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# Microbial abundance of the Soil and Rhizosphere During the Growing Season as affected by the Sugar beet Genotype

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**Abstract:** The objective of the study was to investigate the dynamic of total number of microorganisms, azotobacter, actinomycetes and fungi in soil and rhizosphere of four sugar beet varieties (Hy-11, Dana, Delta, Norma). The samples were taken on three different dates. Dana had the largest positive influence on total microbial abundance and azotobacter numbers.

**Key words:** genotype, sugar beet, total microbial abundance

## Introduction

The microbial abundance of the soil is an indicator of its potential and effective fertility. This characteristic depends primarily on the soil type. A significant amount of attention has been payed to the microbial acivity of chernozem depending on the crop (wheat, maize, soybean, sugar beet, sunflower) (Saric, 1968, 1972, 1973, 1976; Mrkovacki, 1985).

The effective fertility of chernozem is a result of its overall microbial activity and its concordance with plant requirements (Saric et al., 1983, Saric and Mrkovacki, 1988).

The dynamics of certain groups of microorganisms have been found to differ depending on the crop species, with wheat and maize having a different effect than sugar beet (Saric, 1968). The total microbial abundance and the abundance of ammonifiers, azotobacters, and oligonitrophilous bacteria in the soil and rhizosphere were positively correlated with wheat and maize yields,

while in the case of the number of actinomycetes and fungi the correlation was negative (Saric et al., 1983).

Microbial dynamics as affected by the rhizosphere and soil zones in sugar beet have been studied as well (Saric, 1968; Saric and Ristic, 1982; Mrkovacki et al., 1998). What has not been studied until now, however, are the microbial dynamics as influenced by the hybid variety of sugar beet.

Therefore, the objective of this paper was to investigate the microbial dynamics (total abundance, abundance of azotobacters, actinomycetes, and fungi) during the growing seasons of four sugar beet genotypes.

## Materials and methods

Four sugar beet genotypes (Hy-11, Dana, Delta, and Norma) were sown at the Rimski Šancevi site on April 7, 1997. The experiment was carried out according to a randomized block design with three replicates. In order to perform microbiological analyses, soil samples were taken from all three replicates on three dates (June 10, August 7, and October 7, 1997). The dynamics of the following microbial groups were studied: total microbial abundance (soil agar, $10^{-6}$ dilution), abundance of azotobacters (the Fedorov medium, $10^{-2}$ dilution), abundance of actinomycetes (synthetic agar, $10^{-4}$ dilution), and abundance of fungi (the Chapek medium, $10^{-4}$ dilution).

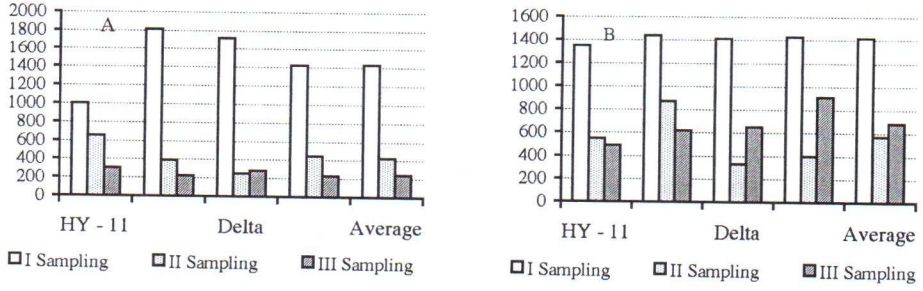
## Results and discussion

The microbial abundance in the soil and rhizosphere depended on the genotype and the sampling date.

### Dynamics of total microbial abundance

The total number of microorganisms ranged from 555 (2nd sampling date) to 1434 (1st sampling date) in the soil and from 303 (3rd sampling date) to 1529 (1st sampling date) in the rhizosphere (Figure 1).

Fig. 1.Dynamic of total number of microorganisms in soil (B) and rhizosphere (A) of four sugar beet varieties



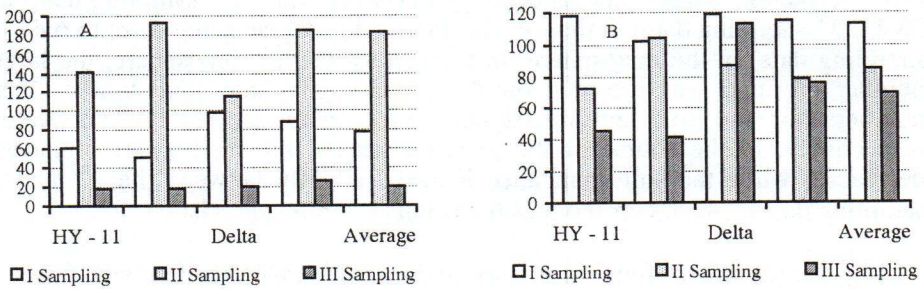
In the soil and rhizosphere alike, the largest number of microorganisms was recorded in the variety Dana on the 1st sampling date.

As the growing season progressed, total microbial abundance decreased, the only exceptions being the rhizosphere abundance in Delta and the soil abundance in Delta and Norma, where the numbers were higher on the 3rd than on the 2nd date. The decrease of soil microbial abundance is in agreement with the results of Saric (1968), but the decrease of rhizosphere abundance is not. In Saric (1968), sugar beet actually promoted the development of all microbial groups in the soil.

Dynamics of azotobacter abundance

Looking at all the genotypes taken together, the total number of azotobacters ranged between 70 (3rd sampling date) and 115 (1st sampling date) in the soil and 21 (3rd sampling date) and 187 (2nd sampling date) in the rhizosphere (Figure 2).

Fig. 2. Dynamic of Azotobacter in soil (B) and rhizosphere (A) of four sugar beet varieties



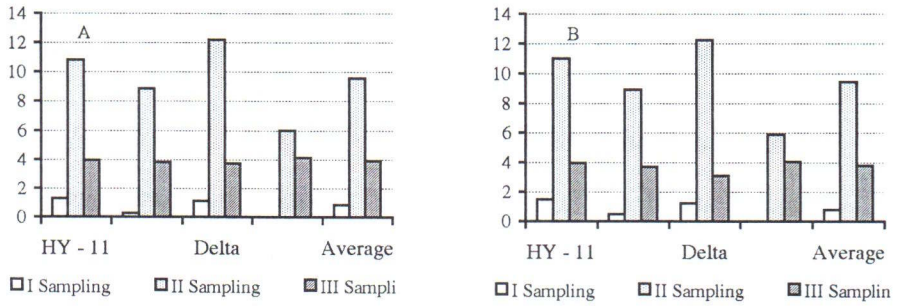

The largest number of azotobacters was found on the 2nd sampling date in the rhizosphere of Delta and Dana, which is in agreement with our earlier results (Mrkovacki et al., 1996; 1997; 1998). Sugar beet has been shown to have the largest stimulatory effect on azotobacter number along with soybean. In the present study, the number of azotobacters in the soil decreased with the progress of the growing season, while the rhizosphere abundance increased on the 2nd sampling date, which supports the results of Saric (1963), where the lowest number of azotobacters was recorded in September and the highest in July.

Dynamics of actinomycete abundance

The average number of actinomycetes for all four genotypes ranged from 0.79 (1st sampling date) to 9.56 (2nd sampling date) in the soil and from 0.84 (1st sampling date) to 9.73 (2nd sampling date) in the rhizosphere (Figure 3). The greatest actinomycete abundance in the soil as well as rhizosphere was found in

Delta on the 2nd sampling date. The number of actinomycetes was higher in the soil than in the rhizosphere, which is in agreement with Saric and Ristic (1982).

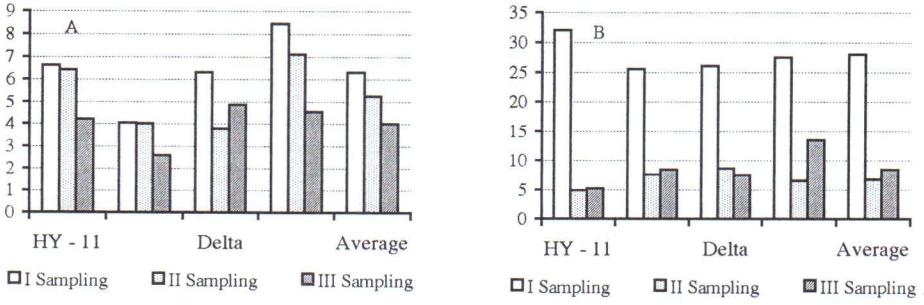
Fig. 3. Dynamic of actinomycetes in soil (B) and rhizosphere (A) of four sugar beet varieties




Dynamics of fungal abundance

Overall, fungal abundance ranged between 7.51 (2nd sampling date) and 28.11 (1st sampling date) in the soil and from 4.17 (3rd sampling date) to 6.41 (1st sampling date) in the rhizosphere. In the soil as well as rhizosphere, the largest number of fungi was recorded on the 1st sampling date. The largest fungal numbers for the soil and rhizosphere were found in Hy-11 and Norma, respectively. In the course of the growing season, the rhizosphere abundance decreased, while the soil abundance increaed slightly between the 2nd and 3rd sampling dates, which corroborates the results of Saric and Ristic (1982).

Fig. 4. Dynamic of fungi in soil (B) and rhizosphere (A) of four sugar beet varieties



## Conclusions

Our study has lead to the following conclusions:

The total microbial abundance in the soil and rhizosphere of sugar beet decreases as the growing season progresses, although there is a slight increase in soil microbial abundance towards the end of the season.

Soil azotobacter abundance was the greatest at the start of the growing season, while the number of azotobacters found the rhizosphere was the highest in mid-growing season.

The abundance of actinomycetes both in the soil and rhizosphere was the largest on the 2nd ampling date. Fungal abundance decreased with the progress of the growing saeson and was significantly greater in the soil.

The largest actinomycete abundance was recorded in the variety Delta on the 2nd
sampling date. The highest number of fungi in the rhizosphere was found in the variety Norma on the 1st sampling date, while the greatest soil abundance of fungi was recorded in Hy-11 on the 1st sampling date.

Bacterial numbers were the highest in the soil and rhizosphere of the variety Dana. This variety also had the largest number of azotobacters in the rhizosphere.

Dana had the largest positive influence on total microbial abundance and azotobacter
numbers.

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# BIOGENOST ZEMLJIŠTA I RIZOSFERE U TOKU VEGETACIJE ŠECERNE REPE U ZAVISNOSTI OD GENOTIPA

-originalni naučni rad-

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## Rezime

Biogenost zemljišta je pokazatelj njegove potencijalne i efektivne plodnosti. Ova osobina prvenstveno zavisi od tipa zemljišta. Stoga smo u našem radu ispitivali dinamiku mikroorganizama u toku vegetacije cetiri genotipa šecerne repe (Hy-11, Dana, Delta i Norma). U ovom radu pracena je dinamika sledecih grupa mikroorganizama: ukupnog broja na zemljišnom agaru, broj azotobaktera na podlozi Fjodorova, broj aktinomiceta na sintetickom agaru, broj gljiva na podlozi Capeka. Za obracunavanje broja pojedinih grupa mikroorganizama korišcena su sledeca razredjenja: za ukupan broj $10^{-6}$; za azotobakter $10^{-2}$; za aktinomicete i gljive $10^{-4}$. Na osnovu rezultata istrazivanja moze se zakljuciti:

Ukupan broj bakterija u zemljištu i rizosferi šecerne repe opada u toku vegetacije sa blagim porastom u zemljištu na kraju vegetacije.

Najveci broj azotobaktera u zemljištu dobijen je na pocetku vegetacije šecerne repe, a u rizosferi sredinom vegetacije.

Brojnost aktinomiceta bila je najveca u II roku i u zemljištu i u rizosferi, a broj gljiva opada u toku vegetacije i znacajno je bio veci u zemljištu. I u zemljištu i u rizosferi sorte Dana dobijen je najveci broj bakterija. Kod ove sorte u rizosferi zabelezen je i najveci broj azotobaktera. Najveci pozitivan uticaj na biogenost, tj. brojnost ukupnog broja i azotobaktera imala je sorta Dana.

Najveca brojnost aktinomiceta dobijena je kod Delte u II roku, a gljiva u I roku i to u rizosferi Norme, a u zemljištu kod Hy-11..