

# Contents

<b>1</b>	<b>Introduction to Plant Growth-promoting Bacteria</b>	<b>1</b>
1.1	The Problem	1
1.2	Possible Solutions	3
1.3	Plant Growth-promoting Bacteria	5
1.3.1	Organisms in Soil	6
1.3.2	Root Exudation	7
1.3.3	Effect of PGPB on Plants	8
1.4	Root Microbiome	13
1.5	PGPB Mechanisms	15
1.6	Screening for New PGPB	16
1.7	Commercial Inoculants	18
1.7.1	Commercial Considerations	19
1.7.2	Inoculation Methods	21
1.7.3	Large-scale Growth of PGPB	22
1.7.4	Commercialized Inoculants	23
	Further Reading	26
<b>2</b>	<b>Resource Acquisition</b>	<b>29</b>
2.1	Nitrogen Fixation	29
2.1.1	Cyanobacteria	30
2.1.2	Rhizobia	32
2.2	Sequestering Iron	52
2.2.1	Siderophore Structure	53
2.2.2	Siderophore Biosynthesis Genes	55
2.2.3	Regulation of Iron Uptake	56
2.2.4	Siderophores in the Rhizosphere	57
2.3	Solubilizing Phosphorus	58
	Further Reading	61

<b>3</b>	<b>Modulating Phytohormone Levels</b>	65
3.1	Auxin	65
3.1.1	Biosynthetic Pathways	68
3.1.2	Regulation	73
3.1.3	Effects on PGPB Survival	77
3.2	Cytokinin	79
3.3	Gibberelin	81
3.4	Ethylene	83
3.4.1	Ethylene Biosynthesis and Mode of Action	83
3.4.2	ACC Deaminase	85
3.4.3	Ethylene and Nodulation	88
3.5	Volatile Organic Compounds	91
	Further Reading	94
<b>4</b>	<b>Some Techniques to Elaborate Plant–Microbe Interactions</b>	97
4.1	Next-Generation DNA Sequencing	97
4.1.1	Dideoxynucleotide DNA Sequencing	98
4.1.2	Primer Walking	99
4.1.3	Pyrosequencing	100
4.1.4	Sequencing Using Reversible Chain Terminators	102
4.1.5	Sequencing by Ligation	102
4.2	Large-Scale DNA Sequencing	105
4.2.1	Shotgun Cloning Strategy	105
4.2.2	Cyclic Array Sequencing	106
4.2.3	Using DNA Sequences	106
4.3	The Polymerase Chain Reaction (PCR)	109
4.3.1	Real-time PCR	110
4.4	Transcriptomics	111
4.4.1	DNA Microarray Technology	112
4.5	Proteomics	115
4.6	Metabolomics	118
	Further Reading	120
<b>5</b>	<b>Biocontrol Mechanisms</b>	123
5.1	Phytopathogens	123
5.2	Antibiotics	124
5.3	HCN	130
5.4	Siderophores	130
5.5	Cell Wall-Degrading Enzymes	132
5.6	Competition	134
5.7	Volatile Compounds	139
5.8	Lowering Ethylene	140
5.9	Systemic Resistance	145
5.9.1	Effects on Plant Gene Expression	146
5.10	Bacteriophages	147

5.11 Quorum Sensing and Quorum Quenching . . . . .	149
5.12 Nematodes and Endophytes . . . . .	152
Further Reading . . . . .	153
<b>6 Environmental Interactions . . . . .</b>	<b>159</b>
6.1 Overview of Stresses . . . . .	159
6.2 Salt and Drought . . . . .	160
6.2.1 IAA . . . . .	161
6.2.2 Ethylene . . . . .	164
6.2.3 Trehalose . . . . .	167
6.2.4 Cytokinin . . . . .	168
6.2.5 Exopolysaccharides . . . . .	171
6.3 Flooding and Anoxia . . . . .	172
6.4 Natural Selection . . . . .	174
6.5 Cold Temperature . . . . .	177
6.5.1 Antifreeze Proteins . . . . .	177
6.5.2 Chilling Stress . . . . .	179
6.6 Methane and Global Warming . . . . .	180
6.7 Mycorrhizae . . . . .	182
6.7.1 Mycorrhiza Helper Bacteria . . . . .	184
6.8 Changing Plant Gene Expression . . . . .	186
Further Reading . . . . .	188
<b>7 Phytoremediation . . . . .</b>	<b>191</b>
7.1 Problem Overview . . . . .	191
7.2 Metals . . . . .	194
7.2.1 Siderophores . . . . .	195
7.2.2 IAA . . . . .	198
7.2.3 ACC Deaminase . . . . .	199
7.2.4 Nitrogen Fixation . . . . .	199
7.2.5 Biosurfactants . . . . .	201
7.3 Arsenic . . . . .	205
7.4 Organics . . . . .	206
7.5 Endophytes . . . . .	210
7.6 Phytoremediation and OMICS . . . . .	213
7.6.1 Changes to Plants . . . . .	213
7.6.2 Changes to PGPB . . . . .	215
Further Reading . . . . .	219
<b>8 Issues Regarding the Use of PGPB . . . . .</b>	<b>223</b>
8.1 PGPB in the Environment . . . . .	223
8.1.1 Environmental Concerns . . . . .	225
8.2 Metabolic Load . . . . .	231
8.3 Patenting . . . . .	234
8.3.1 Patenting in Different Countries . . . . .	238

8.3.2	Patenting DNA Sequences . . . . .	239
8.3.3	Patenting Multicellular Organisms. . . . .	240
8.3.4	Patenting and Fundamental Research. . . . .	240
	Further Reading. . . . .	242

<http://www.springer.com/978-3-319-13920-3>

Beneficial Plant-Bacterial Interactions

Glick, B.R.

2015, XII, 243 p. 153 illus., 67 illus. in color., Hardcover

ISBN: 978-3-319-13920-3