
Preface

Over the past three decades, microbial biotechnology has benefited greatly from the extraordinary advances in molecular biology and nanotechnology. This has helped not only in the identification of microbial communities but their functional and metabolic diversity too and has resulted in the identification of potential microbial gene pool, proteins, or metabolites. There have been tremendous research advances in the study of plant-microbe (beneficial) and plant-pathogen interactions, pathogen recognition, induced systemic resistance and innate immunity mechanisms in plants, root rhizosphere biology, mechanisms of plant growth promotion and antagonism within microbial communities, and impact assessment of inoculated microbes on soil, plant, and other beneficial microorganisms to establish proof of concept behind microbial inoculation in soils or plants. Dynamic interactions between root exudates, microbial activity, genetic exchange, nutrient transformation, and gradient diffusion are the most likely factors shaping the belowground activities where microbial inoculants need to survive to produce beneficial impacts. Consequently, there remained an increasing demand to understand belowground functioning to effectively manage ecosystem and harness potential benefits. Manipulation of the rhizosphere with microbial inoculation is now being considered as a key mechanism for solving critical issues for agricultural sustainability, food quality management, mitigation of climate change, and conservation of biodiversity. Plants interact with groups of soil microbial communities at different trophic levels for alleviation of biotic and abiotic stresses which involve positive and negative feedbacks between soil microbes, plants, and their chemical environment. These issues have been worked out critically in different plant-microbe systems and led to a broad, yet clearer, understanding of the mechanisms of inoculation of plants with microbes. With this background, the demand for totally novel microbial products creates pressure on microbial biotechnologists to search for more potent and ecologically robust organisms and their specific interactive targets within the plants for developing potential microbial inoculants. Mass-scale inoculation comprises the supply of high-density viable and efficient microbial formulations in the field for a rapid colonization of the host rhizosphere. Prior to registration and commercialization of microbial inoculants, there remain a number of steps to consider. From laboratory to the industrial scale-up, this requires process scaling and mass production of the defined organism

under commercial fermentation conditions while maintaining quality, stability, and efficacy of the product.

The book *Microbial Inoculants in Sustainable Agricultural Productivity Vol. II Functional Applications* addresses the field usage of microbial inoculants (biofertilizers, biostimulants, biopesticides) that need several stages to undergo. Authors contributing to this volume have presented detailed account of mass production of microbial inoculants that involves scaling-up of production process of an efficient microbe from laboratory to industrial level, development of efficient production technology, quality control, commercial aspects, intellectual property rights involved, cross-boundary registration methods, biosafety and biosecurity concerns, and their legal sanctity. It also discusses formulation development that needs to consider factors such as base material, shelf life, compatibility with existing agricultural practices and materials (chemicals, other organisms), cost, and ease of applications. Biosafety and biosecurity considerations were also presented at length as per territorial guidelines to address such issues as nontarget effects on microbes and other organisms, toxigenicity, allergenicity and pathogenicity, persistence in the environment and potential for horizontal gene transfer, etc. Capitalization costs, techno-commercial issues, and potential markets were considered as key issues for making decisions to commercialize microbial inoculants. We are thankful to all the contributing authors for putting their efforts to complete this volume.

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Microbial Inoculants in Sustainable Agricultural
Productivity

Vol. 2: Functional Applications

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2016, XVI, 308 p. 29 illus., 12 illus. in color., Hardcover

ISBN: 978-81-322-2642-0