

CONTENTS

Contributors	<i>xi</i>
Foreword	<i>xv</i>
Preface	<i>xvii</i>

1. Transcription Factors Based Genetic Engineering for Abiotic Tolerance in Crops	1
Venura Herath	
1. Introduction	1
2. Discovery of Candidate TFs	3
3. Major Transcription Factor Families	4
4. Development of Engineered TF Crops	7
5. Limitations	9
6. Synthetic TFs	10
7. Concluding Remarks	11
Acknowledgments	11
References	11
2. Sugars Play a Critical Role in Abiotic Stress Tolerance in Plants	17
Manu P. Gangola, Bharathi R. Ramadoss	
1. Introduction	17
2. Metabolism of Sugars Important for Abiotic Stress Tolerance: A Brief Introduction	19
3. Diverse Roles of Sugars During Abiotic Stress Tolerance	21
4. Targeting Sugars to Develop Abiotic Stress Tolerant Crop Varieties	30
5. Limitations and Challenges	32
6. Conclusions	32
References	33
Further Reading	38
3. Polyamines Metabolism: A Way Ahead for Abiotic Stress Tolerance in Crop Plants	39
Pratika Singh, Sahana Basu, Gautam Kumar	
1. Introduction	40
2. Biosynthesis of Polyamines Under Abiotic Stresses	41
3. Polyamines in Response to Different Abiotic Stresses	44
4. Interconnection Between Polyamines Catabolism, ROS Generation, and Metabolic Routes	48
5. Concluding Remarks	51
References	52
Further Reading	55

4. Cold Tolerance in Plants: Molecular Machinery Deciphered	57
Mahmood Maleki, Mansour Ghorbanpour	
1. Introduction	57
2. Effect of Chilling on the Physiological Processes of Plants	58
3. Cold Stress Signaling	61
4. The Responses of Plants to Cold Stress	62
5. Conclusions	67
References	67
Further Reading	71
5. Impact of Soil Moisture Regimes on Wilt Disease in Tomatoes: Current Understanding	73
Aarti Gupta, Dharanipathi Kamalachandran, Bendangchuchang Longchar, Muthappa Senthil-Kumar	
1. Introduction	73
2. Stress Interaction: At the Juncture of the Rhizosphere and the Roots	74
3. Physiological Changes During Stress Interaction	77
4. Conclusions and Future Perspectives	78
Acknowledgments	80
References	80
6. Field Performance of Transgenic Drought-Tolerant Crop Plants	83
Muhammad Sadiq, Nudrat A. Akram	
1. Introduction	83
2. Crop Development and Response Against Drought Stress	85
3. Drought Endurance and Crop Achievements	86
4. Major Drought-Tolerant Transgenic Plants	87
5. Field Performance of Transgenic Plants	93
6. Major Problems Under Field Conditions	94
7. Social and Economic Benefits of Genetically Modified Plants	95
8. Conclusions and Prospects	96
References	96
7. DNA Helicase-Mediated Abiotic Stress Tolerance in Plants	103
Maryam Sarwat, Narendra Tuteja	
1. Introduction	103
2. Genomics	104
3. Structure of the Helicase	104
4. Identification of Helicases	105
5. DNA Helicases	106

6. Conclusion	112
References	112
Further Reading	115
8. RNAi Technology: The Role in Development of Abiotic Stress-Tolerant Crops	117
Tushar Khare, Varsha Shriram, Vinay Kumar	
1. RNAi-Based Technology: An Emerging Novel Approach	117
2. RNAi: Brief History and Basic Mechanism	119
3. Involvement of RNAi in Abiotic Stress Responses	123
4. Utilization of RNAi for Crop Improvement	125
5. Conclusion: Pros and Cons of RNAi, and the Future	128
Acknowledgments	128
References	129
9. Genome-Wide Association Studies (GWAS) for Abiotic Stress Tolerance in Plants	135
Surekha Challa, Nageswara R.R. Neelapu	
1. Introduction	135
2. Genome-Wide Association Study, Design, and Analysis	138
3. Applications of GWAS for Abiotic Stress Tolerance in Plants	141
4. Conclusion	148
Acknowledgments	148
References	148
Further Reading	150
10. Targeting the Redox Regulatory Mechanisms for Abiotic Stress Tolerance in Crops	151
Punam Kundu, Ritu Gill, Shruti Ahlawat, Naser A. Anjum, Krishna K. Sharma, Abid A. Ansari, Mirza Hasanuzzaman, Akula Ramakrishna, Narsingh Chauhan, Narendra Tuteja, Sarvajeet S. Gill	
1. Introduction	152
2. Reactive Oxygen Species: Chemical Behavior, History, and Production Sites	153
3. Overproduction of ROS Species in Stressful Environments	159
4. Dual Behavior of ROS	163
5. Defence System Against ROS: The Role of Antioxidants	173
6. Oxidative Stress Tolerance in Plants by Developing Transgenic Lines	198
7. Conclusion and Future Perspectives	198
Acknowledgments	201
References	201
Further Reading	220

11. Compatible Solute Engineering of Crop Plants for Improved Tolerance Toward Abiotic Stresses	221
Titash Dutta, Nageswara R.R. Neelapu, Shabir H. Wani, Surekha Challa	
1. Introduction	221
2. Compatible Solute-Mediated Abiotic Stress Response	223
3. Compatible Solute Engineering: Biosynthesis and Accumulation of Osmolytes	224
4. Conclusion	245
Acknowledgments	245
References	245
Further Reading	254
12. Single-Versus Multigene Transfer Approaches for Crop Abiotic Stress Tolerance	255
Parul Goel, Anil K. Singh	
1. Introduction	255
2. Rise of the Transgenic Approach for Enhancing Abiotic Stress Tolerance in Plants	257
3. Conclusions	266
Acknowledgments	267
References	267
Further Reading	274
13. Crop Phenomics for Abiotic Stress Tolerance in Crop Plants	277
Balwant Singh, Shefali Mishra, Abhishek Bohra, Rohit Joshi, Kadambot H.M. Siddique	
1. Introduction	277
2. Techniques to Elucidate a Plant's Phenome	280
3. Phenotypic and Biochemical Changes in Crops Under Abiotic Stresses	285
4. Application of Phenomics in Improving Abiotic Stress Tolerance in Plants	289
5. Conclusion and Prospects	290
Acknowledgments	291
References	291
Further Reading	296
14. Overview on Effects of Water Stress on Cotton Plants and Productivity	297
Muhammad Tehseen Azhar, Abdul Rehman	
1. Drought	298
2. Effects of Drought Conditions on Plants	298
3. Drought Tolerance	299
4. Drought-Resistance Mechanisms	299
5. Impact of Water Stress on Physiological Traits	301

6. Impact of Water Stress on Quantitative Traits	303
7. Genetic Variability for Drought Tolerance in Cotton and Other Field Crops	306
8. Genetic Basis of Yield and Related Traits	307
References	312
Further Reading	316
<i>Index</i>	317