PREFACE

Since the concept of beneficial symbiosis between plants and microbes was introduced almost 130 years ago, research has led to an understanding about the mechanistic complexity in these interactions. Plants associate with various benign microbes, and the last five years of work has shown significant growth in our understanding of plant-associated microbiomes. Plants grow in close association with large communities of microbes, yet comparatively little is known about the diversity of these plant-associated microbes and their interactions and effects on plant performance, crop yields and plant protection. Even though the effect of beneficial microbes on plants is discussed in the literature, there has been comparatively much less progress in elucidating the underlying mechanisms that are involved in beneficial microbes' effect(s) on plant performance and disease evasion, with the exception of the best-studied model systems. The work related to human gut microbiome revealed the functional importance of microbes in evading disease and immune response in higher animals. Since plants are more exposed to microbes than animals, it is easier to speculate that plants have evolved to facilitate more benign than pathogenic interactions. With the advances in the sequencing technology, it is now easier to find out the 'who is there' aspect of the microbiome associated with plants. The scenario related to 'what are these microbes doing' with plant associations is yet to be elucidated. Our approaches to understand plant-associated symbiotic microbiomes have changed over the last decade. Over the last 5 years or so, we have advanced our understanding of why some benign microbes associate with plants. The classical symbiotic tale of legume and *Rhizobium* species catalysed of our thinking related to how root-mediated processes play a critical role in plant–microbe interactions. Our knowledge related to root-mediated processes and mainly root exudations confirmed the functional role of root secretions as the main driving force to increase microbial associations.

Plants primarily depend on small molecular weight compounds to initiate positive or negative interactions. The knowledge pertaining to the plethora of chemicals that plants produce to initiate plant–plant and plant–microbe interactions is increased at a radicle speed. Among the most spectacular interactions mediated by a chemical exchange was the one elucidated for legume–*Rhizobium* partnerships. Over time, various interactions mediated by chemicals signifying beneficial plant–microbe interactions were elucidated. Spectacularly, there is an upsurge that plants associate with beneficial

microbes under stress conditions. The overall concept of 'botanical cry's' in plants under stress is not new, but plants signalling during stress to recruit beneficial microbes adds another layer of complexity in understanding plant–microbe interactions.

The previous attempts to highlight plant–microbe communications revolved around all interactions involving both beneficial and pathogenic microbes. Here, individual chapters deal with diverse benign microbe–plants interactions. The topics include how beneficial microbes associate with plants, the interactions are usually not that symbiotic in nature. The chapters discuss how beneficial microbe hijacks plant immune system to colonize. One of the chapters talks about how beneficial microbe–plant partnerships could be utilized for sustainable and responsible agricultural practices. The shift of using beneficial microbes as biocontrol is discussed against foodborne human and plant pathogens. Chapter also discusses the different diffusible and volatile organic compounds produced by benign microbes as biocontrol agents against plant pathogens. Two chapters deal with the different factors that regulate classical legume–*Rhizobium* symbiosis. Finally, chapters discuss the involvement of other factors in rhizosphere, such as nematodes in plant communication in a tritrophic setup.

Roots and the rhizosphere have no longer remained a 'hidden half' of plants. The upsurge in understanding various rhizospheric processes has led to various scintillating discoveries in the last decade. The concept of how plants interact with beneficial microbes has taken an interesting turn. More high-throughput molecular approaches are now tested to understand the functional role of plant-associated microbiome. Plants are different than animals in the way they mediate symbiotic associations. The secondary metabolism in plants leading to production of plethora of small molecular weight compounds hold the key to drive various microbial associations. How plants use this currency towards its benefit will carve new frontiers in terms of understanding the role of plant-derived products in shaping its microbiome. In addition, the concept of 'soil health' in general has been a global point of discussion to improve sustainable crop practices. Most importantly, the overuse of fertilizers, soil salinization and microbial shifts caused by soil disturbances have further compounded the agronomic problems. The green approach of using soil microbes as biofertilizers and biocontrol agents may work as an inexpensive and sustainable to replace chemical fertilizers. The commercial use of benign microbes to improve crop yield and protection holds the future, though a note of caution should be exercised to validate and strengthen the claims of how these benign microbes improve

plant growth and yield. Much of this validation would come from the lab studies that are currently lined up to understand the functional response of microbiome on plants at the molecular level. We can look forward to witnessing the next wave of novel discoveries.

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