THE EVOLUTION OF CELLULOLYTIC POTENTIAL OF THE FAR RHIZOSPHERE ZONE AND OF THE NEAR-ROOT AREA OF SPECIES *VICIA SATIVA*

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Abstract: *Legumes, of which Vicia sativa is one, can be used successfully as green fertilizers. They can contribute to improving the characteristics of soil: density, porosity, humus accumulation in the soil, and they live in symbiosis with nodule bacteria, which can make atmospheric nitrogen fixation happen. (CLARK, 2007, JEON et al., 2009). Plants can foster their own growth, by chemical changes (the case of the available nutriments) and biological changes at soil level (NIU ET AL. 2007). Through some substances named elicitors, the plant select the microflora in the area near the root, and together with this selection, some other changes are taking place in the dynamics of vital processes in the soil. Among the sources of energy used by microorganisms, the cellulose in plant debris contains the largest quantity of organic carbon. Because of the microbial decomposition of this polysaccharide, the humus content of soil increases. Because of the contribution that cellulolysis has in increasing the fertility potential of soils, the study in this paper is focussed on this vital soil parameter. The soil, moderately glazed Eutric Cambisol, is to be found in Ciacova commune, Timis County. The soil was sown with common vetch (Vicia sativa). Soil lab analysis was performed in the autumn of 2011. In order to determine the cellulolytic potential, we took 10 soil samples from the edaphosphere and near-root area of species Vicia sativa, plus a control variant. The sapling depth was between 0 and 20 cm. The method for finding the quantity of decomposed celluloses was the one presented by STEFANIC (2006). The study revealed positive development of this vital process in the area near the root, under the influence of vegetal exudates and moisture index. These chemical changes in the near-root area lead to selection of the microbial community, while at the same time inducing increased microbial activity. The decomposing process and the moisture content depend on the humus in the soil. By reference to the edaphosphere, vicinity is noticed between the control variant and the near-root area. The % variance on PC1 is 80.997 and on PC2 19.003 so we choose to represent the eigenvalues only on the most significant axis (PC1).*

Key words: *cellulolytic potential, far rhizosphere zone, near-root area, Vicia sativa*

INTRODUCTION

Although the presence of microbial communities is vital for the functioning of terrestrial ecosystems, its reaction to the changes in plant diversity has rarely been studied directly (BROUGHTON et al, 2000; YIN et al, 2000).

Soil microflora performs its vital activities in direct link with the existent energetic and trophic sources or exterior sources, and thus numerical or biomass ratios are formed among different segments of soil micro-populations (STEFANIC AND SANDOIU, 2011).

A large number of studies have been focused on various microbial communities and biologic processes of arable soils, whether in use or abandoned, as well as on the soils of pastures and meadows. These studies have shown the strong influence of plant diversity (NAEEM et al. 1994; TILMAN et al. 1996, 1997; BARDGETT et al. 1999; WARDLE et al. 1999; MALY et al. 2000; SPEHNET al. 2000).

The studies made in areas of influence of non-legumes and legumes indicate differences in the quality and quantity of their rhizodeposition, especially regarding the nitrogen content, which is higher in the case of legumes (HAMER AND MAKESCHIN, 2009). Due to their symbiosis with nitrogen-fixating bacteria of genus *Rhizobium*, the legumes (species such as *Vicia villosa*, *Vicia sativa*) have often been used as green fertilizer and winter crops for covering the land (CARRERA et al 2007; CHOI AND DAIMON 2008; ROSECRANCE et al. 2000).

The largest quantity of organic carbon in the soil is found in the celluloses from plant debris. Vegetal debris is object for soil microflora but also for soil microfauna and mesofauna. Of these two groups, microflora is responsible for the chemical biodegradation of cellulolytic matter. An effect of cellulose decomposition is that the soil becomes richer in humus (МУРОМЦЕВ, 1990).

Cellulolytic activity is influenced by biotic and abiotic factors, but also by anthropic intervention, especially by the chemical substances and doses used in agricultural practice (BOROZAN et al, 2009).

According to LÎKOV and his co-workers (2004), the presence of cellulolytic microflora in the soil confirms fair nitrogen content, sufficient aeration, normal temperature regimen and normal humidity.

MATERIAL AND METHODS

The experiment was set up in Ciacova commune in Timis County, on moderately-gleyed eutric cambisol.

The vetch, Jose variety (of Mexican origin) was sown on September 20th, after a crop of aristate ryegrass. The quantity used was 60 kg/ ha. The vetch crop is used as green fertilizer and it will be incorporated into the soil at ploughing.

Soil samples were taken from the new-root area of species *Vicia sativa* and from far rhizosphere zone, at 0-20 cm depth, in the autumn of 2010 (November 11th). Apart from these samples, another sample was taken - a control sample.

The method for processing and setting up the experiment was performed in laboratory conditions. It was the one resented by STEFANIC (2006). The incubation temperature was 280 for three weeks.

Statistical analysis

The statistical evaluation of the experimental data was made using MVSP 3.1 and PAST 2.14.

Principal Components Analysis (PCA) is a mathematical model that permits to identify patterns in the data by "expressing the data to highlight their similarities and differences" (SMITH LINDSAY I., 2002).

Principal components analysis (PCA) is a procedure for finding hypothetical variables (components) which account for as much of the variance in the multidimensional data as possible (DAVIS, 1986, HARPER 1999). These new variables are linear combinations of the original variables (HAMMER O., 2001).

Cluster Analysis is a statistical method that groups data objects based on information found in the data that describes the objects and their relationship.

The cluster analysis was performed using two-way clustering, based on the average distance between all members in the two groups (www.users.cs.umn.edu/~kumar/dmbook/ch8.pdf).

RESULTS AND DISCUSSION

The experimental data obtained after 42 days were processed statistically and expressed graphically. (Figures 1 to 4).

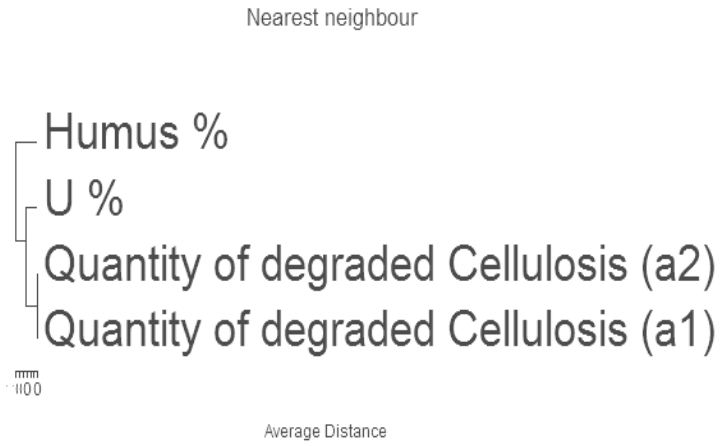

Figure 1. Cluster analysis Representation of the nearest neighbour using Average Distance

The cluster analysis shows that there are no differences between the potential for biodegradation of the two repetitions (a_1 and a_2). The cellulolytic capacity is influenced especially by moisture content. The degradation process and moisture factor depend on the humus in the soil (Figure 1). These chemical changes in the periradicular area lead to selection of microbial community and at the same time they induce higher microbial activity. Elimination of exudates by plant roots attracts both chemical and microbial actions that lead to changes in vital soil activities. (HAMER AND MAKESCHIN, 2009).

According to bibliographic data, the cellulolytic potential depends largely on the climate conditions of each particular year, on the species sown and the soil. (NICORICI, 2009).

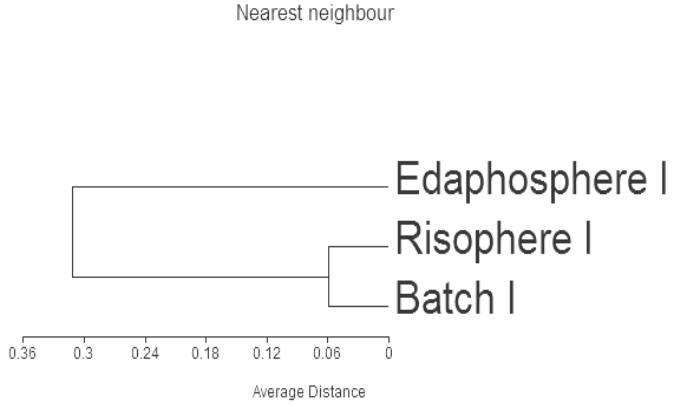

Figure 2. Cluster analysis Representation of the nearest neighbour Transposed Data using Average Distance

Using cluster analysis we delimited the studied areas. By reference to the edaphosphere, vicinity is noticed between the control variant and the near-root area (Figure 2).

The main component analysis applied to PCA data highlights bigger cellulolytic potential in the rhizosphere, with stronger influence of moisture content rather than humus

content.

The % variance on PC1 is 80.997 and on PC2 19.003, therefore we choose to represent the eigenvalues only on the most significant axis (PC1), Figure 3.

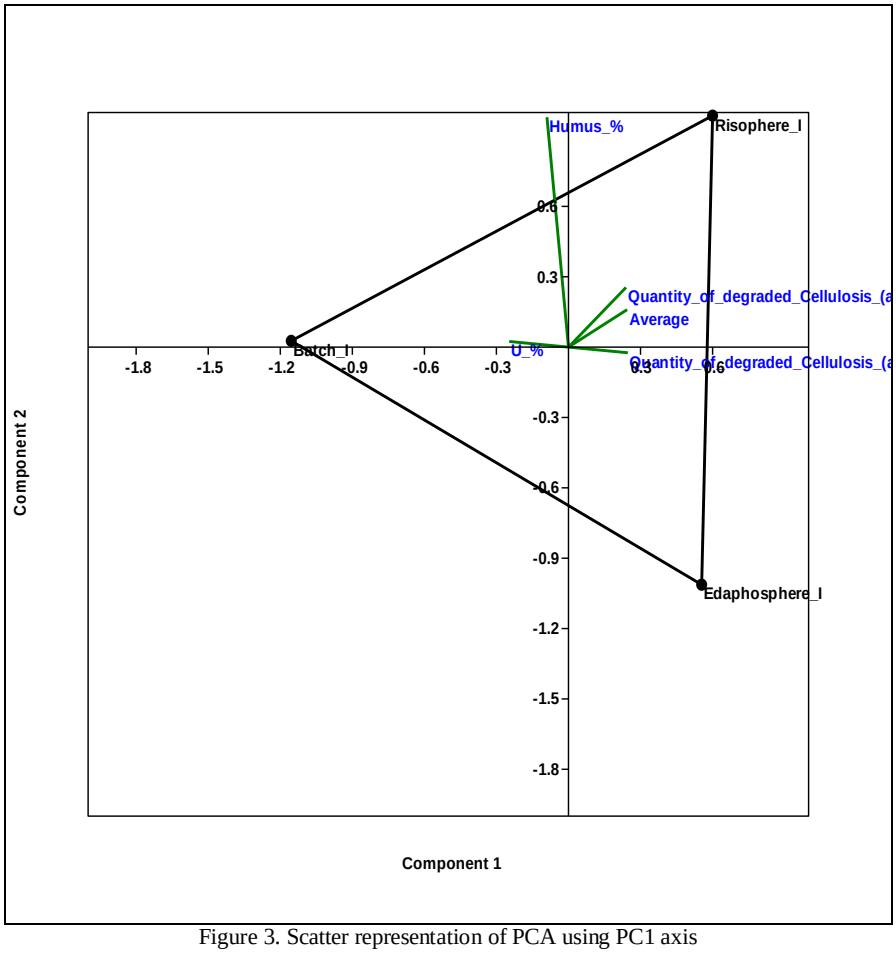

Figure 3. Scatter representation of PCA using PC1 axis

On PC1 axis, the quantity of degraded celluloses presents positive correlations (a1 , a2 and the average) while humus % and moisture% present negative correlations. On PC2 axis, the quantity of degraded celluloses presents positive correlations (a2 and the average), humus % and moisture %, while the quantity of degraded celluloses (a1) presents negative correlation.

CONCLUSSIONS

Current data confirm that effective fertility is mainly a result of the activity of the microorganisms in the soil.

Legumes produce changes in soil chemistry and biology; these changes are materialized in changes in the structures of microbial communities and processes. Edaphosphere is the most different area in terms of its cellulolytic activity, as compared to the

near-root area and the control variant.

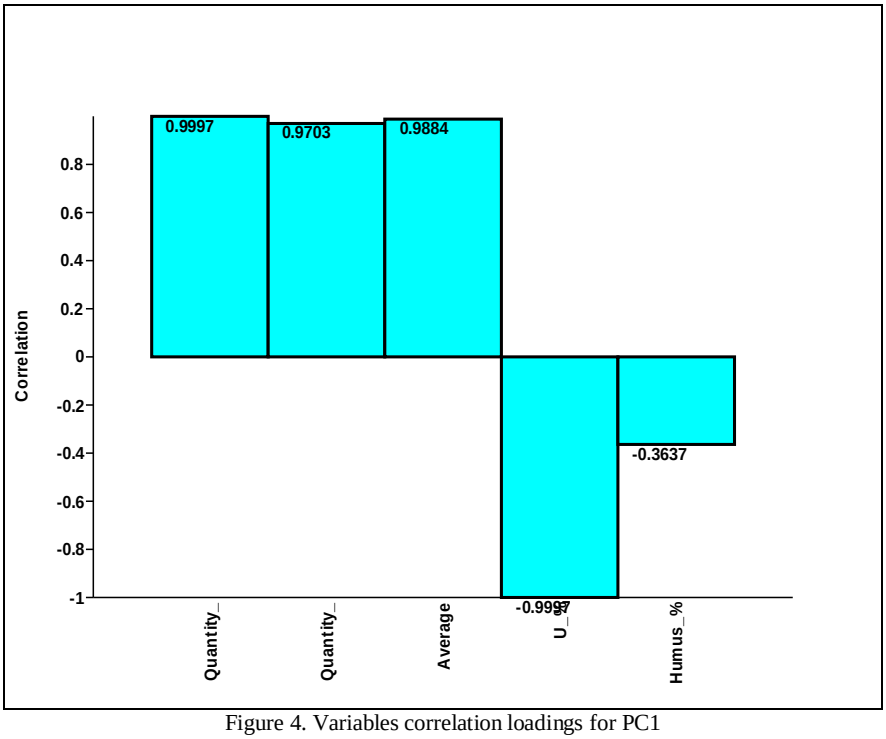

Figure 4. Variables correlation loadings for PC1

Although the vicinity between the control areas and rhizosphere was noticed, there are small differences between these too, regarding the intensity of cellulolytic activity, which favour the rhizosphere.

Of the two factors: humus and moisture content, the latter has stronger impact on the activity of cellulolytic microorganisms in the rhizosphere.

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