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Microbiological Activity of some Field Crops in Rhizosphere Soil

M. Govedarica, B. Spasojevic, D. Milosev
Faculty of Agriculture, Novi Sad, Yugoslavia

Nada Milosevic
Research Institute of Field and Vegetable Crops, Novi Sad, Yugoslavia

D. Djukic, L. Mandic
Faculty of Agronomy, Cacak, Yugoslavia

Abstract: Many factors influence the increase or decrease of the microbiological activity in the soil. The paper deals with the microbiological activity of some significant field crops in the rhizosphere soil. Cultivation, fertilizing with manure and ploughing in of the harvest residues caused the increase in the number and enzymic activity of microorganisms in all the field crops examined. The highest microbiological activity was determined in stock beet and potato, and the lowest one in oats.
Key words: cultivation, fertilization, ploughing-in, microorganisms, enzymes

Introduction

By nature of its origin and historically speaking, soil is an open system of many components, formed in the process of functioning of an infinite number of factors, among which microorganisms are of the greatest importance. A great amount of potential energy, water and nutritive substances necessary for the life and development of plants is accumulated in the soil. Therefore, the soil is considered to be a natural geochemical accumulator, in which humus is the most important chemical substance, providing its fertility and stability. Humus is extremely important to a soil, because it provides and determines its fertility,

whether potential or effective. Based on the high puferity and resistance of humus to physical and chemical effects, the soil stability is also provided. The general potential humus energy on our planet corresponds to the general pote-ntial energy accumulated in the whole plant biomass of our planet. The soil, as an irreplaceable natural resource, is exposed to a constant influence of a great number of abiotic and biotic factors. A large number of different species of microorganisms live in the soil. Their biomass is 1-5, and according to some researchers, 10 and even 20 tons per hectare of the soil. This huge mass of microorganisms are capable of reacting to all impacts, whether those of physical or chemical nature. Owing to that, the number and enzymic activity of microor-ganisms can serve as a clear indicator of biogenity, i. e. of the fertility of the soil (Klevenskaja, 1970; Alexander, 1977; Misustin, 1978; Kiss et al., 1978; Skujins, 1978; Lynch, 1983; Milosevic et al., 1990; Govedarica et al., 1993; Govedarica i Jarak, 1995). Vegetable and animal production need to be increased in order to feed the mankind on our planet.

Bearing all that in mind, the aim of the research has been set up - to examine the microbiological activity of some field crops in the rhizosphere soil.

Materials and Methods

Brown skeletal soil formed on slate was selected for these researches. The examined soil is located in the National park Tara (the Kaludjerska bara locality). The trial had the following variants: control soil under meadow (pH KCl 4.65; pH H_2O 5.82; % of $CaCO_3$ 0.42; % of humus 4. 47; % of N 0.295; mg P_2O_5/100 g of soil 2.7; mg K_2O/100 g of soil 11.5) and a meadow soil which was turned into an arable soil (pH KCl 6.32; pH H_2O 7.33; % of $CaCO_3$ 1.46; % of humus 5.23; % of N 0.445; mg P_2O_5/100g of soil 29.7; mg K_2O/100 g of soil 55.0). 1t/ha of manure was applied to the arable soil each year and harvest residues were ploughed in each year. Samples for microbiological analyses were taken from the rhizosphere of the examined plant species at the end of the vegetation period.

The number of microorganisms was determined by standard microbiological methods (Pochon i Tardieux, 1962; Krasiljnikov, 1965). By the method of dilution the following was determined: the total number of microorganisms in the aggarized soil extract (10^{-6}), the number of ammonifiers on MPA (10^{-6}), the number of actinomycetes on a synthetic agar, by Krasiljnikov (10^{-4}), the number of fungi on Capek's agar (10^{-4}), the number of azotobacter on Fjodorov stock (10^{-1}), the number of oligonitrophilic bacteria on Fjodorov stock (10^{-5}), the number of cellulolytic microorganisms on the Waxman-Carey stock (10^{-3}). The time and temperature of incubation depended on the species of microorganisms. The Lenhard's method, modified by Thalman (1968), was applied for the measuring of the dehydrogenation enzymic activity. The protease activity of soil was determined by titration method by Romeik (1969) and the urease activity by the Tabatabai and Bremner method (1972).

Results and Discussion

The application of manure and harvest residues, along with the appropriate agricultural measures, caused the increase of the microbiological activity in the rhizosphere soil of all the examined crops.

The obtained results (Tab. 1) show that cultivation and fertilization of soil caused the increase in the total number of microorganisms, as well as in the number of ammonifiers, actinomycetes, fungi, azotobacter, oligonitrophilic bacteria and cellulolytic microorganisms in all field crops.

Tab. 1 Number of microorganisms (g/soil)

Microorganisms	Pasture	Avena sativa	Solanum tuberosum	Zea mays	Beta vulgaris crassa
Total number of microorganisms (10^6/g soil)	160.6	243.2	1584.9	630.9	245.1
Ammonifiers (10^6/g soil)	80.8	179.3	762.7	261.1	832.2
Actinomycetes (10^4/g soil)	2.6	5.12	54.8	47.05	62.6
Fungi (10^4/g soil)	15.6	12.8	28.3	28.8	25.5
Azotobacter (10^1/g soil)	2.1	4.1	8.8	12.1	19.5
Oligonitrophilic bacteria (10^5/g soil)	143.1	465.9	531.1	451.2	982.5
Cellulolytic microorganisms (10^3/g soil)	15.1	19.1	24.0	18.2	30.2

Dehydrogenase, protease and urease activity has also been increased (Tab. 2).

Tab. 2. Dehydrogenase, protease and urease activity

Enzymes	Pasture	Avena sativa	Solanum tuberosum	Zea mays	Beta vulgaris crassa
Dehydrogenase activity (μg TPF/10 g soil)	292.0	333.0	477.0	495.0	582.0
Protease activity (gel. units/1g soil)	15.0	17.1	26.6	23.0	25.0
Urease activity μg N-NH_4/1 g soil/2h	25.0	35.0	41.0	40.0	70.8

The number and enzymic activity of microorganisms are highest in soils under stock beet and potato, and lowest in soils under oats. The obtained results show that meadow soil cultivation and fertilization can increase the microbiological activity and, thus, the fertility of soil. The application of organic fertilizers to the soil causes the increase in the microbiological activity, which is confirmed by many researchers (Mancenkov et al., 1979; Rempe et al., 1986; Popov and Jurkin, 1986; Milosev et al., 1989; Govedarica et al., 1991). According to Misustin (1972) and Muramcov (1980), the application of organic fertilizers has a positive impact on the physical and chemical properties of the soil as well as on the biological activity of microorganisms.

These, as well as future researches, are supposed to show whether the meadow soil can be used for the production of some significant field crops after the appropriate cultivation and fertilization.

Conclusion

By cultivation and fertilization of the meadow soil, as well as by the ploughing in of the harvest residues, arable soil of greater biogenity and fertility can be formed.

The application of appropriate agrotechnical measures, fertilization with manure and ploughing in of the harvest residues caused the increase in the number of all the examined species of microorganisms as well as the increase in the dehydrogenase, protease and urease activity.

The highest microbiological activity was determined in stock beet and potato, whereas the lowest one in oats.

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MIKROBIOLOŠKA AKTIVNOST U RIZOSFERNOM ZEMLJIŠTU NEKIH RATARSKIH KULTURA

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M. Govedarica, B. Spasojević, D. Milošev
Poljoprivredni fakultet, Novi Sad

Nada Milošević
Naučni institut za ratarstvo i povrtarstvo, Novi Sad

D. Đukić, L. Mandić
Agronomski fakultet, Čačak

Rezime

Mikroorganizmi zemljišta učestvuju u stvaranju svih neophodnih asimilativa za biljku. Cilj ovih istraživanja je bio da se ispita mikrobiološka aktivnost u rizosfernom zemljištu kod nekih ratarskih kultura. Za ova istražibanja odabrano je smeđe skeletno livadsko zemljište na kojem su nakon obrade i đubrenja uzgajane različite ratarske kulture. Obradom i đubrenjem livadskog zemljišta kao i zaoravanjem žetvenih ostataka se može dobiti obradivo zemljište veće biogenosti i plodnosti. Primena odgovarajuće agrotehnike, đubrenja sa stajnjakom i zaoravanje žetvenih ostataka izazvalo je povećanje brojnosti svih ispitivanih grupa mikroorganizama kao i dehidrogenazne, proteazne i ureazne aktivnosti. Najveća mikrobiološka aktivnost utvrđena je kod stočne repe i krompira, a najmanja kod ovsa.