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Managing soil microbial communities in grain production systems through cropping practices

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Cropping practices can significantly influence the composition and activity of soil microbial communities with consequences to plant growth and production. Plant type can affect functional capacity of different groups of biota in the soil surrounding their roots, rhizosphere, influencing plant nutrition, beneficial symbioses, pests and diseases and overall plant health and crop production. The interaction between different players in the rhizosphere is due to the plethora of carbon and nutritional compounds, root-specific chemical signals and growth regulators that originate from the plant and are modulated by the physico-chemical properties of soils. A number of plant and environmental factors and management practices can influence the quantity and quality of rhizodeposition and in turn affect the composition of rhizosphere biota communities, microbe-fauna interactions and biological processes. Some of the examples of rhizosphere interactions that are currently considered important are: proliferation of plant and variety specific genera or groups of microbiota, induction of genes involved in symbiosis and virulence, promoter activity in biocontrol agents and genes correlated with root adhesion and border cell quality and quantity. The observation of variety-based differences in rhizodeposition and associated changes in rhizosphere microbial diversity and function suggests the possibility for the development of varieties with specific root-microbe interactions targeted for soil type and environment i.e. designer rhizospheres. Spatial location of microorganisms in the heterogeneous field soil matrix can have significant impacts on biological processes. Therefore, for rhizosphere research to be effective in variable seasonal climate and soil conditions, it must be evaluated in the field and within a farming systems context. With the current focus on security of food to feed the growing global populations through sustainable agricultural production systems there is a need to develop innovative cropping systems that are both economically and environmentally sustainable.