

CONTENTS

Contributors

ix

Preface

xi

1. Not Just Sweet Talkers: How Roots Stimulate Their Colonization by Beneficial Bacteria

1

Pascale B. Beauregard

1. Introduction

2

2. Attraction

3

3. Nutrition

6

4. Colonization

7

5. General Effects

10

6. Compounds from the Plant That Affect the PGP Effect of Bacteria

12

7. Conclusion and Perspectives

14

References

14

2. Molecular Patterns of Rhizobacteria Involved in Plant Immunity Elicitation

21

Martin Mariutto and Marc Ongena

1. Host Resistance Elicitation as Part of Rhizobacteria-Mediated Biocontrol

22

2. Global Aspect of Microbe-Induced Plant Immunity

24

3. MAMPs from Bacterial Pathogens and Early Physiological/Signalling Events Associated with Their Perception

25

4. Elicitors of Plant Immunity from Beneficial Bacteria

29

5. Concluding Remarks

47

Acknowledgement

48

References

48

3. Root Microbiome Assemblage is Modulated by Plant Host Factors

57

Venkatachalam Lakshmanan

1. Introduction

58

2. Microbiome Assemblage is Influenced by the Host Genome

60

3. Microbiome Assemblage is Influenced by the Host Developmental Stage

63

4. Microbiome Assemblage is Influenced by the Host Health and Fitness

67

5. Microbiome Assemblage is Influenced by Alteration in Plant Signalling	69
6. Implications and Future Prospects	70
References	72
4. PGPR Interaction: An Ecofriendly Approach Promoting the Sustainable Agriculture System	81
Usha Bishnoi	
1. Introduction	82
2. Rhizosphere, the Hot Spot for PGPR Interaction	84
3. Colonization and Competence	88
4. PGPR Rooting for the Sustainable Agriculture	89
5. Commercialization of PGPR	99
6. Conclusion	103
Acknowledgements	104
References	104
5. Human Pathogen–Plant Interactions: Concerns for Food Safety	115
Sarah M. Markland and Kalmia E. Kniel	
1. Introduction: Merging Plant Science and Food Science to Address Food Safety	116
2. Human Pathogens on Plants	116
3. Human Pathogen Interactions with Phytobacteria and Rhizobacteria	120
4. Relationships Between Plant Stomata, Circadian Rhythm and Human Pathogens	123
5. Control and Prevention Strategies: Biocontrol and Plant 'Probiotics'	125
6. Attachment and Attraction Mechanisms of Human Pathogens to Plants	127
7. Research Needs and Conclusions	129
References	130
6. Early Responses in the Root–Rhizobia Interaction	137
Oswaldo Valdés-López and Georgina Hernández	
1. Innate Immunity Must Be Regulated during the RN Symbiosis	139
2. Searching for Missing Regulators of the Early Responses of the RN Symbiosis	141
3. miRNAs as Regulators of the Early Events of the RN Symbiosis	143
4. Conclusions and Remarks	144
Acknowledgements	144
References	145

7. The Implications of Polyploidy for the Evolution of Signalling in Rhizobial Nodulation Symbiosis	149
Adrian F. Powell and Jeff J. Doyle	
1. Introduction	150
2. Nodulation Signalling: Determinants of Symbiotic Interactions	152
3. WGD as a Process Altering Plant Signalling, Biotic Interactions and Ecological and Geographical Ranges	158
4. Potential Implications of Polyploidy for Nodulation Signalling	162
5. Evidence of Roles for Polyploidy in the Evolution of Nodulation and Rhizobial Signalling	170
6. Current and Future Studies of Polyploidy and Nodulation: Challenges and Opportunities	175
7. Conclusion	179
References	180
8. Plant Cues and Factors Influencing the Behaviour of Beneficial Nematodes as a Belowground Indirect Defense	191
Jared Gregory Ali and Elizabeth Davidson-Lowe	
1. Nematode Diversity	193
2. A Nematode's Sensory Tool Kit	194
3. Entomopathogenic Nematodes	195
4. Indirect Defences and Herbivore-Induced Plant Cues Belowground	196
5. Sampling Belowground Herbivore-Induced Volatiles	200
6. Manipulation of Root Volatiles for Agricultural Improvement	203
7. Multitrophic Interactions and Paradox Surrounding Belowground Indirect Defences	206
Acknowledgements	209
References	209
9. Forest Canopy Precipitation Partitioning: An Important Plant Trait Influencing the Spatial Structure of the Symbiotic Soil Microbial Community	215
Carl L. Rosier, Leslie Dean Moore, Tiehang Wu and John T. Van Stan	
1. Introduction: Canopy Precipitation Partitioning and Its Potential Influence on Symbiotic Root Microbial Communities	216
2. Potential Throughfall and Stemflow Impacts on N-fixing Nodule-Forming Bacterial Signalling Pathways	219
3. Potential Throughfall and Stemflow Impacts on Endo- and Ectomycorrhizal Fungi Host Root Signalling	225

4. Future Directions for Evaluating Throughfall and Stemflow Influences on Symbiotic Microbes	230
Acknowledgement	231
References	232
 10. Soluble and Volatile Metabolites of Plant Growth-Promoting Rhizobacteria (PGPRs): Role and Practical Applications in Inhibiting Pathogens and Activating Induced Systemic Resistance (ISR)	241
Gul Shad Ali, David Norman and Ashraf S. El-Sayed	
1. Overview of Current Disease Management Practices	242
2. Plant Growth-Promoting Rhizobacteria	244
3. Beneficial Soluble Metabolites of PGPRs	247
4. Volatile Organic Compounds	254
5. Practical Uses in Agriculture	272
6. Outlook – Opportunities and Challenges	273
Acknowledgements	275
References	275
 11. Flying Whispers of Inter-kingdom Conversation: A Complementary Perspective of Plant and Bacterial Volatile Signals	285
Gopinath Selvaraj	
1. Introduction	286
2. Volatile Organic Compounds from Plants	287
3. Influence of Plant VOCs on Rhizosphere and Phyllosphere Bacteria	290
4. VOCs from Bacteria and Their Effects on Plants	292
5. Bacterial Volatiles in QS and QQ	299
6. Commonness and Distinctions among Plant and Bacterial VOCs	300
7. Future Perspectives	303
Acknowledgement	304
References	304
 <i>Subject Index</i>	311
<i>Author Index</i>	319