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Rhizosphere: a leverage for tolerance to water deficits of soil microflora ?

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Microbial soil communities play a fundamental role in soil organic matter mineralization, which is a key process for plant nutrition, growth and production in agro-ecosystems. A number of these microbial processes take place in the rhizosphere: the soil zone influenced by plant roots activity, which is a "hotspot " of biological and physico-chemical activity, transfers and biomass production. The knowledge of rhizosphere processes is however still scanty, especially regarding the interactions between physico-chemical processes occurring there and soil microorganisms. The rhizosphere is a place where soil aggregates are more stable, and where bulk density, porosity, water and nutrients transfer are modified with respect to the bulk soil (e.g. because of production of mucilage, of which exo-polysaccharides (EPS) produced by roots and microorganisms. During a maize field experiment, rhizospheric soil (i.e. soil strongly adhering to maize roots) and bulk soil were sampled twice in spring and summer. These soil samples were characterized for physicochemical parameters (water retention curves and analysis of exopolysaccarides) and microflora (microbial biomass, catabolic capacities of the microbial communities assessed with the MicroRespTM technique, stability of soil microbial respiration faced to a heat-drought disturbance). We observed differences between rhizospheric and bulk soils for all parameters studied: Rhizospheric soils showed higher microbial biomasses, higher quantities of exopolysaccarides and a higher water retention capacity compared to bulk soil measurements. Moreover, microbial soil respiration showed a higher stability confronted to heat-drought stress in the rhizospheric soils compared to bulk soils. Results were more pronounced during summer compared to spring. Globally these data obtained from field suggest that in a changing climate conditions, the specific physico-biological conditions in the rhizosphere partially linked to exopolysaccarides, could induce stability (Resistance, Resilience) of soil microbial communities towards stresses, in particular severe drought. The knowledge of these interactions in the rhizosphere between local hydric soil properties and microbial behaviour facing drought, could allow a better understanding of the functioning of agro-ecosystems for their management in a changing climate.