SEASONABLE CHANGES OF DIFFERENT MICROBIOLOGICAL PROPERTIES OF A HAPLIC LUVISOLS

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Abstract

Degradation of soil properties following long-term soil cultivation may lead to decreases in soil microbial diversity and functional stability. In this study, we investigated the seasonable changes of different microbial parameters in three different cultivation methods, in the soils of a cropland, an orchard with apricot tree and in an uncultivated pasture. In spring and autumn of the years 2010 and 2011 we investigated the microbiological soil properties of a haplic luvisols and we try to compare the effects of different cultivation methods and land use on the processes taking place of soil. The seasonal variations of soil microorganisms depend on changes in the soil chemical properties and the microbiological processes of soil are determined in main by different cropping systems, soil management and season. Investigation of the microbiological properties of a haplic luvisol, under different cultivation conditions showed that anthropogenic factors such as fertilization and treatments with pesticides was favourable for certain microorganisms while others were inhibited by these factors.

Keywords: cropland, orchard, pasture, microorganisms.

INTRODUCTION

The removal of natural vegetation followed by cultivation can cause severe changes to physical, chemical, and biological soil properties. These changes are often associated with reduction of soil organic matter, deterioration of soil structure, and decreases in microbial biomass and activity. Many studies have also shown that deforestation and soil cultivation alter soil microbial community structure and may lead to reduction in microbial biodiversity. It is uncertain how deterioration of soil properties and changes in microbial communities affect the functional stability of soils (Guilherme C., 2009).

Soil microorganisms are very important as almost every chemical transformation taking place in soil involves active contributions from soil micro-organisms. In particular, they play an active role in soil fertility as a result of their involvement in the cycle of nutrients like carbon and nitrogen, which are required for plant growth. Soils have a large number of essential functions, some of them for the environment (protection function) and others for human or animal nutrition (production function). Most soil functions are significantly influenced by the quantity and quality of soil organic matter. This factor is essential for soil organisms and their diversity, plant nutrition, water holding capacity, aggregate stability and erosion control (Ellen Kandeler, 2005).

MATERIALS AND METHODS

The researches were carried out in 2011 and 2012 on the haplic luvisol. We investigate one soil type and three cultivation methods: cropland, orchards and pasture. In cropland and orchards are always applied chemical fertilizers and treatment with pesticides but the untilled soil from pasture has not got any pesticides or fertilizers. The experimental plots field is localized at 10 kilometers from Oradea, Bihor County. The soil was collected from the depth of 0-20 cm in spring (March) and autumn (October) of years 2011 and 2012. In the laboratory plant material and soil macro fauna were removed and the soil samples were sieved (<2mm) and mixed. Bacterial and fungal population sizes were determined using the standard soil dilution plate method. Dilutions were used for the determination of the number of culturable cells as colony forming units (CFU) and expressed on dry mass soil. In the studied soil samples, the following microorganisms were estimated: the number of *Actinomycetes* on the Pochon medium, the number of bacteria from genus *Azotobacter* on Ashby's glucose agar and fungi on Sabouraud agar. Plate count method was used to estimate total number of microorganisms on a solid nutrient medium containing meat extract (Atlas, 2004).

RESULTS AND DISCUSSION

The results presented in this research suggest that the number of soil microorganisms shows a dynamic which depends by the quantity and quality of nutrients and by different cropping systems and soil management.

Table 1

Quantity change of the number of aerobic mesophilic heterotrophs in haplic luvisol (log CFU×g^{-1} dw soil)

Vegetation period	Average values		
	Pasture	Cropland	Orchards
spring 2011	7.46	7.39	7.27
autumn 2011	7.61	7.47	7.32
spring 2012	7.44	6.17	6.27
autumn 2012	7.50	7.43	7.04

Table 2

Quantity change of the number of *Actinomycetes* in haplic luvisol (log CFU×g^{-1} dw soil)

Vegetation period	Average values		
	Pasture	Cropland	Orchards
spring 2011	7.53	7.35	6.44
autumn 2011	7.79	7.13	6.64
spring 2012	7.64	3.38	4.47
autumn 2012	6.27	6.14	6.11

Table 3

Fungal population size in haplic luvisol
(log CFU×g^{-1} dw soil)

Vegetation period	Average values		
	Pasture	Cropland	Orchards
spring 2011	4.75	5.12	5.96
autumn 2011	4.88	5.06	6.07
spring 2012	4.46	5.63	5.75
autumn 2012	5.27	5.84	6.49

Table 4

Quantity change of the number of *Azotobacter* in haplic luvisol
(log CFU×g^{-1} dw soil)

Vegetation period	Average values		
	Pasture	Cropland	Orchards
spring 2011	6.25	2.50	2.43
autumn 2011	-	2.09	-
spring 2012	2.25	4.10	2.37
autumn 2012	-	5.95	-

Incorrect agrotechnical treatments and irrational application of fertilization may cause disturbances in the functioning of the whole agrosystem and contribute to the development in soil environments of different noxious compounds acting unfavourably on soil microorganisms, on the cultivated plants as well as on the fertility (K. Styla, 2010). The evolution of soil microbiota indicate that in 2011, in cropland and orchards presented a number of aerobic mesophilic heterotrophs lower in comparison with the number of microorganisms counted in pasture (table 1). *Actinomycetes* are more developed in uncultivated soils (pasture) than in the agricultural soils (table 2). The development of these microorganisms depends on the presence in soils of plant residues.

The soil of cropland and orchards presented a higher number of fungi in comparison with the number counted in pasture (table 3). Fertilization with mineral nitrogen may increases the populations of fungi as a result of the improvement of nitrogen availability in the soil and causes changes in the physical and chemical properties. Nitrogen fertilization exerts an effect on microorganisms, mainly by affecting soil pH of arable soils. Repeated mineral fertilization, particularly with high doses of nitrogen, can cause strong acidification of soils and increase the development of fungi (K. Styla, 2010). The data in table 3 show that combinations between fertilizers and treatments with pesticides caused an increase of fungi number. High mineral fertilization, particularly with nitrogen as well as the use of pesticides can constitute factors favouring the occurrence of toxinogenic fungi. Under the influence of the use of great amounts of chemical agents and high doses of nitrogen fertilizers, the qualitative composition of biocenoses is subject to modification – there follows a recession of bacteria and the domination in microbiocenoses is taken over by other species – mainly by fungi (K Styla, 2010). The treatments with pesticides and chemical fertilizers have inhibitory effects on the living conditions of the *Azotobacter* (table 4).

CONCLUSIONS

Investigation of the microbiological properties of a haplic luvisol, under different cultivation conditions showed that anthropogenic factors such as fertilization and treatments with pesticides was favourable for certain microorganisms while others were inhibited by these factors.

The microbiological analysis of soil samples from haplic luvisol suggest that microbiological processes of soil shows a seasonal fluctuations and changes determined in three different cropping systems, so the soil managements and seasons take part in the changes of microbial activity of soil.

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