THE PLANT MICROBIOME IN SUSTAINABLE AGRICULTURE

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Preface

Global agriculture is facing a major challenge of ensuring sustainable and healthy food production for an ever exploding human population, while seeking to reduce adverse effects on the ecosystem. Recent reports indicate that factors like soil health (nutrients, water, and pH), vulnerability to diseases and pests, agronomic practices and climate change affect crop growth and yield. These factors are the prime cause of crop failure and decline in average yields.

The quest to harness the potential of useful microbes from different ecological niches have shown interesting outcomes in that microbiome plays an important role in growth and development of other living communities. Plants depend on their microbiome for multifarious life supporting activities including nutrient acquisition and augmentation of the defense system towards biotic and abiotic stresses. However, the process of crop domestication may have negative associations with the composition and function of the host associated microbiota, thereby limiting their advantageous effects on crop health and development. With major emphasis on agriculture, characterizing the plant microbiome and its function could be applied for better crop designing and management to grow crops in resource limited environments, and protect them from intruding pathogens. Unfortunately, at present, most of the breeding programs across the globe have not taken microbial action into account. Therefore, a deeper understanding of the interrelationships of the soil–plant–microorganism system is essential for improving the efficacy and potential applications of plant growth promoting inocula for achieving sustainable food security and development.

Many of the laboratories working on plant growth-promoting rhizobacteria (PGPR) have reported that cocktails of useful bacteria in the form of synthetic communities are better than the single inoculants which face competition from other microorganisms and which could be killed or suppressed under suboptimal conditions. These findings clearly establish the importance of the microbial community in the well-being of crop plants. Now the researchers are focusing towards deciphering the microbial communities using next generation molecular approaches, and they are dominating the conventional methods. Modern molecular tools are utilized to recover the microbial information's links with different ecological niches. This information can be used to establish and maintain plant and human health, and finally to achieve comprehensive information of the plant microbiome that can be helped to improve agricultural production. In the past two decades, the plant microbiome has gained interest and crop performance is increasingly being recognized as the result of multipartite interactions. The huge gene pool of the microorganisms living in close association as endosymbionts and surface colonizers extends to the host genome and contributes to its phenotype. The studies clearly indicate that the totality of this genetic information in the form of the hologenome may allow adaptation of crops to diverse environmental conditions and interactions.

The present book provides a comprehensive review and compiled information on different aspects of plant microbe research with reference to its scope in the agriculture system which can be transformed by a complete understanding and application of the specific microbiota in a holistic manner. In the book, the chapters are contributed by active researchers having expertise in the domain.

Following an introduction to the specificities of microbiome research, modern tools and techniques to understand the plant microbiome are described. The updated information on the microbiome of different crops and cropping systems, followed by functional ecology and its potential for abiotic and biotic stress management, crop health and nutrient fortification, has been presented in different chapters. As they are of particular relevance for the future of agriculture in a sustainable manner, the biotechnological and molecular aspects of the translational microbiome are thoroughly covered across the book. Lastly, the relevance of the microbial community as the reservoir of novel genes and metabolites and as the key to green and clean agriculture have been discussed. This book will stimulate the readers to understand this complex subject in a lucid manner. It provides a path to researchers to address some of the contemporary issues before the scientific community, towards development of environmentally friendly and sustainable agriculture to meet the needs of our universe. With great pleasure, the editors acknowledge the efforts and contributions of expert authors, which were crucial for the quality of information provided.

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Dr. Alok Kumar Srivastava is a dedicated scientist in the area of molecular microbiology, presently working as Principal Scientist, ICAR-National Bureau of Agriculturally Important Microorganisms, India. He has made an outstanding and pioneering contribution in the area of Molecular Plant Pathology, contributed to structural, functional and comparative genomics of agriculturally important microorganisms, pathogens, development of molecular diagnostic tools and biological control of important diseases. He successfully sequenced the whole genome of 15 AIMs, deciphered microbial communities of Leh, mangrove soil of Andaman, landfill sites, and saline soils through metagenomics. Dr. Srivastava is Ph.D. from Banaras Hindu University, India, and completed his post doc at Otto Warburg Centre of Biotechnology with Prof Ilan Chet, at The Hebrew University of Jerusalem, Israel. He has also visited several countries including Hungary, France, The Netherlands, and Norway. He worked as a visiting research scientist in the Department of Plant Sciences, McGill University, Canada in the year 2010. He has 31 years of research experience in the area of biological control of fungal pathogens and plant growth-promoting rhizobacteria (PGPRs) and has supervised eight PhD students. He has successfully completed several externally funded research projects from DST, DBT and other agencies of the Indian Government. He has published about than 130 research papers in journals of international repute, several review articles, edited three books, and has more than 2473 citations to his credit (H index-25, I_{10} index 55). He is also associated with the capacity building program in the area of microbiology and has organized/participated in many training programs as a resource expert. Currently, he is associated with one of the mega network projects, “Application of Microorganisms in Agriculture and Allied Sectors (AMAAS)” of ICAR, India and is performing whole genome sequencing of important microorganisms. He is also providing molecular identification services for the microorganisms to be registered with the Central Insecticide Board and Registration Committee (CIB&RC) Govt. of India. His group is focusing on the management of abiotic stresses and soil health through *Bacillus* and other predominant genera as PGPR, its capabilities related to soil fertility and plant nutrition mobilization, the production of bacterial phytohormones and solubilization of mineral phosphates, allowing them to inhabit diverse niches in agro-ecosystems. For further details of this work visit https://scholar.google.co.in/citations?user=De5ciSsAAAAJ&hl=en