INFLUENCE OF FERTILIZATION AND DIFFERENT TILLAGE SYSTEMS ON SOIL MICROFLORA

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Abstract

Researches were carried out on rapeseed (*Brassica napus* L.) field trials located in the south region of Moldavian plain (Ezareni Farm), studying the effects of fertilization (organic, mineral) and soil tillage systems on soil population. Soil tillage has been realized with plough (in classic system), with chisel, rotary harrow (in minimum soil tillage) and in no-till system.

The objectives of this investigation were to isolate and quantify the existing microbial population in soil (Gram positive bacteria, Gram negative bacteria, micromycetes) establishing their participation ratio, the main fungus genres which activate in soil and their activity level for each variant.

The results illustrate the influence of the fertilization and soil tillage systems on the dinamic of microorganisms population, on the relationship between the main groups (bacteria and fungi), and on the micromycetes spectrum determined in each variant of our experiment.

Key words: *Brassica napus* L., land use system, fertilizer, soil microflora.

Soil microflora is a sensitive indicator of soil functionality when investigating the impacts of management practices, such as fertilisation (García-Ruiz et al. 2008) and land use systems (Alvear et al. 2005). Microorganisms are beneficial in increasing the soil fertility and plant growth as they are involved in biochemical transformation and mineralisation activities in soils. Type of cultivation and crop management practices found to have greater influence on the activity of soil microflora (Mc Gill et al, 1980). Continuous use of fertilizers over a long period can influence negatively the soil microflora balance and thereby indirectly affect biological activities of soil leading to soil degradation (Manickam and Venkataraman, 1972).

The purpose of present investigation was to know the demography of soil microflora (bacteria, micromycetes) and their relationship under different land use and fertilization systems.

MATERIAL AND METHOD

The trial was conducted with rapeseed (*Brassica napus* L.) grown on a 2-3% slope field from the Ezăreni Farm, which belongs to the University of Agricultural Sciences and Veterinary Medicine, Iaşi. Soil is a clayey loam cambic chernozem, weakly degraded, with pH comprised between 6.7 and 6.8, humus content 2.73- 2.93%, 51-55 ppm P_2O_5, 314-336 ppm K_2O and 184-187 ppm CaO. The area is characterized by mean annual temperatures of 9.6^oC, annual rainfall of 517.8 mm and air relative humidity of 69%. From the physical-geographical viewpoint, this territory is found in the Southern area of the Moldavian Plain, which is named the Lower Jijia Plain and the Bahlui Plain, being situated in the South-Western extremity of this natural zone.

The effects of fertilization and soil tillage systems on soil population were observed. Soil tillage has been realized with plough (classic system, V1), with chisel, rotary harrow (minimum soil tillage, V2) and the last variant was in no-till system (V3). The inorganic (N, P, K) and organic fertilizers (sewage sludge) were applied in different doses.

For determining the number of microorganisms per 1 g soil, we have used the culture method in Petri dishes. Soil samples were gathered in paper bags, by means of a metallic spatula and the used material was previously sterilized. Soil was sampled at 10 cm depth and then samples were processed by grinding and homogenization in a sterile mortar. Soil dilutions were prepared according to the method of successive dilutions and sowing was done in Petri dishes, by the incorporation in medium.

For an easy identification of colonies, we have used different culture mediums, specific to each systematic group. Thus, for determining the total number of microorganisms, we have used the simple PDA (potato-dextrose-agar) medium, for determining the number of Gram-positive bacteria (G+), we have used the PDA with streptomycin (35 ppm) medium and for determining the number of micromycetes, we have used the PDA with rose bengal (33 ppm) medium (Constantinescu, 1974).

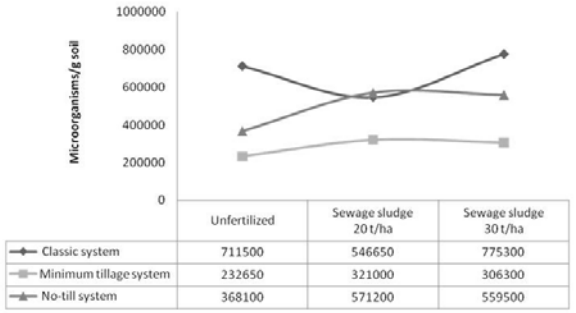
Sowing was done by introducing an ml of dilution in each Petri dish with melted and cooled medium at 45°C. The sown dishes were incubated in a thermostat at 28°C. The number of bacterial colonies was determined at 24 hours and the fungus

colonies at 5 days; counting was done by naked eye, using a marker. At high densities, the Wolfhügel plate was used (Larpent et al., 1990).

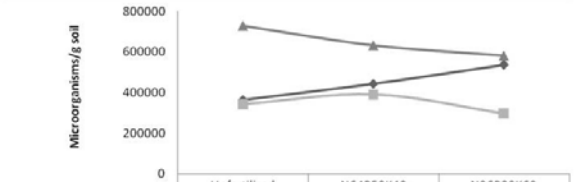
RESULTS AND DISCUSSIONS

The populations of soil fungi and bacteria reacted different on fertilizers and land use systems.

Organic fertilizers have been increases the microbial activity with percentage between 8.9 and 52.0 in the applied land use systems in comparacy with unfertilised control variant. The most obvious and continuous increase activity was observed in case of no-till system from 36.8 x 104 to 55.9 x 104 microorganisms/g soil. When inorganic fertilizers were applied an increased microbiological activity with 47.3% for conventional tillage system compared with unfertilised control variant was noted. In case of minimum and no-till systems variants the number of microorganisms/g soil registered a decrease of 13.4 and 20.2 percent, respectively (*figure 1*).



	Unfertilized	Sewage sludge 20 t/ha	Sewage sludge 30 t/ha
Classic system	711500	546650	775300
Minimum tillage system	232650	321000	306300
No-till system	368100	571200	559500



	Unfertilized	N64P50K40	N96P80K60
Classic system	365250	444600	537950
Minimum tillage system	343550	391650	297450
No-till system	729200	633000	582050

Figure 1 **Number of microorganism/g soils for different land use systems and fertilizers**

Organic fertilisation and intensive tillage are cited as two contrasting practices since they increase and decrease, respectively, soil microflora (Laudicina et al., 2010). Our results indicated the sewage sludge input as the factor by far mostly affecting microbial biomass when was applied in dose of 20 t/ha in case of classic land use system.

Analyzing the ratio between the main groups of microorganisms found in the soil when mineral fertilizers were applied we found significant differences among the variants.

The best represented microorganism group for all tillage systems is that of Gram-negative bacteria (G-), which represent between 59.4 and 88.0% from total number of microorganism. In case on minimum tillage system when N64P50K40 was applied the number of G- bacteria decrease in comparacy with unfertilized variant. The microbial quotient of G+ bacteria varied from 11.2 to 36.5%. The numbers of fungi ranged from 0.8 to 4.1% (*figure 2*).

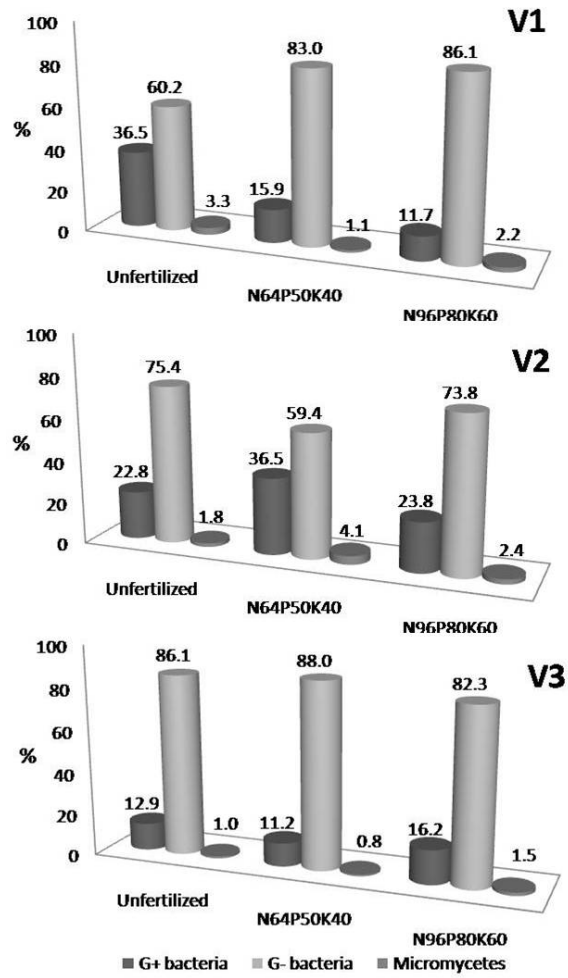


Figure 2 **Main groups of microorganisms when mineral fertilizers were applied**

When organic fertilizers were applied the G- bacteria was the best represented group of microorganism in case of classical and minimal tillage systems, but their percentage decrease slightly. This decreasing was in detriment of G+ bacteria which increase their percentage until 54.7 in case of no-till system. Micromycetes were present in range from 0.7 to 2.6%. The sewage sludge input and reduced tillage have beneficial effects on soil microflora diversity and nutrient availability (*figure 3*).

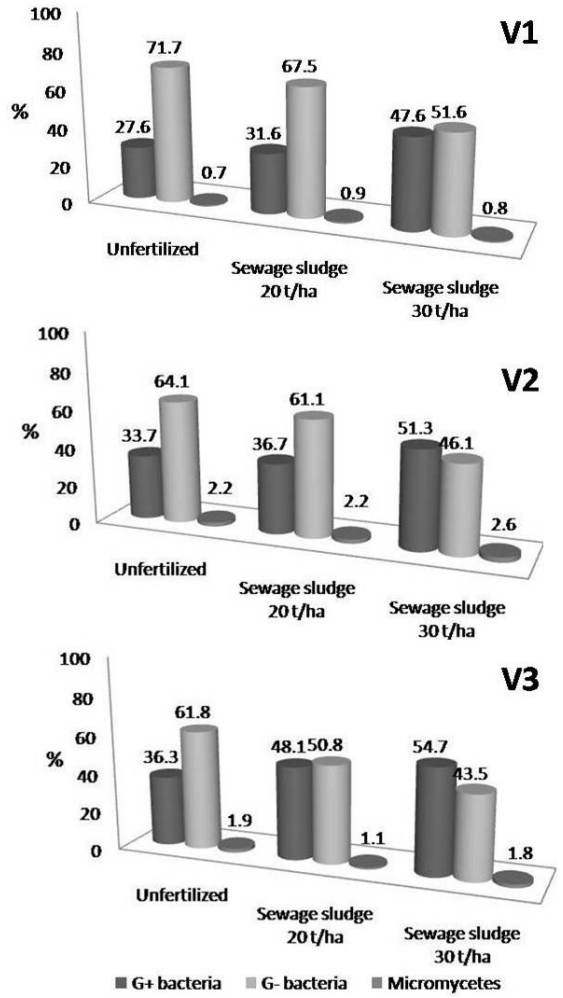


Figure 3 **Main groups of microorganisms when organic fertilizers were applied**

The results of Laudicina et al. (2010) showed that intensive tillage caused a higher soil aeration and organic substrates accessibility than reduced tillage and this speed up the mineralization of organic matter from soil. The best practices for improving soil fertility are represented by reduced land use systems coupled with high input of compost.

The investigations conducted on the frequency and spectrum of micromycetes genera shown different values depending of fertilization rates and tillage systems.

Also, in case of conventional system (with plough) we noticed that the greatest number of isolated fungus genera was in case of unfertilized variant (9) followed by the variant fertilized organic and inorganic (5). The best represented fungus genera were in all variants *Penicillium* (17-43%), *Fusarium*, *Trichoderma* and *Rhizopus* (*figure 4*).

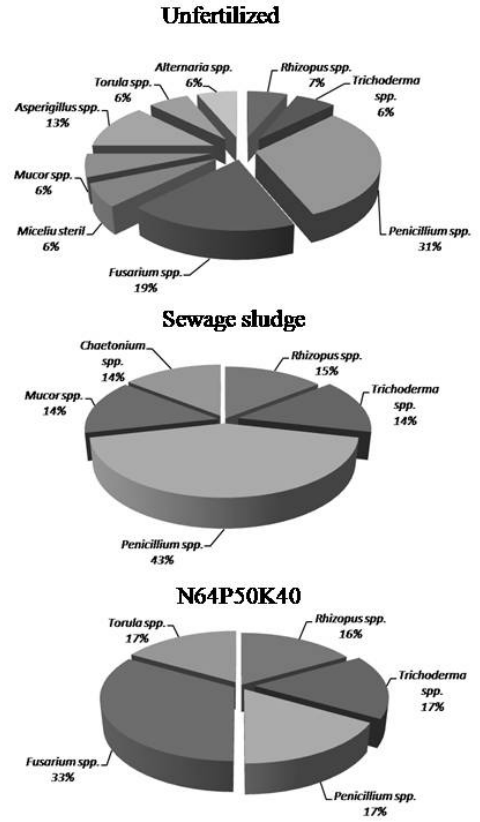


Figure 4 **Micromycetes genera isolated in case of classical tillage system**

For minimum tillage system the most isolated species belonging to eight micromycetes genera (*Penicillium*, *Trichoderma*, *Rhizopus*, *Fusarium*, *Torula*, *Aspergillus Cladosporium* and *Mycelia sterilia*) were in case of unfertilized variant. Interesting was the fact that when organic fertilizer was applied the number of genera was reduced to three (*Trichoderma*, *Rhizopus*, *Aspergillus*) (*figure 5*).

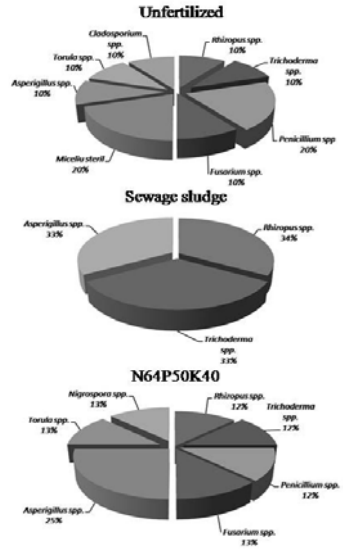


Figure 5 **Micromycetes genera isolated in case of minimum tillage system**

In case of no-till system we noticed that the number of isolated fungus genera was the highest for the fertilized variants in comparacy with the control (unfertilized). Also, for the variant fertilized with mineral compounds we isolated species belonging to eight micromycetes genera (*Penicillium*, *Trichoderma*, *Rhizopus*, *Fusarium*, *Torula*, *Aspergillus* *Cladosporium* and *Nigrospora*). Among the determined micromycetes in all the studied variants, we pointed out *Aspergillus* and *Fusarium* genera, which were isolated at a rate comprised between 17 and 54% and 8 to 25%, respectively (*figure 6*).

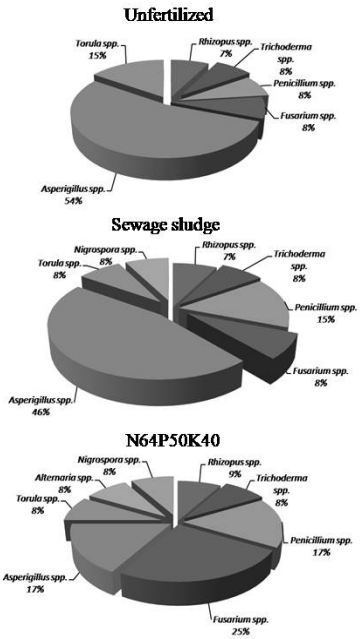


Figure 6 **Micromycetes genera isolated in case of no-till system**

CONCLUSIONS

Our observation on microbiological activity showed different reactions on fertilizers and land use systems. Between the analyzed variants the microbial activity was higher in the sampling soils from the classical tillage system when mineral fertilizers were applied and in case of no-till system when organic fertilizers were applied.

The investigations conducted on the frequency and spectrum of micromycetes genera shown different values depending of fertilization rates and tillage systems. In case of conventional and minimum tillage systems we noticed that the greatest number of isolated fungus genera was in case of unfertilized variant. For no-till system the number of isolated fungus genera was the highest in case fertilized variants in comparacy with the control (unfertilized).

Aknowledgements

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