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Microbial Inoculants in Sustainable Agricultural Productivity

Vol. 1: Research Perspectives

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Microbial Inoculants In Sustainable Agricultural Productivity Vol 1 Research Perspectives

Parul Chaudhary,Anuj Chaudhary

Microbial Inoculants In Sustainable Agricultural Productivity Vol 1 Research Perspectives:

Microbial Inoculants in Sustainable Agricultural Productivity Dhananjaya Pratap Singh,Harikesh Bahadur Singh,Ratna Prabha,2016-02-22 How to achieve sustainable agricultural production without compromising environmental quality agro ecosystem function and biodiversity is a serious consideration in current agricultural practices Farming systems growing dependency on chemical inputs fertilizers pesticides nutrients etc poses serious threats with regard to crop productivity soil fertility the nutritional value of farm produce management of pests and diseases agro ecosystem well being and health issues for humans and animals At the same time microbial inoculants in the form of biofertilizers plant growth promoters biopesticides soil health managers etc have gained considerable attention among researchers agriculturists farmers and policy makers The first volume of the book Microbial Inoculants in Sustainable Agricultural Productivity Research Perspectives highlights the efforts of global experts with regard to various aspects of microbial inoculants Emphasis is placed on recent advances in microbiological techniques for the isolation characterization identification and evaluation of functional properties using biochemical and molecular tools The taxonomic characterization of agriculturally important microorganisms is documented along with their applications in field conditions The book exploresthe identification characterization and diversity analysis of endophytic microorganisms in various crops including legumes non legumes as well as the assessment of their beneficial impacts in the context of promotingplant growth Moreover it provides essential updates onthe diversity and role of plant growth promoting rhizobacteria PGPR and arbuscular mycorrhizal mycorrhizal fungi AMF Further chaptersexamine in detailbiopesticides thehigh density cultivation of bioinoculants in submerged culture seed biopriming strategies for abiotic and biotic stress tolerance andPGPR as abio control agent Given its content the book offers a valuable resource for researchers involved in research and development concerningPGPR biopesticides and microbial inoculants **Microbial Inoculants in Sustainable Agricultural Productivity** Dhananjaya Pratap Singh,Dr. H. B. Singh,Ratna Prabha,2016 How to achieve sustainable agricultural production without compromising environmental quality agro ecosystem function and biodiversity is a serious consideration in current agricultural practices Farming systems growing dependency on chemical inputs fertilizers pesticides nutrients etc poses serious threats with regard to crop productivity soil fertility the nutritional value of farm produce management of pests and diseases agro ecosystem well being and health issues for humans and animals At the same time microbial inoculants in the form of biofertilizers plant growth promoters biopesticides soil health managers etc have gained considerable attention among researchers agriculturists farmers and policy makers The first volume of the book Microbial Inoculants in Sustainable Agricultural Productivity Research Perspectives highlights the efforts of global experts with regard to various aspects of microbial inoculants Emphasis is placed on recent advances in microbiological techniques for the isolation characterization identification and evaluation of functional properties using biochemical and molecular tools The taxonomic characterization of agriculturally

important microorganisms is documented along with their applications in field conditions The book explores the identification characterization and diversity analysis of endophytic microorganisms in various crops including legumes non legumes as well as the assessment of their beneficial impacts in the context promoting plant growth Moreover it provides essential updates on the diversity and role of plant growth promoting rhizobacteria PGPR and arbuscular mycorrhizal fungi AMF Further chapters examine in detail biopesticides the high density cultivation of bioinoculants in submerged culture seed biopriming strategies for abiotic and biotic stress tolerance and PGPR as abio control agent Given its content the book offers a valuable resource for researchers involved in research and development concerning PGPR biopesticides and microbial inoculants

Microbial Inoculants Ajay Kumar,Joginder Singh Panwar,Ana Maria Queijeiro López,Ravindra N Kharwar,2025-05-23 Microbial Inoculants Soil Dynamics and Nutrient Bioavailability is an essential volume in the Plant and Soil Microbiome series This book delves into the foundational and contemporary details regarding the use of microbial inoculants which are living organisms like fungi bacteria and microalgae sourced from soil plants water and organic materials Acting as biostimulants or biocontrol agents these inoculants offer an environmentally friendly alternative to synthetic fertilizers and pesticides playing a crucial role in soil conservation plant health and crop yield enhancement Apart from exploring the nexus between plant and soil the book also discusses the range of applications of microbial inoculants in agricultural and environmental practices It provides insights into how these microorganisms contribute to sustainable farming by enhancing nutrient bioavailability and protecting crops from diseases thus promoting better yield and overall plant vitality This volume is a valuable resource for those interested in advancing agricultural techniques through the utilization of natural biotic solutions Includes perspectives from soil and plant nutrient impact Presents developments in dynamic network modeling including new experimental designs and techniques Emphasizes the diverse function of plant associated microbiomes

Microbial Inoculants Vijay Kumar Sharma,Ajay Kumar,Michel R Zambrano Passarini,Shobhika Parmar,Vipin Kumar Singh,2023-05-26 In the recent past beneficial microorganisms have been sustainably used in agriculture as a safe economic and effective alternative to chemical fertilizers or pesticides These beneficial microbes including bacteria actinomycetes and yeast were efficiently applied in soil seeds fruits or plants as inoculants to achieve the optimum agricultural yield An efficient delivery method or enhanced shelf life of microbial inoculants in the soil or seed is still a matter of concern The response of local genetic or ecological factors after microbial applications are also unknown and less studied Therefore Microbial Inoculants Recent Progress and Applications fulfills the need to explore and learn about an efficient delivery mechanism selection of microbial strain as inoculants and related technological advances for the efficient and productive use of microbial inoculants Moreover factors like methods of formulation interaction between host plant and microbe impact of inoculation on the metabolomics of plants the effect of microbial inoculants on soil dynamics proteomics approach of plant microbe interaction as well as the registration and regulation process of bio inoculants for commercial production are described in 16

chapters by the leading academicians and researchers from different parts of the world Sums up the latest approaches and advancements in the field of microbial inoculants in microbial formulations and applications Proofs the potential development and applications of microbial inoculants as an alternative to chemical fertilizers herbicides and pesticides Shows the impact of microbial inoculants on microbial dynamics bioavailability and abiotic stress mitigation Gives insights on emerging challenges with the commercialization of microbial formulations technology patenting and legal perspectives Microbial Inoculants Parul Chaudhary,Anuj Chaudhary,2024-04-13 This book discusses the role of microbes in agriculture for plant attributes soil fertility and bio remediation which aid in sustainable agriculture Nowadays due to increase in human population it is essential to increase food productivity in the near future but exhaustive non sustainable agricultural practices such as the usage of agrochemicals threaten food security the economy and the environment globally Soil deterioration is the most serious environmental threat to food production resulting in poverty and hunger in developing countries As a result the global community has faced challenges regarding the development of ecologically sound efficient and long term alternative options to meet rising food requirements Therefore to contribute to food security the advancement of sustainable and innovative modern agriculture aimed at addressing environmental economic and social challenges connected with present intense non sustainable agriculture practices is required As a result beneficial microbial inoculants will be widely used in the development of new strategies to increase sustainable food production Bioinoculant application helps to provide nutrients that directly support soil health and sustainable food production Hence this book offers the role of microbial inoculants for better agronomical performance for sustainable advancement in agriculture and also pays attention to soil health improvement for extensive period benefits The book will be highly recommended for agriculture microbiologists agronomists plant pathologists and related areas **Microbial Interventions in Agriculture and Environment** Dhananjaya Pratap Singh,Vijai Kumar Gupta,Ratna Prabha,2019-11-27 Microbial communities and their functions play a crucial role in the management of ecological environmental and agricultural health on the Earth Microorganisms are the key identified players for plant growth promotion plant immunization disease suppression induced resistance and tolerance against stresses as the indicative parameters of improved crop productivity and sustainable soil health Beneficial belowground microbial interactions with the rhizosphere help plants mitigate drought and salinity stresses and alleviate water stresses under the unfavorable environmental conditions in the native soils Microorganisms that are inhabitants of such environmental conditions have potential solutions for them There are potential microbial communities that can degrade xenobiotic compounds pesticides and toxic industrial chemicals and help remediate even heavy metals and thus they find enormous applications in environmental remediation Microbes have developed intrinsic metabolic capabilities with specific metabolic networks while inhabiting under specific conditions for many generations and so play a crucial role The book Microbial Interventions in Agriculture and Environment is an effort to compile and present a great volume of authentic high quality

socially viable practical and implementable research and technological work on microbial implications The whole content of the volume covers protocols methodologies applications interactions role and impact of research and development aspects on microbial interventions and technological outcomes in prospects of agricultural and environmental domain including crop production plan soil health management food nutrition nutrient recycling land reclamation clean water systems and agro waste management biodegradation bioremediation biomass to bioenergy sanitation and rural livelihood security The covered topics and sub topics of the microbial domain have high implications for the targeted and wide readership of researchers students faculty and scientists working on these areas along with the agri activists policymakers environmentalists advisors etc in the Government industries and non government level for reference and knowledge generation Microbial Biotechnology for Sustainable Agriculture Volume 2 Naveen Kumar Arora,Brahim Bouizgarne,2024-10-15 This book focuses on the applications of plant growth promoting microorganisms PGPMs in the form of bioinoculants to enhance the crop productivity and resilience against pathogens Chapters explain the latest findings on development of the bioinoculants utilizing the modern technologies and agri wastes It also provides the latest information on methods of improving quality and efficiency of bioformulations and utilization of advanced biotechnological tools for developing precision products PGPMs play important roles in survival and health of the plant These useful microorganisms provide plants with nutrients protect them from pathogens and help in combating abiotic stresses It is important that these mutualistic interactions between plant and soil microbes are well understood so as to develop reliable products in the form of biostimulants biopesticides and manage biotic and abiotic stresses in crops Apart from enhancing crop productivity plant microbe interactions can also perform activities such as reclamation of degraded lands degradation of pollutants and remediation of saline or marginal lands This book is of interest to teachers researchers plant scientists and microbiologists Also the book serves as an additional reading material for undergraduate and graduate students of agriculture microbiology ecology soil science and environmental sciences Plant-Microbial Interactions and Smart Agricultural Biotechnology Swati Tyagi,Robin Kumar,Baljeet Saharan,Ashok Kumar Nadda,2021-09-23 Considering the ever increasing global population and finite arable land technology and sustainable agricultural practices are required to improve crop yield This book examines the interaction between plants and microbes and considers the use of advanced techniques such as genetic engineering revolutionary gene editing technologies and their applications to understand how plants and microbes help or harm each other at the molecular level Understanding plant microbe interactions and related gene editing technologies will provide new possibilities for sustainable agriculture The book will be extremely useful for researchers working in the fields of plant science molecular plant biology plant microbe interactions plant engineering technology agricultural microbiology and related fields It will be useful for upper level students and instructors specifically in the field of biotechnology microbiology biochemistry and agricultural science Features Examines the most advanced approaches for genetic engineering of agriculture CRISPR TALAN ZFN etc

Discusses the microbiological control of various plant diseases Explores future perspectives for research in microbiological plant science Plant Microbial Interactions and Smart Agricultural Biotechnology will serve as a useful source of cutting edge information for researchers and innovative professionals as well as upper level undergraduate and graduate students taking related agriculture and environmental science courses *New and Future Developments in Microbial Biotechnology and Bioengineering* Harikesh Bahadur Singh,Anukool Vaishnav,2021-11-03 This book provides a comprehensive overview of different agriculturally important microorganisms and their role as plant biostimulants Arbuscular Mycorrhizal Fungi Trichoderma Cyanobacteria Endophytes and Plant growth promoting rhizobacteria have the potential to promote plant growth disease management nutrient acquisition stress alleviation and soil health management Presenting an all inclusive collection of information this book will be important for students academicians researchers working in the field of sustainable agriculture microbial technology and biochemical engineers It will also be of use for policymakers in the area of food security and sustainable agriculture Introduces new microorganisms as plant biostimulants Describes potential mechanisms of plant microbe interaction for stress alleviation and crop improvement Provides information about different microbial formulations consortium and their application to the alleviation of different abiotic stresses salt drought nutrient deficiency heavy metal etc in plants Discusses about psychrophilic microbes endophytic microbes and total plant microbiome and their uses as biostimulants for improving plant health **Perspectives and Insights on Soil Contamination and Effective Remediation Techniques** ,2024-10-30 Weathering of rocks and subsequent enrichment of organic matter contribute to soil formation but soil contaminants can arise from diverse sources such as industrial activities agricultural practices and improper waste disposal These pollutants may include radioactive materials petroleum products heavy metals and pesticides To restore soil quality the harmful effects of these contaminants must be reduced through effective remediation approaches Selecting an appropriate remediation method requires careful consideration of the type of contamination the characteristics of the soil and the regulatory requirements for a given site Managing soil pollution demands a multifaceted strategy that incorporates several remediation tactics customized to specific contamination scenarios Successful soil remediation programs rely on collaboration between environmental authorities academic institutions and industry stakeholders By prioritizing soil health and sustainability we can protect the environment for future generations and preserve our natural resources This book provides a comprehensive overview of ecosystem approaches and phytotechnologies to solve various environmental problems It includes six chapters that describe and discuss soil contamination sources and remediation strategies Microbial Biostimulants for Plant Growth and Abiotic Stress Amelioration Puneet Singh Chauhan,Nikita Bisht,Renuka Agarwal,2024-06-19 Microbial Biostimulants for Plant Growth Development and Abiotic Stress Amelioration provides readers with insights into the major role of biostimulants in plant growth and development while under abiotic stress The term biostimulants is broadly used to reference a group of diverse substances and microorganisms that stimulate

life or that promote favorable plant responses They stimulate natural processes to enhance benefit nutrient uptake nutrient efficiency tolerance to abiotic stress and crop quality Many biostimulants improve nutrition and they do so regardless of their own nutrient contents Further recently microbe based biostimulants have emerged as important plant protectors under a range of adverse conditions Microbial Biostimulants for Plant Growth Development and Abiotic Stress Amelioration is the latest volume in the Biostimulants and Protective Biochemical Agents series Presents the potential for more environmentally sustainable interventions against abiotic stresses Highlights the variety of applications for which biostimulants are proving effective Includes coverage of commercialization and role in addressing Sustainability Development Goals **Land and Water Degradation in Ethiopia** Assefa M. Melesse,Mekdelawit M. Deribe,Ethiopia B. Zeleke,2024-08-05 Water is life for all human beings and is essential for sustainable economic development Access to freshwater is a fundamental human right Ensuring access to safe drinking water and sanitation is vital for economic growth poverty reduction and enhancement of human well being Yet uncertain global water availability compounded by factors such as climate change and land degradation have made meeting the growing water demand a daunting task for many communities The world is facing an unprecedented climate crisis intricately linked with water resources We have witnessed frequent and intense hydrologic extremes floods and droughts In the past decade alone floods storms droughts and other weather related events accounted for over 90% of natural disasters Water being at the center of national policies of many countries the impact of climate change on water resources extends across multiple sectors including energy production food security health environmental conservation and economic development Research has shown that climate change has impacted the hydrologic cycle affected the availability and predictability of water and hence threatened the efforts of poverty reduction and economic development These impacts are more pronounced in developing countries exacerbating existing socioeconomic challenges and hindering progress towards self sufficiency in food water and energy production The impact of climate change on these countries is further aggravated by land degradation land use changes unsustainable agricultural practices poor watershed management and ecological degradation and loss of biodiversity This book aims to explore these issues with chapters dedicated to examining land and water degradation water quality irrigation groundwater management land use dynamics and the impacts of climate change on freshwater resources in Ethiopia **Termites and Sustainable Management** Md. Aslam Khan,Wasim Ahmad,2017-12-01 This termite Volume 2 comprises 13 chapters in an attempt to bring all available information on sustainable and eco friendly termite management The previous Volume considered the biology social behaviour and economic importance of these insects Chapters in this book dealing with damage and specific management of fungus growing termites provide a review on most recent methodologies used for management Termite damage crops from sowing till harvest As it is difficult to detect damages in field usually it is too late when the symptoms are noticed A separate chapter on issues related to Indian agriculture and the contemporary practices being followed by majority of the Indian farmers is quite

informative Similarly a case study for termites infesting Malaysian forests constitutes an important contribution Various issues related to integrated and eco friendly termite management in tropical conditions have been addressed comprehensively Potential role of microbes has also been discussed in detail in other chapters The information contained under these chapters should help termite management in a way that natural resources can be used and maintained for the generations to come Similarly the chapter on physical barriers contributes a wealth of information that can be useful all over the world where termite is a problem Emphasis has been laid on reviewing contribution of synthetic chemical insecticides in termite management A separate chapter dealing with standard norms in wood protection constitute a significant step in this direction A further chapter throws light on the potential of biotechnology as a tool in management *Plant Microbiomes for Sustainable Agriculture* Ajar Nath Yadav,Joginder Singh,Ali Asghar Rastegari,Neelam Yadav,2020-03-06 This book encompasses the current knowledge of plant microbiomes and their potential biotechnological application for plant growth crop yield and soil health for sustainable agriculture The plant microbiomes rhizospheric endophytic and epiphytic play an important role in plant growth development and soil health Plant and rhizospheric soil are a valuable natural resource harbouring hotspots of microbes and it plays critical roles in the maintenance of global nutrient balance and ecosystem function The diverse group of microbes is key components of soil plant systems where they are engaged in an intense network of interactions in the rhizosphere endophytic phyllospheric The rhizospheric microbial diversity present in rhizospheric zones has a sufficient amount of nutrients release by plant root systems in form of root exudates for growth development and activities of microbes The endophytic microbes are referred to those microorganisms which colonize in the interior of the plant parts viz root stem or seeds without causing any harmful effect on host plant Endophytic microbes enter in host plants mainly through wounds naturally occurring as a result of plant growth or through root hairs and at epidermal conjunctions Endophytes may be transmitted either vertically directly from parent to offspring or horizontally among individuals The phyllosphere is a common niche for synergism between microbes and plant The leaf surface has been termed as phyllosphere and zone of leaves inhabited by microorganisms as phyllosphere The plant part especially leaves is exposed to dust and air currents resulting in the establishments of typical flora on their surface aided by the cuticles waxes and appendages which help in the anchorage of microorganisms The phyllospheric microbes may survive or proliferate on leaves depending on extent of influences of material in leaf diffuseness or exudates The leaf diffuseness contains the principal nutrients factors amino acids glucose fructose and sucrose and such specialized habitats may provide niche for nitrogen fixation and secretions of substances capable of promoting the growth of plants The microbes associated with plant as rhizospheric endophytic and epiphytic with plant growth promoting PGP attributes have emerged as an important and promising tool for sustainable agriculture PGP microbes promote plant growth directly or indirectly either by releasing plant growth regulators solubilization of phosphorus potassium and zinc biological nitrogen fixation or by producing siderophore

ammonia HCN and other secondary metabolites which are antagonistic against pathogenic microbes The PGP microbes belong to different phylum of archaea Euryarchaeota bacteria Acidobacteria Actinobacteria Bacteroidetes Deinococcus Thermus Firmicutes and Proteobacteria and fungi Ascomycota and Basidiomycota which include different genera namely Achromobacter Arthrobacter Aspergillus Azospirillum Azotobacter Bacillus Beijerinckia Burkholderia Enterobacter Erwinia Flavobacterium Gluconoacetobacter Haloarcula Herbaspirillum Methylobacterium Paenibacillus Pantoea Penicillium Piriformospora Planomonospora Pseudomonas Rhizobium Serratia and Streptomyces These PGP microbes could be used as biofertilizers bioinoculants at place of chemical fertilizers for sustainable agriculture The aim of Plant Microbiomes for Sustainable Agriculture is to provide the current developments in the understanding of microbial diversity associated with plant systems in the form of rhizospheric endophytic and epiphytic The book is useful to scientist research and students related to microbiology biotechnology agriculture molecular biology environmental biology and related subjects **Plant Growth-Promoting Microorganisms for Sustainable Agricultural Production** Everlon Cid Rigobelo,Saveetha Kandasamy,Duraisamy Saravanakumar,2022-04-18 Agricultural Biotechnology Charles Oluwaseun Adetunji,Deepak Gopalrao Panpatte,Yogeshvari Kishorsinh Jhala,2022-12-21 This book presents strategies and techniques highlighting the sustainability and application of microbial and agricultural biotechnologies to ensure food production and security This book includes different aspects of applications of Artificial Intelligence in agricultural systems genetic engineering human health and climate change recombinant DNA technology metabolic engineering and so forth Post harvest extension of food commodities environmental detoxification proteomics metabolomics genomics bioinformatics and metagenomic analysis are discussed as well Features Reviews technological advances in microbial biotechnology for sustainable agriculture using Artificial Intelligence and molecular biology approach Provides information on the fusion between microbial biotechnology and agriculture Specifies the influence of climate changes on livestock agriculture and environment Discusses sustainable agriculture for food security and poverty alleviation Explores current biotechnology advances in food and agriculture sectors for sustainable crop production This book is aimed at researchers and graduate students in agriculture food engineering metabolic engineering and bioengineering Microbes Based Approaches for the Management of Hazardous Contaminants Ajay Kumar,Livleen Shukla,Joginder Singh,Luiz Fernando Romanholo Ferreira,2024-07-08 Learn the various microbiological aspects one deals with in environment management and the remediation of toxic contaminants in the environment In recent years the accumulation of hazardous contaminants has caused a broad based deterioration in global environmental quality These have had wide ranging negative social impacts affecting climate soil and water ecosystems and more As traditional methods of contaminant mitigation have proven inadequate to the task microbial based remediation offers the clearest most environmentally friendly path forward for this crucial aspect of global environmental stewardship Microbes Based Approaches for the Management of Hazardous Contaminants offers comprehensive coverage of novel and indigenous

microbes and their applications in contaminant mitigation Surveying all the major microbial products and methods for degrading and remediating hazardous pollutants it offers a key tool in the fight against global environmental degradation The result is a cutting edge introduction to an essential subject Microbes Based Approaches for the Management of Hazardous Contaminants will also find Current and future approaches to microbial degradation Detailed discussion of biofilms exopolysaccharides enzymes metabolites and many more Coverage of metabolic engineering as an alternative strategy Microbes Based Approaches for the Management of Hazardous Contaminants is ideal for those working in the field for the application of microbes in the remediation of hazardous pollutants and environment management particularly those interested in environmental sciences microbiology and microbial technology environmental biotechnology and molecular biology **Agricultural Nutrient Pollution and Climate Change** Naseer Hussain,Chih-Yu Hung,Lixia Wang,2025-02-10 This book presents a comprehensive exploration of advanced scientific techniques for reducing agricultural nutrient pollution in the context of climate change It delves into the sources pathways and extent of nutrient release into the environment offering stakeholders valuable insights into how scientific advancements can help reduce environmental footprints The authors critically examine key knowledge gaps policy interventions and challenges related to nutrient management from agrochemicals synthetic fertilizers and organic manures As the demand for safe sustainable and environmentally friendly agricultural practices grows in the face of climate change this book synthesizes scientific research reports and policies It provides reliable information for scientists students policymakers and organizations to promote effective nutrient utilization in agriculture while minimizing environmental impacts **Rhizosphere Engineering** Ramesh Chandra Dubey,Pankaj Kumar,2022-02-15 Rhizosphere Engineering is a guide to applying environmentally sound agronomic practices to improve crop yield while also protecting soil resources Focusing on the potential and positive impacts of appropriate practices the book includes the use of beneficial microbes nanotechnology and metagenomics Developing and applying techniques that not only enhance yield but also restore the quality of soil and water using beneficial microbes such as Bacillus Pseudomonas vesicular arbuscular mycorrhiza VAM fungi and others are covered along with new information on utilizing nanotechnology quorum sensing and other technologies to further advance the science Designed to fill the gap between research and application this book is written for advanced students researchers and those seeking real world insights for improving agricultural production Explores the potential benefits of optimized rhizosphere Includes metagenomics and their emerging importance Presents insights into the use of biosurfactants **Endophytes: Mineral Nutrient Management, Volume 3** Dinesh Kumar Maheshwari,Shrivardhan Dheeman,2021-03-04 The challenges to meet the food requirement of the burgeoning population and stabilized productivity of agriculture lands can only be met by a second green revolution After steadily declining for over a decade hunger is on the rise again affecting million people of the global population Therefore crop yields must be increased substantially over the coming decades to keep pace with global food demand The plant

rhizosphere is a multidimensional and dynamic ecological environment of complicated microbe plant interactions for harnessing essential macro and micronutrients from a limited nutrient pool This book will showcase naturally occurring endophyte which can be explored for nutrient mineralization and mobilization for sustainable agriculture This will cover recent trends prospects critical commentaries and advancement in the research area focusing on naturally occurring beneficial endophytic microbes Thus it is proposed to bring out new scientific insights and frontiers of research that have exploration of endophyte for mineral nutrient management in soil and crops The chapters are contributed by leading scientists across the globe The book will be useful to agronomists microbiologists ecologists plant pathologists molecular biologists environmentalists policy makers conservationists and NGOs working for the crop production and productivity development and consequently over all agricultural significance

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