

Special Issue

Crop Microbiome and Stress: Interactions, Mechanisms, and Applications

Message from the Guest Editors

Understanding and harnessing plant microbiomes—which encompass the rhizosphere, endosphere, and phyllosphere communities—are essential for improving nutrient cycling, suppressing pathogens, and enhancing stress resilience in agriculture. Nonetheless, the efficacy of microbial inoculants in field trials is frequently constrained by edaphic heterogeneity, climatic fluctuations, and context-dependent plant-microbe interactions, including cultivar-specific responses. Mechanistic insights into signalling networks, metabolite exchange, and community assembly remain scarce, and multi-omics datasets are often analysed in silos. This Special Issue tackles these bottlenecks by spotlighting high-throughput metaomics for capturing microbial diversity, spatial metabolomics to map in situ chemical dialogues, and emerging genome- and microbiome-editing tools. Systems-level modelling and machine learning approaches enable the rational design of synthetic consortia, while root-exudate engineering and holobiont-based breeding integrate microbes into plant improvement programmes. We will also address the regulatory, ethical, and socio-economic frameworks that shape field deployment.

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