

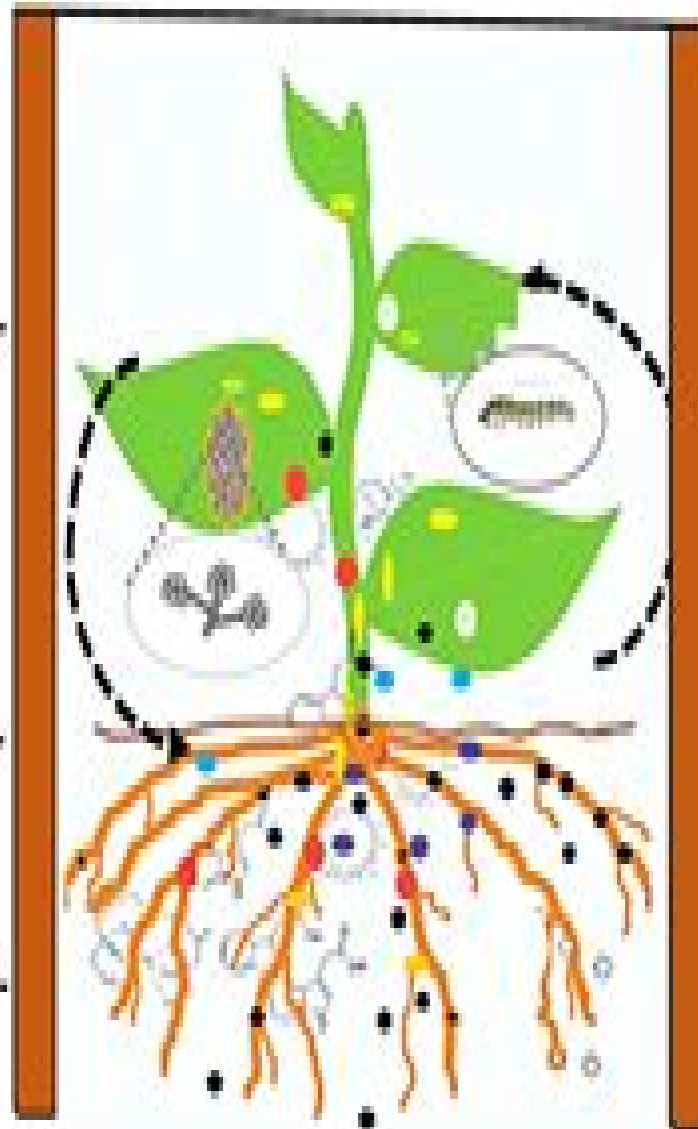
Endophytic bacteria in biological control and inducing plant defenses

Antimicrobial compounds

- Antibiotics (peptides and polypeptides, peptide derivatives, polyketides, phospholipid)
- Hydrolytic enzymes (chitinase, glucanase, protease, lipase, cellulase, amylase ...)
- Volatile organic compounds (VOCs) (alcohols, alkanes, esters, ketones, benzene derivatives, terpenoids and hydrocarbons)

Quenching the quorum sensing (QS) of phyto-pathogens

Competing with pathogens for nutrients and space



Induction of Pathogenesis-related proteins (PRs)
PR-1, PR-2 (β -1,3-glucanase), PR-3 (chitinase), and PR-4

Induction of antioxidant enzymes
superoxide dismutase (SOD), peroxidase (POD), polyphenol oxidase (PPO), phenylalanine- ammonia lyase

Stimulation of plant SM and metabolites transformation

- Activation of the host metabolism by the ED
- Activation of the ED metabolism by the host
- Host and ED partially share a specific pathway
- The host metabolites secrete from the ED
- The ED metabolites secondary compounds from the plant

Microbial Endophytes

Anna Maria Pirttilä, A. Carolin Frank



Microbial Endophytes:

Microbial Endophytes Ajay Kumar,Vipin Kumar Singh,2019-09-27 *Microbial Endophytes Prospects for Sustainable Agriculture* discusses the practical and theoretical aspects regarding the use of endophytic microorganisms in agriculture providing insights on the biotechnological applications associated with long term crop production Chapters deal with the various aspects of endophytic microorganisms including isolation enumeration characterization procedures diversity analysis and their role as biofertilizer biocontrol agent and microbial inoculants Framed to discuss the present and future potential of microbial endophytes in biotic and abiotic stress management bioremediation bioactive compounds production and in nanotechnology this book provides a single volume resource that will be valuable to academics and researchers interested in microbiology agricultural sciences and biotechnology Explores aspects of sustainable agriculture by using endophytic microorganism such as bacteria fungi and actinobacteria Presents insights into the use of endophytes as biofertilizer and biocontrol agents in sustainable agriculture Relates endophyte organisms and nano technology *Microbial Root Endophytes* Barbara J.E. Schulz,Christine J.C. Boyle,Thomas N. Sieber,2007-05-24 This is the first book dedicated to the interactions of non mycorrhizal microbial endophytes with plant roots The phenotypes of these interactions can be extremely plastic depending on environmental factors nutritional status genetic disposition and developmental stages of the two partners This book explores diversity life history strategies interactions applications in agriculture and forestry methods for isolation cultivation and both conventional and molecular methods for identification and detection of these endophytes

Microbial Endophytes Ajay Kumar,E.K. Radhakrishnan,2020-03-05 *Microbial Endophytes Functional Biology and Applications* focuses on endophytic bacteria and fungi including information on foundational endophytes and the latest advances in relevant genomics proteomics and nanotechnological aspects The book provides insights into the molecular aspects of plant endophytes and their interactions and applications also exploring the potential commercialization of endophytic microorganisms and their use as bio fertilizers in biocontrol and as bioactive compounds for other sustainable applications Coverage of important and emerging legal considerations relevant to those working to implement these important bacteria in production processes is also included Presents discussion on entry colonization and the distribution of endophytic microorganisms Explores the phyto immunological functions of endophytic microorganisms Provides genomic insights on plant endophyte interaction Identifies bio commercial aspects of microbial endophytes for sustainable agriculture including potential legal issues and IPR in microbial research *Endophytes: Biology and Biotechnology* Dinesh K. Maheshwari,2017-11-02 This book discusses the latest developments in our understanding of microbial endophytes their ecology diversity and potential biotechnological applications It covers all the latest advances concerning the endophytic interaction of microorganisms in a wide array of plants reported on by experts from the entire globe The diverse microbial community which consists of archaeal bacterial fungal and protistic taxa can be found in all plants The endophytic lifecycle

reveals how microorganisms play essential roles in plant growth fitness and diversification Diversity is an integral component of ecology In soil ecology below ground interactions of plant and microorganisms are accomplished by endophytes which reside in the plant s internal tissues The microbial world in general and endophytes in particular reflect a unique degree of genetic and functional metabolic diversity Currently significant attention is being paid to endophytic microorganisms as their repertoire of cells and metabolites hold immense potential with regard to biotechnological applications for sustainable development The diversity of bacterial endophytes guarantees that there are endophytes capable of forming compatible associations with all agronomically important plants including monocots and dicots The study of endophytes diverse nature in connection with biodiesel medicinal and agriculturally important crop can lead to a better understanding of applicable facets The topics in this dynamic field of study are so diverse and vast This volume will benefit all botanists microbiologists ecologists plant pathologists physiologists agronomists molecular biologists environmentalists policymakers conservationists and NGOs working to protect species and prevent the loss of biologically significant genetic material

Microbial Endophytes Charles W. Bacon,James White,2000-02-25 Examining intercellular infections in certain plant species that lead to a symbiotic relationship between the host and its endophytic microbes this volume demonstrates the ability of many types of endosymbionts acting as a unit with hosts to better survive compete and reproduce Practical applications of such endophytes are also discussed for example pharmaceutical developments and agricultural management

Microbial Endophytes and Plant Growth Manoj Kumar Solanki,Mukesh Kumar Yadav,Bhim Pratap Singh,Vijai Kumar Gupta,2022-11-19 Microbial Endophytes and Plant Growth Beneficial Interactions and Applications explains how modern molecular tools can unlock the plant s microbial network building the bridge between plant and environment Chapters describe the usefulness of the endophytic microbiome of different crops including cereals vegetables and horticulture and delve into the latest research surrounding the applications of plant microbe interactions in improving plant growth Other topics discussed include root endophytes and their role in plant fitness seed associated endophytes and their functions and microbial endophytes and nanotechnology This is a one stop resource for scientists wanting access to the latest research in plant microbiology The book also provides advanced techniques for using multi omics approaches to study plant microbe interactions providing readers with a practical approach Outlines multi omics approaches to study plant endophytes interactions Describes the efficacy of endophytes to combat biotic and abiotic factors Defines the prominent role of endophytic microbes to improve plant growth

Endophytes of Forest Trees Anna Maria Pirttilä,A. Carolin Frank,2011-07-11 Found in every plant species the diversity of endophytic micro organisms can be extremely high within different plant organs and tissue types In trees their ecological roles with respect to host tree can vary from latent pathogens or saprophytes to neutral commensalists and mutualists Given their high diversity and their bio active nature endophytes are currently being associated with a role in tree health against insect herbivores and fungal pathogens as well as improving tree properties in phytoremediation Meanwhile

there is increasing interest in the potential of some tree endophytes as new sources of drug compounds The first book on tree endophytes in several years and containing contributions from leading authors in the field this book provides an important reference text for professional researchers and advanced students Endophytes and Secondary Metabolites Sumita Jha,2019-07-24 This reference work presents an authoritative review of endophytes and their applications to human welfare Endophytes have become a class of interesting and curious microorganisms due to their intimate intra and intercellular association with plants for competence survival and reproduction They can be bacteria or fungi and they are usually non pathogenic to their host Endophytes have important applications in agriculture and industry namely they can help with plant growth act as biocontrol agents and biosurfactant and secondary metabolite producers and they are also rich sources of bioactive natural products Novel and beneficial effects of endophytes are constantly emerging and this book divided into four sections provides readers with the latest developments in this fast expanding field In the first section readers will discover the biology of the major groups of endophytes followed by a summary of conventional and molecular tools for endophytes identification in Section II The production of high value metabolites by endophytes will be explored in the third section of this book and in the final section readers will find several case studies examples and prospects for endophytes application in agriculture and industry Written by leading international authors this reference work will appeal to a wide readership from students and researchers in the field of botany biotechnology and agriculture to professionals interested in the production and applications of endophytic metabolites Recent Advancements in Microbial Diversity Surajit de Mandal,Pankaj Bhatt,2020-06-02 Microorganisms are a major part of the Earth s biological diversity Although a lot of research has been done on microbial diversity most of it is fragmented This book creates the need for a unified text to be published full of information about microbial diversity from highly reputed and impactful sources Recent Advancements in Microbial Diversity brings a comprehensive understanding of the recent advances in microbial diversity research focused on different bodily systems such as the gut Recent Advancements in Microbial Diversity also discusses how the application of advanced sequencing technologies is used to reveal previously unseen microbial diversity and show off its function Gives insight into microbial diversity in different bodily systems Explains novel approaches to studying microbial diversity Highlights the use of omics to analyze the microbial community and its functional attributes Discusses the techniques used to examine microbial diversity including their applications and respective strengths and weaknesses *Biocontrol Mechanisms of Endophytic Microorganisms* E.K. Radhakrishnan,Ajay Kumar,R. Aswani,2021-11-24 Biocontrol Mechanisms of Endophytic Microorganisms introduces endophytic microorganisms colonization diversity and distribution describes the isolation and identification of endophytic microorganisms by traditional cultivation and by next generation sequencing technologies and covers biocontrol mechanisms bacterial priming endophytic based methods the significance on fungi and metabolite based formulations The book concludes with chapters on biofilms microbiota and safety issues of microorganisms The intensive use

of chemicals to control these plant pathogens has resulted in negative consequences such as the release of toxic chemicals in the environment reduced soil fertility and human health problems Therefore environmentally friendly and sustainable replacement of chemical fertilizers or pesticides is highly challenging Contains exclusive information about research on immunogenetics going on all over the world Includes all the minute and recent details that will be the prerequisite requirement for any researcher who wants to work on immunogenetics and its applications Comes fully equipped with pictures illustrations and tables delivering the information in a meticulous manner that makes it more attractive to readers

Bacterial Endophytes for Sustainable Agriculture and Environmental Management Amit Kishore Singh,Vijay

Tripathi,Awadhesh Kumar Shukla,Pradeep Kumar,2022-03-25 This book is a comprehensive account of recent advances in the endophytic research It covers recent perspective of endophytic research molecular diversity bioprospecting of novel genes using high throughput molecular techniques and most importantly application of endophytes in practicing sustainable agriculture Endophytic micro organisms are mysterious living component associated mutually with plant roots and soil microbes Various endophytic bacteria have attracted considerable attention for their ability to promote plant growth through direct mechanisms or by acting as biocontrol agents Endophytes also find use in biocontrol medicine agriculture and food industry This is a useful reading for the student of agriculture environmental microbiology and biotechnology

Rhizosphere Biology: Interactions Between Microbes and Plants Vadakattu V. S. R. Gupta,Anil K.

Sharma,2020-08-21 This book presents a detailed discussion on the direct interactions of plants and microorganisms in the rhizosphere environment It includes fifteen chapters each focusing on a specific component of plant microbe interactions such as the influence of plants on the root microbiome and the downstream effects of rhizosphere microbial dynamics on carbon and nutrient fluxes in the surroundings As such the book helps readers gain a better understanding of diversity above the ground and its effect on the microbiome and its functionality

Azospirillum VI and Related Microorganisms Istvan Fendrik,Maddalena Del Gallo,Jos Vanderleyden,Miklos, de Zamaroczy,2013-06-29 Azospirillum is a plant growth promoting rhizobacterium used for inoculation of cereal and forage crops The book covers its physiology ecology biochemistry and molecular biology The most advanced molecular techniques to understand the regulatory mechanisms of nitrogen fixation and ammonia assimilation as well as the basis of phytohormone production are included In particular the identification of novel types of promoters specific regulatory circuits and new regulatory proteins is described New insights in the plant growth promoting role of the bacteria through the analysis of their interactions with the plant are presented Also discussed are field applications allowing the evaluation of the physiological and agronomic involvement of Azospirillum inoculations

Plant-Associated Bacteria Samuel S. Gnanamanickam,2007-09-29 This volume is envisioned as a resource for

researchers working with beneficial and harmful groups of bacteria associated with crop plants The book is divided into two parts with Part I on beneficial bacteria including chapters on symbiotic nitrogen fixers and rhizosphere bacteria The second

part consists of detailed descriptions of 8 genera of plant pathogenic bacteria including *Agrobacterium* and *Herbaspirillum*. Each chapter covers terminology, molecular phylogeny and more soft rot *Pseudomonas*, *Xanthomonas*, *Ralstonia*, *Burkholderia* and *Acidovorax*. There is an opening chapter on the plant associated bacteria survey, molecular phylogeny, genomics and recent advances. And each chapter includes terminology, definitions, molecular phylogeny methods that can be used both traditional and latest molecular tools and applications.

Bioprospecting of Plant Biodiversity for Industrial Molecules
Santosh Kumar Upadhyay, Sudhir Pratap Singh, 2021-06-22

BIOPROSPECTING OF PLANT BIODIVERSITY FOR INDUSTRIAL MOLECULES A comprehensive collection of recent translational research on bioresource utilization and ecological sustainability. Bioprospecting of Plant Biodiversity for Industrial Molecules provides an up to date overview of the ongoing search for biodiverse organic compounds for use in pharmaceuticals, bioceuticals, agriculture and other commercial applications. Bringing together work from a panel of international contributors, this comprehensive monograph covers natural compounds of plants, endophyte enzymes and their applications in industry, plant bioprospecting in cosmetics, marine bioprospecting of seaweeds and more. Providing global perspectives on bioprospecting of plant biodiversity, the authors present research on enzymes, mineral micro nutrients, biopesticides, algal biomass and other bioactive molecules. In depth chapters assess the health impacts and ecological sustainability of the various biomolecules and identify existing and possible applications ranging from ecological restoration to production of essential oils and cosmetics. Other topics include bio energy crops as alternative fuel resources, the role of plants in phytoremediation of industrial waste and the industrial applications of endophyte enzymes. This comprehensive resource includes a thorough introduction to plant biodiversity and bioprospecting. Will further the knowledge of application of different plants and improve research investigation techniques. Summarizes novel approaches for researchers in food science, microbiology, biochemistry and biotechnology. Bioprospecting of Plant Biodiversity for Industrial Molecules is an indispensable compendium of biological research for scientists, researchers, graduate and postgraduate students and academics in the areas of microbiology, food biotechnology, industrial microbiology, plant biotechnology and microbial biotechnology.

Advances in Endophytic Research Vijay C. Verma, Alan C. Gange, 2016-08-23

In recent years there has been significant attention paid on the endophytic research by various groups working within this domain. Mutualistic endophytic microbes with an emphasis on the relatively understudied fungal endophytes are the focus of this special book. Plants are associated with micro organisms, endophytic bacteria and fungi which live inter and intra cellularly without inducing pathogenic symptoms but have active biochemical and genetic interactions with their host. Endophytes play vital roles as plant growth promoters, biocontrol agents, biosurfactant producers, enzymes and secondary metabolite producers as well as providing a new hidden repertoire of bioactive natural products with uses in pharmaceutical, agrochemical and other biotechnological applications. The increasing interest in endophytic research generates significant progress in our understanding of the host endophyte relationship at molecular and genetic level. The bio

prospection of microbial endophytes has led to exciting possibilities for their biotechnological application as biocontrol agent bioactive metabolites and other useful traits Apart from these virtues the microbial endophytes may be adapted to the complex metabolism of many desired molecules that can be of significant industrial applications These microbes can be a useful alternative for sustainable solutions for ecological control of pests and diseases and can reduce the burden of excess of chemical fertilizers for this purpose This book is an attempt to review the recent development in the understanding of microbial endophytes and their potential biotechnological applications This is a collection of literature authored by noted researchers having signatory status in endophytic research and summarizes the development achieved so far and future prospects for further research in this fascinating area of research

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