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Rhizospheric microbiome: Bio-based emerging strategies for sustainable agriculture development and future perspectives

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In the light of intensification of cropping practices and changing climatic conditions, nourishing a growing global population requires optimizing environmental sustainability and reducing ecosystem impacts of food production. The use of microbiological systems to ameliorate the agricultural production in a sustainable and eco-friendly way is widespread accepted as a future key-technology. However, the multitude of interaction possibilities between the numerous beneficial microbes and plants in their habitat calls for systematic analysis and management of the rhizospheric microbiome. This review exploits present and future strategies for rhizospheric microbiome management with the aim to generate a comprehensive understanding of the known tools and techniques. Significant information on the structure and dynamics of rhizospheric microbiota of isolated microbial communities is now available. These microbial communities have beneficial effects including increased plant growth, essential nutrient acquisition, pathogens tolerance, and increased abiotic as well as biotic stress tolerance such as drought, temperature, salinity and antagonistic activities against the phyto-pathogens. A better and comprehensive understanding of the various effects and microbial interactions can be gained by application of molecular approaches as extraction of DNA/RNA and other biochemical markers to analyze microbial soil diversity. Novel techniques like interactome network analysis and split-ubiquitin system framework will enable to gain more insight into communication and interactions between the proteins from microbes and plants. The aim of the analysis tasks leads to the novel approach of Rhizosphere microbiome engineering. The capability of forming the rhizospheric microbiome in a defend way will allow combining several microbes (e.g. bacteria and fungi) for a given environment (soil type and climatic zone) in order to exert beneficial influences on specific plants. This integration will require a large-scale effort among academic researchers, industry researchers and farmers to understand and manage interactions of plant-microbiomes within modern farming systems, and is clearly a multi-domain approach and can be mastered only jointly by microbiology, mathematics and information technology. These innovations will open up a new avenue for designing and implementing intensive farming microbiome management approaches to maximize resource productivity and stress tolerance of agro-ecosystems, which in return will create value to the increasing worldwide population, for both food production and consumption

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