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Effect of Fertilization and Combined Inoculation with Azospirillum brasilense and Pseudomonas fluorescens on Rhizosphere Microbial Communities of Avena sativa (Oats) and Secale Cereale (Rye) Grown as Cover Crops

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Abstract : Cover crops are an agri-technological alternative to improve all properties of soils. Cover crops such as oats and rye could be used to reduce erosion and favor system sustainability when they are grown in the same agricultural cycle of the soybean crop. This crop is very profitable but its low contribution of easily decomposable residues, due to its low C/N ratio, leaves the soil exposed to erosive action and raises the need to reduce its monoculture. Furthermore, inoculation with the plant growth promoting rhizobacteria contributes to the implementation, development and production of several cereal crops. However, there is little information on its effects on forage crops which are often used as cover crops to improve soil quality. In order to evaluate the effect of combined inoculation with Azospirillum brasilense and Pseudomonas fluorescens on rhizosphere microbial communities, field experiments were conducted in the west of Buenos Aires province, Argentina, with a split-split plot randomized complete block factorial design with three replicates. The factors were: type of cover crop, inoculation and fertilization. In the main plot two levels of fertilization 0 and 7 40-0-5 (NPKS) were established at sowing. Rye (Secale cereale cultivar Quehué) and oats (Avena sativa var Aurora.) were sown in the subplots. In the sub-subplots two inoculation treatments are applied without and with application of a combined inoculant with A. brasilense and P. fluorescens. Due to the growth of cover crops has to be stopped usually with the herbicide glyphosate, rhizosphere soil of 0-20 and 20-40 cm layers was sampled at three sampling times which were: before glyphosate application (BG), a month after glyphosate application (AG) and at soybean harvest (SH). Community level of physiological profiles (CLPP) and Shannon index of microbial diversity (H) were obtained by multivariate analysis of Principal Components. Also, the most probable number (MPN) of nitrifiers and cellulolytics were determined using selective liquid media for each functional group. The CLPP of rhizosphere microbial communities showed significant differences between sampling times. There was not interaction between sampling times and both, types of cover crops and inoculation. Rhizosphere microbial communities of samples obtained BG had different CLPP with respect to the samples obtained in the sampling times AG and SH. Fertilizer and depth of sampling also caused changes in the CLPP. The H diversity index of rhizosphere microbial communities of rye in the sampling time BG were higher than those associated with oats. The MPN of both microbial functional types was lower in the deeper layer since these microorganisms are mostly aerobic. The MPN of nitrifiers decreased in rhizosphere of both cover crops only AG. At the sampling time BG, the NMP of both microbial types were larger than those obtained for AG and SH. This may mean that the glyphosate application could cause fairly permanent changes in these microbial communities which can be considered bio-indicators of soil quality. Inoculation and fertilizer inputs could be included to improve management of these cover crops because they can have a significant positive effect on the sustainability of the agro-ecosystem.

Keywords : community level of physiological profiles, microbial diversity, plant growth promoting rhizobacteria, rhizosphere microbial communities, soil quality, system sustainability
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