

Plant Microbe Symbiosis: Fundamentals and Advances

Naveen Kumar Arora
Editor

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 Springer

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Preface

Symbiosis is a biological phenomenon that involves close association between two or more organisms. Plant microbe symbiosis is one of the most intriguing relationships in the living world which has to be exploited for feeding an ever increasing human population in a sustainable way, maintaining the balance, diversity and productivity of agroecosystems in an ecofriendly manner. It takes several millions of years for establishing an intimate relationship between as diverse organisms as those belonging to prokaryota, fungi and plantae. Plants and microbes communicate and understand each other by the help of molecular dialogues. It is essential to decode these dialogues so as to establish a successful symbiotic relationship for the enhancement of crop productivity. This book looks into the plant growth promoting (PGP) microbes that generally colonize the rhizosphere region and help the host plant in one way or the other. Understanding of how symbiotic associations are established between plants and microbes that can be of particular relevance to modern day agriculture is also provided in the book.

The book comprises 16 chapters contributed by researchers from around the globe that provide detailed review on current status of research related to plant microbe interactions for developing new and alternative ecofriendly agrotechnologies. The diversity of plant ecosphere is huge and we still know only a fraction of what is happening in this dynamic ecosystem. There are so many useful microorganisms residing in the rhizosphere region which form symbiotic relationships with plants. Some of the best known or studied PGP microorganisms like *Rhizobium*, *Pseudomonas*, mycorrhiza, endophytes etc. have helped in understanding the symbiotic relationships between plants and diverse microbes of the rhizosphere or soil. But still a lot has to be done so as to use these beneficial microbes as sustainable and successful agri-biotechnology. Overall, a comprehensive approach that merges the fundamentals with the advanced techniques in the fields of functional genomics, proteomics, metabolomics and bioinformatics is required to bioengineer the future formulations that are reliable and more effective in their action. The book on one hand covers the fundamentals of plant microbe symbiosis and on the other hand provides inputs for the future research in the field. It is now clear that the multifaceted and diverse mechanisms of plant associated microbes

participate and are involved in promoting plant growth, protecting plant health, sustaining the plant under stress, pollutant or contaminant affected conditions and protecting plants from the attack of phytopathogens.

Researchers working in the field of rhizosphere biology, PGPRs, plant-microbe interactions, bioformulation technology and related fields will find the compilation extremely useful. The book will be of great value to the teachers and graduate and postgraduate students of life sciences, specifically microbiology, biotechnology, biochemistry and agriculture sciences. Readers will find a feast of updated information as well as the future direction for research in the field.

Finally, I would like to thank all those who have in one way or other helped in compilation of this wonderful volume. I acknowledge the support of all the contributors to this tome. My sincere thanks to all the authors for their cooperation, providing latest information on the subject and despite their busy schedules sticking to the timelines of the project. Thanks to Dr. Mamta Kapila from Springer (India) for pushing me hard to initiate the project and once the initiation materialized, the product was also formed. My gratitude to Prof. D. K. Maheshwari, Department of Botany and Microbiology, GKVV, Haridwar, for time to time advice, ideas and support. I would like to thank my research scholars Mr. Sachin Singh, Ms. Sakshi Tewari, Mr. Jitendra Mishra and Ms. Rachna Singh for helping in compilation of manuscript. Last but not least, special thanks to my wife Ms. Preeti Arora for her tolerance and tireless support during the phase of compilation and my sons Pranay and Nav for their rejuvenating presence.

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About the Editor

Dr. Naveen Kumar Arora, Ph.D. Microbiology, Associate Professor in Department of Environmental Microbiology, Babasaheb Bhimrao Ambedkar University (a central university), Lucknow, Uttar Pradesh, India, is a renowned researcher in the field of Environmental Microbiology and Biotechnology. His specific area of research is rhizosphere biology and PGPR. He has 35 research papers published in premium international journals and is a member of several national and international societies. He is also a reviewer of several international journals. He has delivered lectures in conferences and seminars around the globe. He has a long-standing interest in teaching at the PG level and is involved in taking courses in bacteriology, microbial physiology, environmental microbiology, agriculture microbiology and industrial microbiology. He has been advisor to 52 postgraduate and 2 doctoral students. Although an academician and researcher by profession, he has a huge obsession for wildlife and its conservation and has authored a book *Splendid Wilds*. He also has a dedicated website www.naveenarora.co.in for the cause of wildlife and environment conservation.

About the Book

Plant microbe interaction is a complex relationship that can have various beneficial impacts on both the communities. An urgent need of today's world is to get high crop yields in an ecofriendly manner. Utilization of beneficial and multifaceted plant growth-promoting (PGP) microorganisms can solve the problem of getting enhanced yields without disturbing the ecosystem thus leading to sustainability. For this to achieve, understanding of the intricate details of how the beneficial microbes form associations with the host plant and sustain that for millions of years must be known. A holistic approach is required wherein the diversity of microbes associated with plant and the network of mechanisms by which they benefit the host must be studied and utilized.

Plant Microbe Symbiosis: Fundamentals and Advances provides a comprehensive understanding of positive interactions that occur between plant and microorganisms and their utilization in the fields. The book reviews the enormous diversity of plant-associated microbes, the dialogue between plant–microbes–microbes and mechanisms of action of PGP microbes. Utilization of PGPR as nutrient providers in combating phytopathogens and ameliorating the stressed and polluted soils is also explained. Importantly, the book also throws light on the unanswered questions and future direction of research in the field. It illustrates how the basic knowledge can be amalgamated with advanced technology to design the future bioformulations.