Evaluation of the microbial soil quality indicators in agricultural soils from Crisurilor Plain

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SUMMARY

The researches were carried out in 2010 and 2011 on the haplic luvisol cultivated in three variant such as: pasture, cropland, and orchards. Based on the total number of microorganisms monitored in the haplic luvisol (aerobic mesophilic heterotrophs, yeast and mould, Actinomycetes*, nitrogen fixing bacteria and nitrifying bacteria) was calculated the bacterial indicators of soil quality (BISQ) and was appreciate the bacterial potential of the haplic luvisol. Seasonal analyses were carried out, and annual BISQ's have been calculated too. The values of the bacterial indicators of the haplic luvisol in different cultivation conditions (pasture, cropland and orchards) indicate a high density of the bacterial groups in 2010 and 2011. In 2010 the values of the BISQs are included between 3.617 (minimum in autumn, in pasture) and 5.458 (maximum, in spring, in pasture). In 2011, the minimum value (3.622) was registered in pasture, in autumn, and the maximum value (4.851) in the haplic luvisol cultivated with maize, in spring. In 2010 and 2011, based on the bacterial indicators of the soil quality values, on the first position is the cropland (4.750, 4.721) followed by orchards (4.615, 3.985) and pasture (4.537, 3.758).*

Keywords: *bacterial indicator, soil, quality, crop*

INTRODUCTION

Scientists use soil quality indicators to evaluate how well soil functions, since soil function often cannot be directly measured. Measuring soil quality is an exercise in identifying soil properties that are responsive to management, affect or correlate with environmental outcomes, and are capable of being precisely measured within certain technical and economic constraints (Doran and Parkin, 1996).

Biological indicators can tell us about the organisms that form the soil food web that are responsible for decomposition of organic matter and nutrient cycling. Information about the numbers of organisms, both individuals and species, that perform similar jobs or niches, can indicate a soil's ability to function or bounce back after disturbance (resistance and resilience) (Doran and Parkin, 1996).

The bacterial potential of the soil is reflected by the values of the bacterial indicators of the soil quality. The bacterial indicators of the analyzed habitats provides an overview of the intensity of microbiological activity of soils (Simule, 2009).

MATERIAL AND METHODS

Seasonal analyses were carried out, in spring and autumn of the years 2011–2012.

The bacterial potential of the haplic luvisol from Crisurilor Plain was appreciate on the base of the bacterial indicators of soil quality (BISQ) values, calculated according with Muntean (1995–1996):

$$BISQ= 1/n \times \sum \log 10\ N,$$

where:

BISQ= bacterial indicator of the soil quality,

n = number of the ecophysiological groups of the monitored microorganisms,

N = number of bacteria that belongs to each ecophysiological groups.

Soil samples were collected from an experimental plots field localized at 10 kilometers from Oradea, at village Cauaceu, Bihor County. The haplic luvisol was cultivated in three variant: cropland (wheat crop in 2010 and maize crop in 2011), orchards and pasture.

Plate count method was used to estimate total number of microorganisms on a solid nutrient medium containing meat extract (Atlas, 2004), total number of *Actinomycetes* on agar with glucose and asparagines and total number of yeast-mold on Sabouraud Agar.

Also, total number of Azotobacter was revealed on Ashby's glucose agar. To estimate the number of nitrifying bacteria the most probable number method (MPN) was used. Nitrat and nitrit-forming bacteria were cultured in a liquid culture medium containing Winogradsky's salt solution.

After incubation the most probable number of nitrifying bacteria was calculated according to the statistical table of Alexander (1965).

RESULTS AND DISCUSSION

Based on the total number of microorganisms monitored in the haplic luvisol (aerobic mesophilic heterotrophs, yeast and mould, *Actinomycetes*, nitrogen fixing bacteria and nitrifying bacteria) was calculated the seasonal and annual bacterial indicators of soil quality (BISQ) after Muntean (1995–1996). The results are presented in the following.

In all the haplic luvisol samples studied, were present 5 groups of bacteria: aerobic mesophilic heterotrophs, yeast and mould, *Actinomycetes*, nitrogen fixing bacteria and nitrifying bacteria. In order the quantitative occurence of microorganisms was aerobic mesophilic heterotrophs (10^5–10^7 cells×g^{-1} dry matter soil) were followed by *Actinomycetes* and yeast and mould (10^3–10^6 cells×g^{-1} dry matter soil), nitrogen fixing bacteria (10^2–10^5 cells×g^{-1} dry matter soil) and nitrifying bacteria (10^{-1}–10^3 cells×g^{-1} dry matter soil).

The values of the bacterial indicators of the haplic luvisol in different cultivation conditions (pasture, cropland, and orchards) indicate a high density of the bacterial groups in 2010 and 2011 *(table1–2)*.

Table 1.

The values of the bacterial indicator of the haplic luvisol quality in the year 2010

Cultivation types of haplic luvisol	Bacterial indicator of the soil quality		
	Spring	Autumn	Annual
Pasture	5.458	3.617	4.537
Cropland	5.246	4.254	4.750
Orchards	5.234	3.997	4.615

Table 2.

The values of the bacterial indicator of the haplic luvisol quality in the year 2011

Cultivation types of haplic luvisol	Bacterial indicator of the soil quality		
	Spring	Autumn	Annual
Pasture	3.894	3.622	3.758
Cropland	4.851	4.592	4.721
Orchards	3.999	3.971	3.985

In 2010 the values of the BISQs are included between 3.617 (minimum in autumn, in pasture) and 5.458 (maximum, in spring, in the same variant of the haplic luvisol) *(table 1)*. In 2011, the minimum value (3.622) was registered in pasture, in autumn, and maximum value (4.851) in haplic luvisol cultivated with maize, in spring *(table 2)*. In all the variant the highest values were registered in spring, and the lowest ones in autumn. In spring, the soil is rich in organic substances easily accessible and the bacteria show an intense activity of mineralization.

Based on the annual values of the bacterial indicators of the haplic luvisol quality was established the hierarchy of the soil variant. In 2010 and 2011 on the first position is cropland (4.750, 4.721) followed by orchards (4.615, 3.985) and pasture (4.537, 3.758).

CONCLUSIONS

In all the haplic luvisol samples studied, were present all the 5 groups of the monitored bacteria: aerobic mesophilic heterotrophs, yeast and mould, *Actinomycetes*, nitrogen fixing bacteria and nitrifying bacteria.

In all the variant the highest values were registered in spring, and the lowest ones in autumn.

In spring, the soil is rich in organic substances easily accessible and the bacteria show an intense activity of mineralization.

The values of the bacterial indicators of the haplic luvisol in different cultivation conditions indicate a high density of the bacterial groups in 2010 and 2011.

In the year 2010 on the first position is cropland, who has registered a BISQ value of 4.750, followed by orchards with a value of BISQ of 4.615 and pasture (4.537).

In the year 2011 was determined the same hierarchy, so cropland is on the first position, with a BISQ value of 4.721, followed by orchards (3.985) and pasture with a BISQ value of 3.758.

In long term, utilization of chemical fertilizers and the treatments with pesticides may have inhibitory effects on microbiological activity but certain microbial groups, such as yeast-mold can be promoted.

Microbiological properties can serve as soil quality indicators because after plants soil microbes are the second most important biological agent of the agricultural ecosystem. Soil microorganisms can be used to assess soil quality or degradation.

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