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## Preface

Plant associated microorganisms (PAMs) play a number of very important roles to better the life of their host plant. It is believed that the origin of plant-microbe interactions is as old as the arrival of plants on land, and both the mutual partners selected each other after a long evolutionary process. These useful microbes provide the plants with nutrients, battle pathogens, combat abiotic stresses, and can play several other roles in the plant ecosphere. Plant-microbe interactions in tandem can perform acts such as reclamation of barren soils, degradation of recalcitrant pollutants, and removal of dangerous compounds from the ecosystems.

Injudicious use of chemicals in agriculture and industries has led to major environmental and health related issues for humans and other organisms inhabiting the planet. These chemicals are accumulating in the food chain and ecosystems. In fact, so many of them reach into the food products which we consume for our sustenance. The indiscriminate use of chemicals is in fact responsible for the reduced fertility of soils by killing several important and useful PAMs. In case of microorganisms we even do not know what we have lost over the years. But one thing is certain that in barren soils the population of useful plant growth promotory (PGP) microbes is very low or even more alarmingly they may altogether be absent from such soils. Hence there is an urgent need to re-introduce these beneficial microbes in the soil along with their compatible plants. The book discusses the various applications of PGP microbes and the importance and utility of plant-microbe interactions in sorting out the issues related to soil degradation and pollution.

The volume is in the form of 19 chapters contributed by experts, from around the globe, involved in research on applied utility of plant-microbe interactions. The tome discusses in great detail the present scenario of utilizing the PGP microbes for enhancement of crop yields by providing nutrients through biocycling or mobilization or fixation, fighting phytopathogens and other stresses such as salinity, drought, pH, etc. An integrated management of nutrients, diseases, and stresses can be achieved by application of diverse PGP microbes in combination. However, to provide these benefits to the plant the PGP microbes have to be augmented in the soil, in particular in the habitats where they are deficient in numbers. This can only be achieved by uplifting the quality of current bioinoculants by evaluating the possible bottlenecks and taking cue from latest research for the development of novel futuristic bioinoculants. Utilization of advanced biotechnological tools such as

genomics, proteomics, and genetic engineering can go a long way in achieving the targets. Bt crops are already proving to be a big success story for the case. Exploitation of plant-microbe symbiosis for reclamation of barren or polluted lands, degradation of pollutants, and combating the impact of climate change are the future directions to be explored. The book focuses on these very issues which will be extremely important for fulfilling the food security aspirations of swelling population on reducing arable land in a sustainable manner.

Researchers involved in the field of bioinoculant technology, PGPRs, plant-microbe interactions, rhizosphere biology, bioremediation, biotic and abiotic stress management for crop production, and related areas will find the compilation extremely useful. The researchers will not only get a comprehensive insight on what is happening in this field around the globe but will also be able to know about the future directions of research. The book will be very useful for faculty and graduate and post-graduate students of life sciences, specifically those pursuing career in agriculture microbiology or biotechnology. The book discusses in detail how the plant-microbe symbiosis have been utilized so far and how we can utilize this wonderful relationship in future so as to use fewer chemicals and ensuring for future generations safe and sustainable agri-ecosystems.

I would like to thank all the contributors for providing great knowledge on diverse aspects of the subject. The applications of plant-microbe associations have been comprehensively covered in the tome due to the vast expertise of the authors, and I can say that it is due to their effort that the book has become unique in itself. I thank Dr. Mamta Kapila, Senior Editor, Springer (India), for her continuous support and pursuance. It is because of her that the project could stick to the time frame and see the light of day. My special thanks to Prof. R. C. Sobti, Vice Chancellor, BBA University, Lucknow, for his incessant support and encouragement. I would like to thank the team of my research scholars including Sakshi Tewari, Jitendra Mishra, Rachna Singh, Maya, Shweta and Jay Prakash for helping in compilation of the manuscript. Most importantly, I have to acknowledge the support and care of my wife, Preeti Arora, for looking after me and my kids, Pranay and Nav, who by their presence make all the tensions and fatigue go burst.

I hope that the readers will find the book very beneficial. For any further suggestions or corrections please get back to yours truly.

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