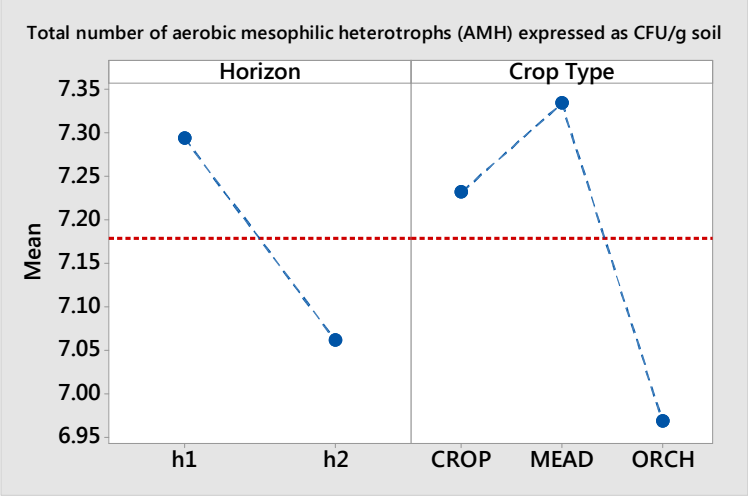

Fig. 1. Graphical representation of the effects of the horizon and crop type factorial components for the variable total number of aerobic mesophilic heterotrophs (AMH) expressed as CFU/g soil (horizontal dotted line is the grand mean).

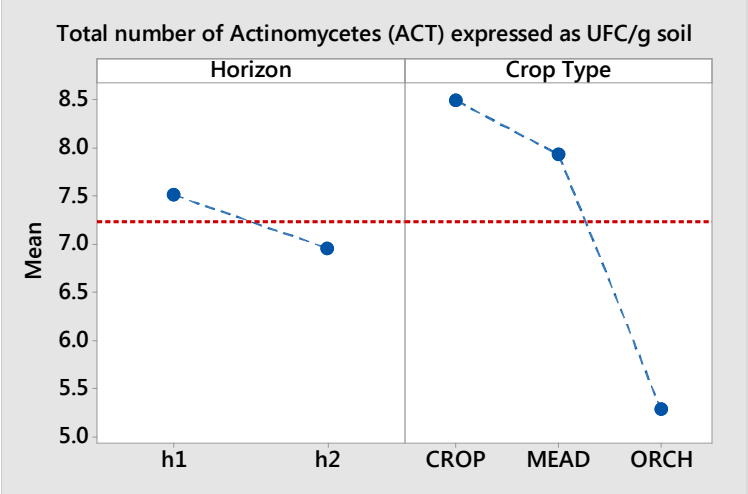

Fig. 2. Graphical representation of the effects of the horizon and crop type factorial components for the variable total number of *Actinomycetes* (ACT) expressed as UFC/g soil (horizontal dotted line is the grand mean).

The dominant effect in terms of the heterotrophic aerobic mesophilic bacteria and *Actinomycetes* (ACT) variation is given by the crop type with the highest amplitude variation (fig. 1, 2).

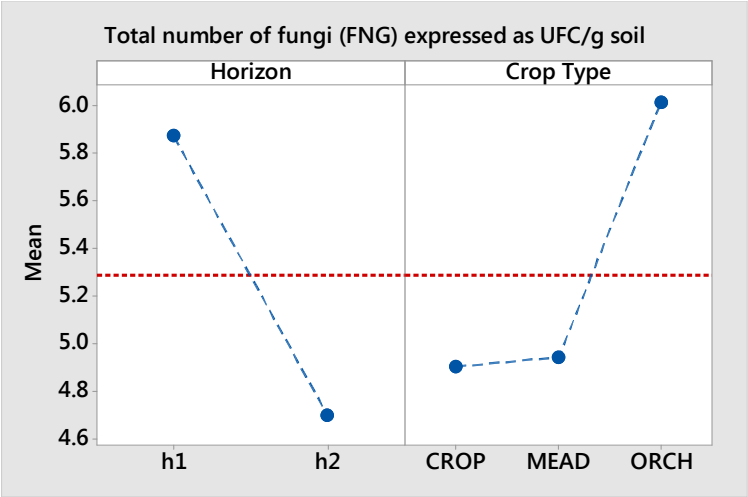

Fig. 3. Graphical representation of the effects of the horizon and crop type factorial components for the variable total number of fungi (FNG) expressed as UFC/g soil (horizontal dotted line is the grand mean).

Concerning the variation of the microbiological variable total number of fungi (yeast and moulds, FNG) the dominant effect is given by the both horizon and crop type factors that shows high variation amplitude (fig. 3).

Research on microbial abundance and diversity of the soil microbial populations as well as numerical presence of microbial groups involved in the biogeochemical soil circuits shall be entered in the field of agricultural research of great interest to our country because the activity of the soil microorganisms can be an indicator of soil quality evaluation under the influence of various technical and agrochemical processes.

CONCLUSIONS

The microbiological analyses of the haplic luvisol suggest that the changes in the number of soil microorganisms are determined by the cropping system. The soil depth is another factor with a great influence on the microorganisms distribution and abundance.

The graphical representation of the statistically interpretation of the values of the soil microbiological parameters and the comparative description of the effects generated by the soil horizon and crop type factors showed that the principal/dominant effect in the variation of the total number of aerobic mesophilic heterotrophic bacteria (AMH) and total number of *Actinomycetes* (ACT) is done by the crop type factor. The principal/dominant effect regarding the variation of the fungi population (FNG) was done by the both soil horizon and crop type factors.

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