MICROBIOLOGICAL CHARACTERISTICS OF THE HAPLIC LUVISOL CULTIVATED WITH MAIZE AND WHEAT IN THE AGROCENOSIS FROM CRISURILOR PLAIN

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Abstract

The researches were carried out in 2012 and 2013 on the haplic luvisol cultivated in two variant such as: cropland cultivated in 2012 with wheat and in 2013 with maize. Soil samples were collected from plots of an experimental field localized at 10 kilometers from Oradea, Bihor County. The quantitative variation of three ecophysiological bacterial groups have been studied: aerobic mesophilic heterotrophs, heterotrophic fungi and nitrogen fixing bacteria Azotobacter. The results presented in this paper suggest that the changes in a soil's microbiological activity are caused by the long term use of pesticides and other agricultural chemicals and the number of soil micro-organisms depends by quantity and quality of nutrients, different cropping systems and soil management. Also, the researches concerning the microbiological properties of haplic luvisol cultivated with maize and wheat showed that chemical fertilizers and pesticides treatments promoted certain microorganisms while others were inhibited.

Keywords: cropland, wheat, maize, microorganisms.

INTRODUCTION

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.

Currently, there are few researches on microbial activity in the soils of ecosystems from Romania and the national strategies of soil quality monitoring are based only on measurements of physical and chemical parameters.

The microbiological analyses highlighting the impact on soil micro-organisms and the biological parameters should be included in the studies of environmental impact assessment.

In our country the soil is under the influence of the strong anthropic actions (use of fertilizer and pesticides, etc.) and it is important to establish the pollutants effects on soil communities of microorganisms.

MATERIAL AND METHODS

The soil samples were collected from an experimental plots field localized 10 kilometers from Oradea, on March 2012 and April 2013.

In the experimental plots field were collected three mixed soil samples from the top soil (0-20 cm) and each one was consisting of 5 individual, randomly collected sub samples.

After skeleton material and plant roots were removed, the samples were stored at 4^0C, sieved on Ø2 mm sieve and mixed.

The quantitative variation of three ecophysiological bacterial groups have been studied: aerobic mesophilic heterotrophs, heterotrophic fungi and nitrogen fixing bacteria *Azotobacter*.

The soil samples (10 g) were suspended in 90 ml distilled water. Dilutions (of 10^{-6}) were prepared from the soil samples using distilled water and these were dispersed with a top drive shaker for 5 min.

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 culturable fungi on Sabouraud Agar and total number of *Azotobacter* on Ashby's glucose agar. After incubation the counts obtained were multiplied by the dilution factor to obtain the number of colony forming unit per gramme of soil.

RESULTS AND DISCUSSION

In order, the quantitative occurence of microorganisms was: aerobic mesophilic heterotrophs (10^6cells×g^{-1}dry matter soil) followed by heterotrophic fungi (10^3cells×g^{-1}dry matter soil) and nitrogen fixing bacteria (10^2cells×g^{-1} dry matter soil).

Table 1

Quantity change of the three ecophysiological bacterial groups monitored in the haplic luvisol under wheat and maize crop

Microorganisms groups	Crop type	Average values of the total number of microorganisms (cells×g^{-1} dry matter soil)
Aerobic mesophilic heterotrophs	Wheat crop	$28.7X10^6$
	Maize crop	$24.8X10^6$
Heterotrophic fungi	Wheat crop	$15.01x10^3$
	Maize crop	$356.5x10^3$
Nitrogen fixing bacteria *Azotobacter*	Wheat crop	$82.5x10^2$
	Maize crop	$47.4x10^2$

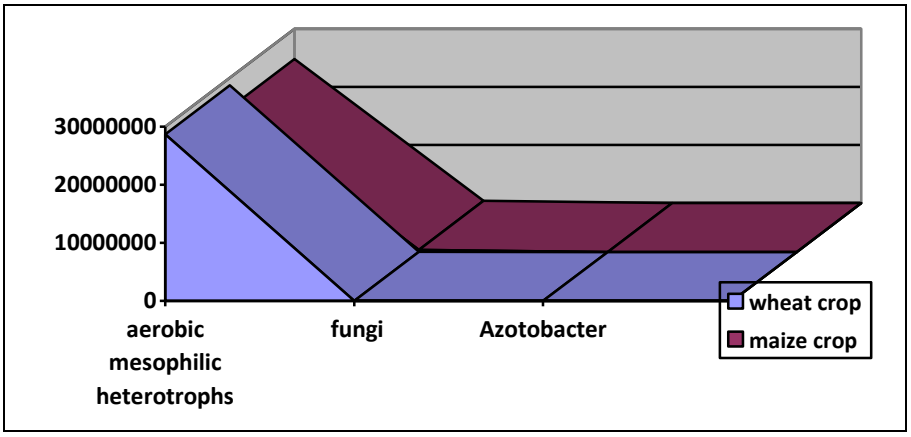

Fig.1. Bacterial and fungal population size in the haplic luvisol

In the haplic luvisol under the wheat crop conditions, the number of aerobic mesophilic heterotrophs was higher compared with the number found under the maize crop (table 1, fig.1).

Under the maize crop the soil contained different acids (oxalic and paracumaric acid) and these acids and compounds have toxic substances wich inhibite the quantities of bacteria.

Also, because of the pH acid values, the number of heterotrophic fungi was found to be higher in the haplic luvisol cultivated with maize. Catabolism and detoxification metabolism occur when a soil microorganism uses the pesticide as a carbon and energy source.

These microorganisms have an important role in affecting the persistence of pesticides, having the capacity for rapid elimination of highly persistent or toxic chemicals.

Azotobacter is distributed in soils having a pH value of 6.0 or above. *Azotobacter* is able to utilize nitrates, ammonium salts, amino acids and peptones as a source of nitrogen, and will only assimilate atmospheric nitrogen when nitrogen in a combined form is absent from the substrate.

The treatments with pesticides and chemical fertilizers have inhibitory effect on the development of the *Azotobacter* because as it can be seen in table 1 and fig. 1, these bacteria are present in a small number.

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).

Many studies showed that the number of microorganisms is lower in cropland in comparison with the number of microorganisms counted in uncultivated soils (pasture).

Also, the soil of cropland may present a higher number of fungi in comparison with the number counted in pasture (K. Styla, 2010). 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 results presented in table 1 and fig.1 reveal that combinations between fertilizers and treatments with pesticides caused an increase of the 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).

CONCLUSIONS

The treatments with pesticides and chemical fertilizers had inhibitory effects on the living conditions of the *Azotobacter*.

In the haplic luvisol cultivated with maize and wheat the fertilization with mineral nitrogen caused increases of the populations of fungi as a result of the improvement of nitrogen availability in the soil.

The degree to which the soil properties influence the soil microbial activity has implications concerning the knowledge of an ecosystem structure and of ecosystems resources management.

The study of microbial populations in a given type of soil could outline the profile of the ecophysiological site.

A strong environmental profile divergence of the site could be an indication of changes in the ecosystem, and installing of new microbial communities.

The need to identify and study a series of indicators to assess the soil quality and fertility leads to deepening of the concepts relating to microbial ecology in the soils of agrocenosis and natural cenosis from our country.

ACKNOWLEDGEMENT

This paper has been financially supported within the project entitled ***"Horizon 2020 - Doctoral and Postdoctoral Studies: Promoting the National Interest through Excellence, Competitiveness and Responsibility in the Field of Romanian Fundamental and Applied Scientific Research",*** contract number POSDRU/159/1.5/S/140106. This project is co-financed by European Social Fund through Sectoral Operational Programme for Human Resources Development 2007-2013. **Investing in people!**

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