

Rhizosphere Biology

Series Editor

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The Series Rhizosphere Biology, emphasizes on the different aspects of Rhizosphere. Major increase in agricultural productivity, to meet growing food demands of human population is imperative, to survive in the future. Along with methods of crop improvement, an understanding of the rhizosphere biology, and the ways to manipulate it, could be an innovative strategy to deal with this demand of increasing productivity. This Series would provide comprehensive information for researchers, and encompass all aspects in field of rhizosphere biology. It would comprise of topics ranging from the classical studies to the most advanced application being done in the field. Rhizosphere is a dynamic environment, and a series of processes take place to create a congenial environment for plant to grow and survive. There are factors which might hamper the growth of plants, resulting in productivity loss, but, the mechanisms are not very clear. Understanding the rhizosphere is needed, in order to create opportunities for researchers to come up with robust strategies to exploit the rhizosphere for sustainable agriculture.

There are titles already available in the market in the broad area of rhizosphere biology, but there is a major lack of information as to the functions and future applications of this field. These titles have not given all the up-to-date information required by the today's researchers and therefore, this Series aims to fill out those gaps.

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Anita Sharma

Editor

Microbes and Signaling Biomolecules Against Plant Stress

Strategies of Plant- Microbe Relationships
for Better Survival



Springer

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Preface

The ever-increasing human population is constantly putting pressure on agriculture production globally. Plants encounter various biotic and abiotic stresses during their life span which significantly affect the overall agricultural produce. Although various agrochemicals provide instant solutions to the problem and help plants to cope up with major biotic and abiotic challenges, their injudicious use also threatens the sustainability of the environment. The present state of environmental conditions demands eco-friendly approaches that help to restore environmental sustainability by using microorganisms as biofertilizers and biopesticides which can be a good alternative for the same. The plant is directly or indirectly affected by its rhizospheric microbiome, a major constituent of soil–plant interaction. A better understanding of plant microbiome, their interactions, mechanisms, and signaling pathways involved in microbe-driven stress alleviation in plants is necessary to develop such eco-friendly approaches. The content of the book revolves around the plant–microbe interaction and the mechanisms involved in stress management by both the partners. Besides, this book also focuses on communication and signaling between plant and associated microorganisms under stress. The content of the book may help in developing a better knowledge regarding cross-talk between plant and its associated microflora and may also help in developing new approaches and techniques that might help in combating the pressure of extreme environmental conditions on plants. Exploring plant–microbe communication and signaling pathways can pave a path for future research as well as rhizosphere engineering which may help in the maintenance of agricultural sustainability as well as harmony with the environment. The synergistic effect of plants and microbes in phytoremediation is also covered in the book. The book helps to uncover the knowledge of molecular (omics) and physiological aspects of the various processes in improving strategies employed by the plants under stress/extreme environmental conditions and ultimately optimizing plant tolerance to various environmental stresses that pose a major threat in agricultural productivity in an eco-friendly way by microbe-driven methods.

Pantnagar, Uttarakhand, India

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Abbreviations

2DE	Two-dimensional electrophoresis
AAS	Atomic absorption spectroscopy
ABA	Absciscic acid
ABC	Antigen-binding cassette
ACC	1-amino-cyclopropane-1-carboxylase
ACCD	Acetyl-coenzyme A carboxylase carboxyl transferase subunit beta
AFP	Antifreeze proteins
AHO	Acetonyl hydroxyindole
AM	Arbuscular mycorrhizae
APX	Ascorbate peroxidase
ATAF	Arabidopsis transcription activation factor
ATSDR	Agency for Toxic Substances and Disease Registry
AzA	Azelaic acid
BR	Brassinosteroid
BTH	Benzothiadiazole carbothioic acid S-methyl ester
CDF	Cumulative distribution function
CDPKs	Calcium-dependent protein kinases/calmodulin-like domain protein kinases
CMC	Critical micelle concentration
COR	Cold-regulated genes
CREs	Cis-regulatory elements
DA	Dehydroabietinal
DAPG	Diacetylphloroglucinol
DHAR	Dehydroascorbate reductase
DREB	Dehydration responsive element binding
EBR	Epibrassinosteroid
EDS	Enhanced disease susceptibility
EEA	European Economic Area
ELISA	Enzyme-linked immunosorbent assay
EPA	Environment protection agency

EPS	Exopolysaccharide
ERD	Early responsive to dehydration
ERM	Extraradical mycelium
ESI-LC-MS/MS	Electrospray ionization liquid chromatography-mass spectrometry
ESTs	Earlier expressed sequence tags
ETC	Electron transport chain
ETI	Effector-triggered immunity
FAO	Food and Agriculture Organization
FT-ICR-MS	Fourier-transform ion cyclotron resonance mass spectrometry
FTIR	Fourier-transform infrared spectroscopy
GC-MS	Gas chromatography-mass spectroscopy
GOGAT	Glutamine synthase
GP	Guaiacol peroxidase
GPx	Glutathione peroxidase
GR	Glutathione reductase
GS	Glutamine synthetase
GSH	Glutathione
GST	Glutathione-s-transferase
HA	Hyperaccumulator
HAPs	Hyperaccumulator plants
HCMV	Human cytomegalovirus
HKT	Histidine kinase transporter
HM	Heavy metals
HNE	Hydroxynonenal
HPLC	High-pressure liquid chromatography
HR	Hypersensitive response
HSP	Heat shock proteins
ICP-AES/OES	Inductively coupled plasma-atomic/optical emission spectrometry
ICP-MS	Inductively coupled plasma-mass spectrometry
ICS	Isochorismate synthase
INA	Isonicotinic acid
IPCC	Intergovernmental Panel on Climate Change
IPLs	Isopyruvate lyases
IP-MS	Immunoprecipitation-mass spectrometry
ISR	Induced systemic resistance
IST	Induced systemic tolerance
ITPS	International Technology Professional Solutions
iTRAQ	Isobaric tag for relative and absolute quantification
JA	Jasmonic acid
LC-MS	Liquid chromatography-mass spectroscopy
LEA Protein	Late embryogenesis abundant protein
LEA	Late embryogenesis abundant protein

LPO	Lipid peroxidation
MALDI-TOF	Matrix-assisted laser desorption/ionization time-of-flight
MAMPs	Microbe-associated molecular pattern
MAPK	Mitogen-activated protein kinase
MDA	Malondialdehyde
MDHAR	Monodehydroascorbate reductase
MG	Methylglyoxal
MT	Metallothionine
NAA	Neutron activation analysis
NAM	No apical meristem
NGS	Next-generation sequencing
NMR	Nuclear magnetic resonance
NPR	Nonexpressor of pathogenesis-related protein
NRAMP	Natural resistance-associated macrophage protein
PAH	Polycyclic aromatic hydrocarbon
PAL	Phenylalanine ammonia-lyase
PAMPs	Pathogen-associated molecular pattern
PC	Phytochelatin
PCBs	Polychlorinated biphenyls
PCD	Programmed cell death
PEG	Polyethylene glycol
PFOA	Perfluorooctanoic acid
PGPR	Plant growth-promoting bacteria
PIP	Plasma membrane intrinsic protein
POPs	Persistent organic pollutants
PPI	Protein–protein interaction
PR	Pathogenesis-related protein
PRX	Peroxiredoxin
PSB	Phosphate-solubilizing bacteria
PUFA	Polyunsaturated fatty acid
PYR	Pyrrolidonyl arylamidase
QTL	Quantitative trait locus
RBOH	Respiratory burst oxidase homologs
RISR	Rhizobacteria-induced systemic resistance
RLKs	Receptor-like kinases
RND	Reflex neurovascular dystrophy
ROPs	Recalcitrant organic pollutants
ROS	Reactive oxygen species
RUBISCO	Ribulose-1,5-bisphosphate carboxylase/oxygenase
RWC	Relative water content
RYMV	Rice yellow mosaic virus
SA	Salicylic acid
SAA	Systemic acquired acclimation
SAR	Systemic acquired resistance

SDS-PAGE	Sodium dodecyl sulfate-polyacrylamide gel electrophoresis
SNPs	Single-nucleotide polymorphisms
SOD	Superoxide dismutase
TCTP	Translationally controlled tumor protein
TEM	Transmission electron microscope
TEM-EDX	Transmission electron microscopy energy-dispersive X-ray spectroscopy
TF	Transcription factor
TMV	Tobacco mosaic virus
TNT	Trinitrotoluene
TRXh	Thioredoxin
VOCs	Volatile organic compound
XRF	X-ray fluorescence
ZFP	Zinc finger protein