INFLUENCE OF AQUASORB AND DIFFERENT SOIL TILLAGE SYSTEMS ON SOIL MICROORGANISMS IN FIELDS CULTIVATED WITH MAIZE

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Abstract

Aquasorb, a hydrophilic polymer (a salt copolymer polyacrylamide), works in absorption-release water cycles and has the property to increase the water holding capacity of soils for several years. The trial was conducted with maize (*Zea mays* L.) grown on a 2-3% slope field from the Ezăreni Farm, which belongs to USAMV Iaşi, studying the effects of polymer quantity ha^{-1}, polymer administration moment and soil tillage systems on soil population. The objectives of this research 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 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, maize (*Zea mays* L.)

Aquasorb, a hydrophilic polymer (a salt copolymer polyacrylamide), works in absorption-release water cycles and has the property to increase the water holding capacity of soils for several years. Aquasorb promotes soil colonization with bacteria and mycorrhiza, but influence of hydrogels depends on soil structure, the concentration of salts and fertilizers, and the type of plant cultivated（Eliade et al. 1975, Anter et al 1976）.

In Romania, a major part from the 9.4 million hectares of arable land (64% of agricultural area) are more or less affected by long droughts periods and in consecutive years.

Water is quantitatively important for the agricultural production and for effective capitalization of water resources usage of hydrophilic polymers in agriculture is very important. Sharma (2004) reported that plants cultivated on soils treated with hydrogel have more water available and for a longer period of time, in comparacy with irrigated control groups.

The objectives of this research 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.

MATERIAL AND METHOD

The trial was conducted with maize (*Zea mays* 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°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.

Researches were carried out on maize (*Zea mays* L.) 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).

The culture technology has been specific for mayze (PR38A24 hybrid). Fertilizers were given in a

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dose of 60 kg/ha P_2O_5 + 40 kg/ha N before the seedbed preparation and 20 kg/ha N in vegetation at first mechanical take, for corn culture. The seedbed was prepared on the day of sowing, using the combinator and the sown was carried out with SPC4-FS + U650.

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.

A close examination of the biological activity from rhizosphere of maize (*Zea mays* L.) after Aquasorb applications show an increase of microbial population for both doses and soil tillage system. Also, a great variability on soil microorganism activity and structure of microbial populations was observed.

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 rotary harrow (39.3 x 10^4 cells per one gram dry weight of soil). For other variants with Aquasorb the number of microorganism ranged from 24.3 x 10^4 (A4) to 36.4 x 10^4 (A3) cells per one gram dry weight of soil. In case of control soil sample (A1) the biological activity was the lowest with only 16.8 x 10^4 cells per one gram dry weight of soil.

This fact can be explained through the influence of Aquasorb polymers, which improve water conservation on soil and create better condition for soil populations.

Analyzing the ratio between the main groups of microorganisms found in the soil occupied by maize, 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 70.0 and 78.7% from total number of microorganism. G+ bacteria were also the best represented group of microorganism in case of control plot classical, but their percentage was only 57.3%.

The selection was made on basis of biochemical proprieties of the radicular secretion via elimination of the genera that could not use them for their vital processes.

The numbers of micromycetes go lower as the control sample in all variants with exception of A5 (4.3%). The results show that ratios ranged from initially 3.7 until 4.3% (Figure 1).

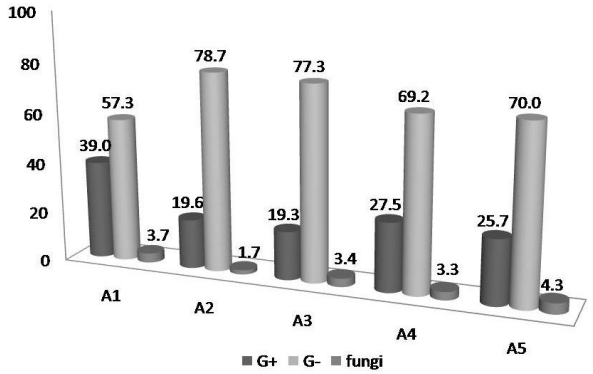

Figure 1 **Main groups of microorganisms/g soils for each experimented variant (%)**

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).

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 (A1) the identification of micromycetes from the rhizosphere area of maize we noticed the following seven fungus genera: *Aspergillus*, *Fusarium*, *Alternaria*, *Trichoderma*, *Penicillium*, *Cladosporium* and *Rhizopus*. The ratio between

these groups is very different, with *Aspergillus* spp. as dominant genus with 36.0% (Figure 2).

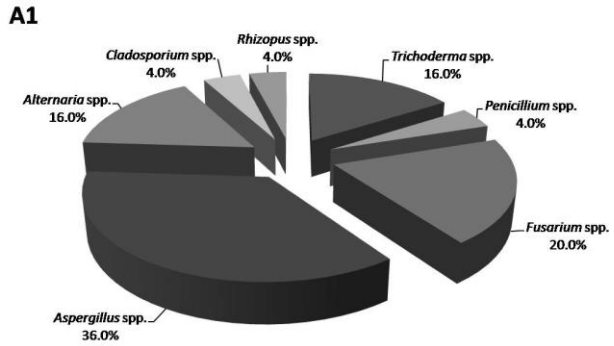

Figure 2 **Micromycetes genera isolated from maize field for control variant**

In case of minimum tillage system (with rotary harrow - A2 and A3) the number of fungal genera ranged between 5 (A2) and 7 (A3). The best represented fungal genus was *Aspergillus* with aproximatively 45%. The other genera *Fusarium*, *Penicillium*, *Trichoderma*, *Alternaria*, *Rhizopus* and *Cladosporium*, cumulate together 55% from all fungi (Figure 3).

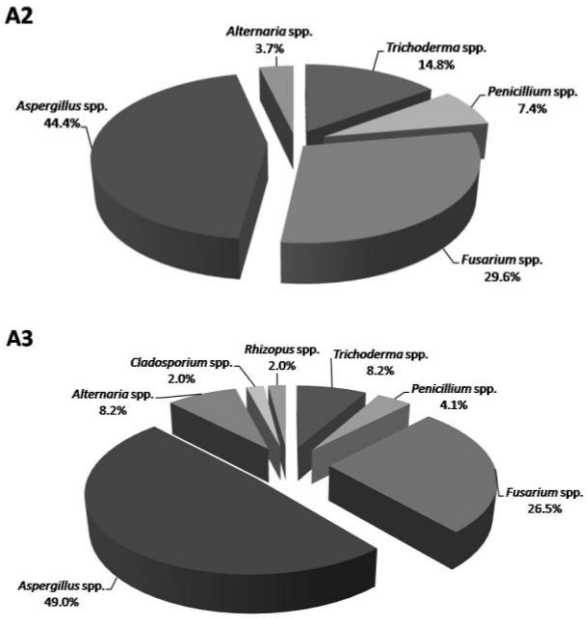

Figure 3 **Micromycetes genera isolated from maize field where for minimum tillage system**

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 15 kg/ha (A5 - eight genera) followed by the variant with 30 kg/ha (A4 - six genera). Among the determined micromycetes, we pointed out *Aspergillus* and *Fusarium* genera, which were isolated at rates comprised between 43.8-71.2% and 11.5-15.6%of the total identified genera. In small ratios and only in case of A5 were present the following micromycetes genera: *Rhizopus* and *Mucor* (Figure 4).

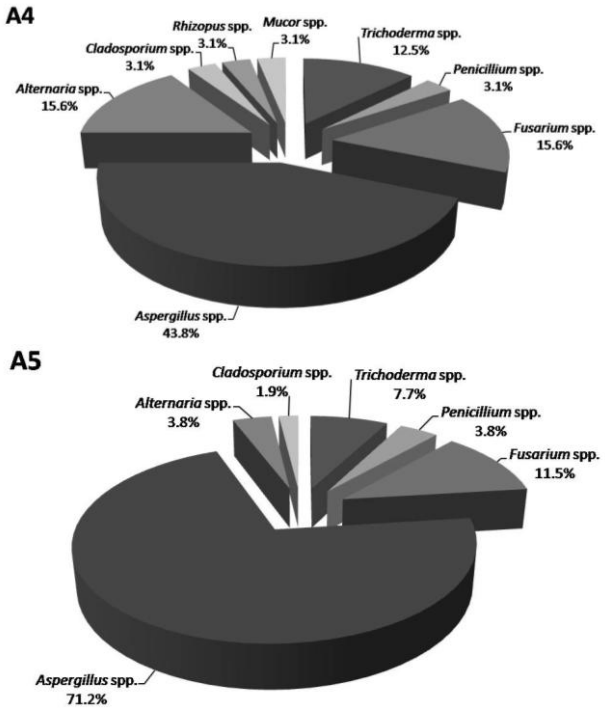

Figure 4 **Micromycetes genera isolated from maize field where for conventional system**

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

Most isolated species in all variants belong to the following micromycetes genera: *Aspergillus*, *Fusarium*, *Penicillium* and *Trichoderma*.

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 maize (*Zea mays* L.) variant where 15 kg/ha Aquasorb were incorporated with rotary harrow (39.3 x 10^4 cells per one gram dry weight of soil - A2).

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

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

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