Geophysical Research Abstracts
Vol. 21, EGU2019-15524, 2019
EGU General Assembly 2019

Bulk soil and rhizosphere micromycete communities of different agricultural crops under organic and mineral fertilizer systems

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The rhizosphere is considered as one of the most complex ecological niches in relation to microbial diversity and interspecies networks. Although the importance of the rhizosphere microbiome for plant growth has been widely recognized, it remains poorly understood how various environmental and plant-related factors affect microbial composition and diversity in the rhizosphere. This study was aimed to assess the influence of plant- (species and development stage) and fertilization-related (mineral and organic systems) factors on the abundance, biomass and composition of rhizosphere and bulk soil micromycete communities. Soil samples were collected from the bulk soil (Eutric Retisol) and rhizosphere of maize, potato, and white mustard under two fertilization treatments (N180P180K180 and 50 t/ha of fresh cattle manure). Micromycete communities were estimated and identified by microbiological plating and ITS rDNA sequencing.

In general, 39 species of micromycetes related to 19 genera were identified. Most of the isolated species were anamorphic representatives of the Deuteromycotina sub-division. Among them, Penicillium, Fusarium, Acremonium, and Aspergillus were represented by the largest number of species. The lowest number of micromycete species was identified in the bulk soil under white mustard. The most common species of micromycetes were Aspergillus ustus, Fusarium poae, Mucor hiemalis, Penicillium funiculosum, Sarocladium kiliense, Trichoderma harzianum. Species Aureobasidium pullulans, Fusarium dimerum, F. solani, Monilia geophila, and Verticillium tenerum were found only in the rhizosphere. Micromycete communities under potato were characterized by the presence of Fusarium dimerum, Stachybotrys sp., and Penicillium spinulosum, as well as the lower diversity of Aspergillus sp. Micromycete communities under maize were characterized by the presence of Paecilomyces, Phialophora, and Phoma.

Fertilization was the most significant factor determining the structure and diversity of both bulk soil and rhizosphere micromycete communities. Our findings revealed that this factor was more important than the soil niche type, crop species or the stage of plant development. The application of mineral fertilizers had an adverse effect on the diversity of micromycetes in soil, while organic fertilizers increased fungal diversity in both bulk soil and rhizosphere. Thus, the application of organic compounds can serve as an effective method to manage micromycete communities in the rhizosphere of agricultural crops.

This research was supported by the Russian Science Foundation, Project No 17-76-00002.