COMPARATIVE ANALYSIS OF THE EFFECTS OF DIFFERENT LAND USE TYPES ON SOIL PROPERTIES

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Abstract

This study was conducted to evaluate the soil properties under different crop type. Soil samples were collected in March 2014 from plots of an experimental field localized at Ianculesti Farm, Satu Mare County. The land use types were pasture and cropland (wheat crop). To compare the soil physical, chemical and microbiological properties under different crop type the samples were processed using two-way variance of analysis (ANOVA). In order to determine the statistical significance of means differences, differences were done between the means of four groups built up by mixing crop type sampling (CROP as cropland and PAST as PASTURE) and soil profile sampling (h1 for 0-20 cm and h2 for 20-40 cm). The analysis of variance (two-way ANOVA, P=0.05) showed statistically significant differences (P<0.0001) of soil humidity, pH, hydrolytic acidity, organic matter content, organic carbon, total nitrogen and microbial populations (heterotrophic bacteria, Actinomycetes and fungi) for the crop type factor. Moreover, statistically significant differences have registered for the both studied soils, at the level of the soil horizon, in relation to soil humidity and fungi populations. Statistically significant differences of soil acidity, organic matter, organic carbon, total nitrogen, heterotrophic bacteria, Actynomycetes and fungi were determined for cropland, between soil horizon h1 (0-20 cm) and h2 (20-40 cm).

Keywords: soil properties, land use, cropland, pasture.

INTRODUCTION

Soil is a complex system wherein chemical, physical and biochemical factors are held in dynamic equilibrium (Kennedy, Papendick, 1995). Long periods of continuous cultivation of cropland led to changes in some of the physical and chemical soil properties (Kizilkaya, Dengiz, 2010).

Recent studies reported that the content and quality of soil organic matter and the biochemical activity are changed when natural ecosystems are replaced by different land uses such as pasture and annual crops (Cardelli, 2012).

Drenovski et al, 2010, described that the main factor driving composition and microbial biomass was land-use type, especially as related to water availability and disturbance.

Distinct microbial communities were associated with land-use types and disturbance at the regional extent. Soil microorganisms respond very quickly to various natural and anthropogenic pressures or stresses acting on the soil ecosystem (Pal, 2012).

Dequiedt et al, 2009, described that soil microbial community structure and activity is shaped by a multitude of factors, including climate (seasonality), soil type, land cover and edaphic factors.

The main objective was to study and compare the physico-chemical and microbiological soil properties under different crop type. The land use types were pasture and cropland (wheat crop). The soil type is chernozem (FAO classification).

MATERIAL AND METHODS

Study site and field data collection

The study was carried out at the Ianculesti Farm, Satu Mare County, in March 2014. In the experimental plots field we collected three mixed soil samples from 0-20 cm and 20-40 cm soil horizon. Each sample was consisting of 5 individual, randomly collected subsamples. After skeleton material and plant roots were removed, the samples were stored at 4^0C, sieved on Ø2 mm sieve and mixed.

Soil physical and chemical properties.

Physical and chemical properties of the soil samples were determined as follows: moisture content (Ur,%) using gravimetrically method by oven-drying fresh soil at 105^0C, hydrolytic acidity (Acid., me/100 g soil) was determined by Kappen procedure, pH in 1:2:5 soil water suspension by pH-meter, organic matter content (humus, %) by using Walkley-Black method. The method used for organic C% determination was wet oxidation method and dosage titration and for the total N% Kjeldahl method.

Bacteriological analysis. The quantitative variation of three ecophysiological bacterial groups have been studied: aerobic mesophilic heterotrophs (AMH), *Actinomycetes* (ACT) and heterotrophic fungi (FNG). Plate count method was used to estimate total number of aerobic mesophilic heterotrophs on a solid nutrient medium containing meat extract (Atlas, 2004), total number of *Actinomycetes* on agar with glucose and asparagines and total number of culturable fungi on Sabouraud Agar. After incubation the counts obtained were multiplied by the dilution factor to obtain the number of colony forming unit per gramme of soil.

Statistical analysis. The samples were processed using two-way variance of analysis (ANOVA) (n=2, in duplicates; P=0.05), in order to determine the statistical significance of means differences. Differences were done between means of four groups built up by mixing crop type sampling (CROP as cropland and PAST as PASTURE) and soil profile sampling (h1 for 0-20 cm and h2 for 20-40 cm). ANOVA results were generated with GraphPad Prism version 5.5 software (GraphPad Software, San Diego, CA, www.graphpad.com) (Abdi H., 2010).

RESULTS AND DISCUSSION

Table 1 present the results of the studied soil parameters under different land use type (CROP-cropland, PAST-pasture) as mean ± standard deviation for evidence the statistically significant differences between mean values according to the two-way ANOVA analysis with the factor Crop type (with levels CROP and PAST), and soil horizon (h1 and h2). The significance of differences between means for each parameter (for type culture factor and factor horizon) are marked with letters after each average.

Different letters designate statistically significant differences between mean values appropriate. Averages multiple comparison was made with the post-hoc Bonferroni test (P = 0.05) in the analysis of variance (ANOVA).

Table 1

The results of the post-hoc tests of Tuckey multiple comparison in the analysis of variance two-way ANOVA for Horizon*Crop type interaction

Variable	Factor Crop type	Factor Horizon: h1 MEAN±SD	Factor Horizon: h2 MEAN±SD
Ur	**CROP**	7.970 c ±0.076	9.470 a ±0.166
	PAST	7.120 d ±0.130	4.600 e ±0.155
pH	**CROP**	7.800 a ±0.125	7.900 a ±0.044
	PAST	6.050 b ±0.118	6.200 b ±0.044
Acid	**CROP**	1.140 d ±0.072	1.790 c ±0.114
	PAST	4.200 a ±0.070	4.580 a ±0.142
Humus	**CROP**	3.250 b ±0.104	2.630 c ±0.027
	PAST	3.490 b ±0.157	2.150 d ±0.087
C%	**CROP**	1.880 b ±0.061	1.520 c ±0.017
	PAST	2.020 b ±0.092	1.240 d ±0.052
N%	**CROP**	0.157 b ±0.002	0.161 b ±0.008
	PAST	0.164 b ±0.001	0.105 c ±0.005
AMH	**AGR**	7.406 a ±0.017	7.263 b ±0.023
	PAST	7.439 a ±0.023	7.025 c ±0.010
ACT	**CROP**	8.114 b ±0.007	7.748 c ±0.014
	PAST	8.146 b ±0.005	8.833 a ±0.003
FNG	**CROP**	5.846 b ±0.025	4.039 f ±0.061
	PAST	5.279 d ±0.013	4.531 e ±0.034

***Note**: inside a cartridge (defined for a variable) different letters designate statistically significant differences between mean values, according to the analysis two-way ANOVA with factors: Horizon (with h1 and h2 levels) and Crop type (with CROP and PAST levels).*

The humidity parameter (table 1) present significantly differences between the two land use types, the significance at the level of the horizon being different, the maximum value (9.470) was registered in cropland, in h2 (20-40 cm) and the minimum value (4.600) in pasture, in the same soil horizon.

Concerning the pH values between the two studied soils were not registered significantly differences because for each crop type the significations at the soil horizon level are the same (same letters).

However, there are significant differences between the average values registered in the studied crops.

The maximum value (7.900) was registered in cropland, in h2 and the minimum value (6.050) was registered in the pasture in h1. No significant differences have registered for the pasture, at the level of the soil horizon, in relation to soil acidity.

For cropland, the significance are different, the maximum value (4.580) was registered in pasture, in h2, and the minimum value (1.140) in cropland, in h1.

The humus content varied significantly on the two soil horizons with statistically significant differences for the studied soils (pasture and cropland). Both maximum and minum values were registered in pasture (the minum value, 2.150 in h2, and the maximum value, 3.490 in h1).

Cultivated soils generally have low organic matter content compared to native ecosystems, since cultivation increases aeration of soil, which enhances decomposition of soil organic matter (Jaiyeoba, 2003).

Organic carbon (C%) parameter presented significantly differences for the studied soils, the significance at the level of the horizon being different, the maximum value (2.020) was determined in pasture, in h1 and the minimum value in h2.

The same situation was identified for total nitrogen parameter, the highest value (0.164) was registered in pasture, in h1, and the lowest (0.105) in h2.

Concerning the studied microbiological parameters (total number of aerobic mesophilic heterotrophs, *Actinomycetes* and fungi) significantly differences were revealed between the soil horizons of the studied soils. The highest value (7.439) of AMH was determined in cropland, in h1 and the lowest (7.025) in pasture, in h2.

A large number of ACT (8.833) was determined in pasture, in h2 but in cropland, in h2, they had a low numerical representation (7.748). The fungi population was well numerically represented in cropland, in h1 (5.846) but in h2 the values were lower (4.039).

CONCLUSIONS

The results show statistically significant differences between cropland and pasture and also between the soil horizons (0-20 cm, 20-40 cm) for the following parameters: soil humidity, pH, hydrolytic acidity, organic matter content, organic carbon, total nitrogen and microbial populations (heterotrophic bacteria, *Actinomycetes* and fungi).

Statistically significant differences have registered for the both studied soils, at the level of the soil horizon, in relation to soil humidity and fungi populations. Statistically significant differences of soil acidity, organic matter, organic carbon, total nitrogen, heterotrophic bacteria, Actynomycetes and fungi were determined for cropland, between soil horizon h1 (0-20 cm) and h2 (20-40 cm).

Agricultural management can have larger effects on soil physical and chemical properties and on soil microbial communities.

The land-use type could be the main factor driving the soil properties and microbial community structure.

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