INFLUENCE OF AQUASORB AND DIFFERENT SOIL TILLAGE SYSTEMS ON SOIL MICROBIAL POPULATIONS IN FIELDS CULTIVATED WITH SOYBEAN (*GLYCINE MAX* MERR.)

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Abstract

Aquasorb 3005 is a hydrophilic polymer (copolymer of acrylamide and potassium acrylate) that, when incorporated into a soil, improve water conservation through increasing of water retains capacity, reducing of infiltration rate and cumulative evaporation. This anionic polyacrylamide polymer works in absorbtion-release water cycles and has the property of absorbing up to 500 times their weight in distilled water. Researches were carried out on soybean (*Glycine max* Merr.) field trials located in the south region of Moldavian plain (Ezareni Farm), studying the effects of polymer quantity ha^{-1}, polymer administration moment and soil tillage systems on soil population. In this study we aimed to evaluate the influence of the hydrophilic polymer (Aquasorb) on 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 Aquasorb 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: Aquasorb, soil population, soil tillage system, soybean (*Glycine max* Merr.)

Aquasorb 3005 is a hydrophilic polymer (copolymer of acrylamide and potassium acrylate) that, when incorporated into a soil, improve water conservation through increasing of water retains capacity, reducing of infiltration rate and cumulative evaporation. This anionic polyacrylamide polymer works in absorbtion-release water cycles and has the property of absorbing up to 500 times their weight in distilled water.

Hydrophilic polymers are uded in agriculture from 1950. Anter and DeBoodt (1976) reported that polymers encouraged the uptake of nutrient elements by plants. Wallace and Wallace (1986) stated that the polymers improved the soil characteristics. The hydrogel provides a range of environmental benefits. Thus, decreases erosion, reducing sediment and nutrient losses and absorb the nutrients to gradually release them , depending on plant requirements. Hydrogel promotes soil colonization with bacteria and mycorrhiza. The influence of hydrogels depends on soil structure, the concentration of salts and fertilizers, and the type of plant cultivated (Peterson, 2009).

Hayat and Rifat (2004) reported that in arid and semiarid areas, Aquasorb was effective in increasing the water retention capacity, reducing the infiltration rate and cumulative evaporation and improving water conservation.

In this study we aimed to evaluate the influence of the hydrophilic polymer (Aquasorb) on 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.

MATERIAL AND METHOD

The trial was conducted with soybean (Glycine max Merr.) 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°C, 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.

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Researches were carried out on soybean (*Glycine max* Merr.) field trials located in the south region of Moldavian plain (Ezareni Farm), studying the effects of polymer quantity ha^{-1}, polymer administration moment and soil tillage systems on soil population.

A dose of 15 kg/ha Aquasorb in A2 and A4 variants and 30 kg/ha Aquasorb in A3 and A5 variants, which are compared with the control variant A1 were applied. The polymer was incorporated on a half of the experimental plot (5x10 m - 50 m^2) using rotary harrow before sowing (A2 and A3) and on the other half of the experimental plot with plough after plant harvest (A4 and A5).

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 DISCUSSION

The populations of soil fungi and bacteria were affected by treatment with Aquasorb. The analysis of the total number of microorganisms in the sampling soils, before (the control soils) and after herbicide application, shown significant increases of soil biological activity in all variants were hydrogel was applied.

Aquasorb applications show an increase of microbial population for both doses and soil tillage system.

The greatest number of microorganisms/g soil was determined in case of sample taken from the application area with 15 kg/ha Aquasorb incorporated with plough (23.8 x 10^4 cells per one gram dry weight of soil). For other variants with Aquasorb the number of microorganism ranged from 8.6 x 10^4 (A2) to 16.1 x 10^4 (A5) cells per one gram dry weight of soil. In case of control soil sample (A1) the biological activity was the lowest with only 7.6 x 10^4 cells per one gram dry weight of soil.

Analyzing the ratio between the main groups of microorganisms found in the soil occupied by soybean, we found significant differences among all variants where Aquasorb was applied.

The best represented microorganism group for all variants with exception of the control is that of Gram-positive bacteria (G+).

In case of all variants were the hydrogel was applied, G+ bacteria represent between 48.1 and 66.8% from total number of microorganism. Interesting was the observation that in the soil sample from the control plot the number of G- bacteria was bigger that number of G+ bacteria (53.1 vs. 36.1).

This can be explained through the influence of Aquasorb polymers, which when incorporated into a soil, improve water conservation through increasing of water retains capacity and absorb the nutrients to gradually release them, depending on plant requirements.

The numbers of micromycetes go lower as the control sample only in case of A4 (4.4%). The results show that ratios ranged from initially 10.8 until 16.6% (Figure 1).

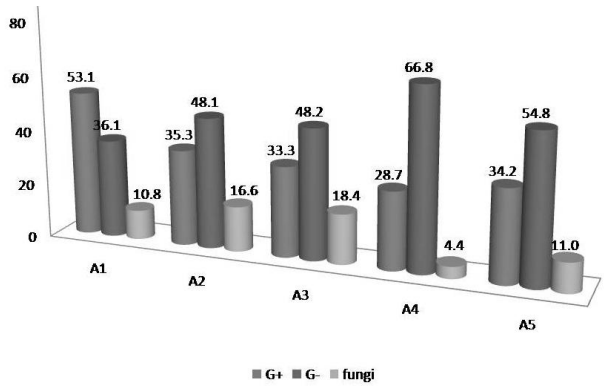

Figure 1 **Main groups of microorganisms/g soils for each experimented variant (%)**

The high rate of soil bacteria in all variants may be explained by their competition against microfungi as concerns some nutrients (Ulea et al., 2002; Wood, 1989).

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

In case of control variant we noticed the following six fungus genera: *Fusarium*, *Aspergillus*, *Penicillium*, *Trichoderma*, *Alternaria* and *Mycelia sterilia*. The best represented fungal genus was *Fusarium* with 33.3% (Figure 2).

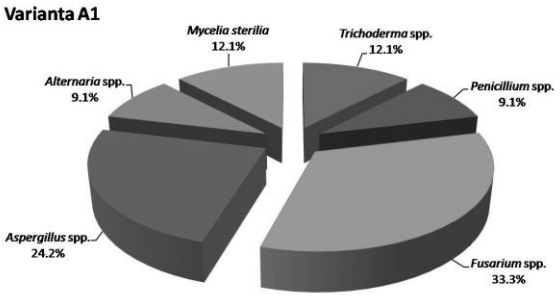

Figure 2 **Micromycetes genera isolated from soybean field for control variant**

For minimum tillage system (with rotary harrow - A2 and A3) the number of isolated fungus genera was equal and identical in case of both variants. Most isolated species belonging to eight micromycetes genera (*Penicillium*, *Fusarium*, *Trichoderma*, *Alernaria*, *Mycelia sterilia*, *Verticillium*, *Aspergillus* and *Mucor*).

Among the determined micromycetes in all the studied variants, we pointed out *Penicillium* genus, which was isolated at a rate comprised between 24.6 and 50.0% of the total identified genera (Figure 3).

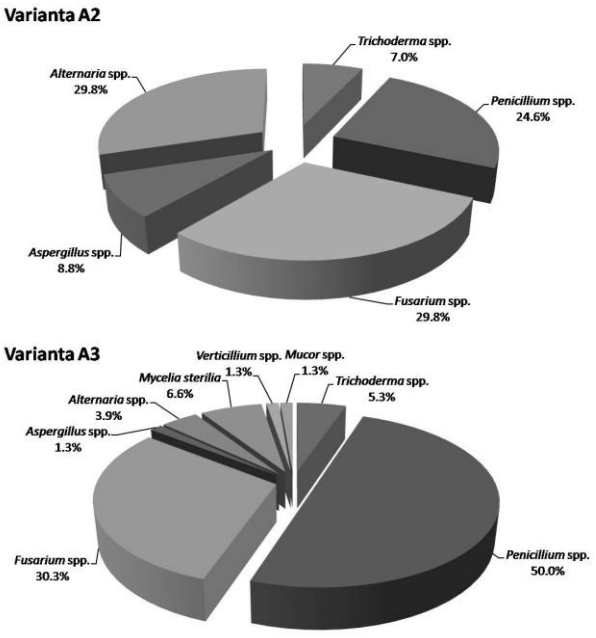

Figure 3 **Micromycetes genera isolated from soybean field where for minimum tillage system**

Also, in case of conventional system (with plough - A4 and A5) we noticed that the greatest number of isolated fungus genera was in case of variant when Aquasorbe was applied in dosage of 30 kg/ha (A5 - ten genera) followed by the variant with 15 kg/ha (A4 - eight genera). The best represented fungus genera were in all variants *Penicillium* (26.2-36.6%), *Fusarium* (31.0-35.2%), *Aspergillus* and *Trichoderma*. In very small ratios and only in case of A5 were present the following micromycetes genera: *Sepedonicum* and *Mucor*.

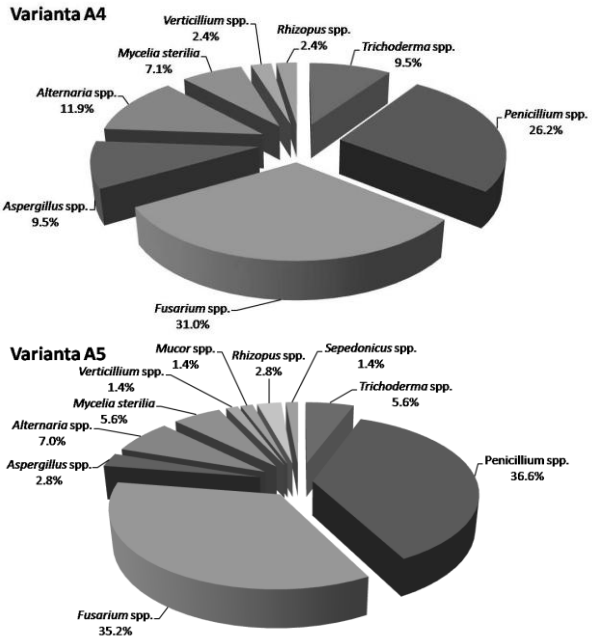

Figure 4 **Micromycetes genera isolated from soybean field where for conventional system**

The investigations conducted on the frequency of micromycetes genera have shown an increasing number in the presence of Aquasorbe.

CONCLUSIONS

Our observation on the total number of microorganisms/g in the sampling soils shown significant increases of soil biological activity in all variants were Aquasorbe was applied.

Between the analyzed variants the highest microbial activity was recorded in the sampling soils collected from soybean (*Glycine max* Merr.) variant where 15 kg/ha Aquasorb were incorporated with plough (23.8 x 10^4 cells per one gram dry weight of soil - A4).

The biological soil activity in other three trials (A2, A3 and A5) was lower compared to the A4 variant, but higher that in the control variant.

In all the studied variants, from all the isolated micromycetes genera, *Penicillium* spp. has the highest frequency; it was followed by, *Fusarium*, *Aspergillus*, *Trichoderma*, *Alternaria*, *Rhizopus*, *Verticillium* and *Mycelia sterilia*.

In very small ratios were isolated the following micromycetes genera: *Sepedonicus* and *Mucor*.

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