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Nutrient Use Efficiency: from Basics to Advances

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Nutrient Use Efficiency From Basics To Advances

Prof Zed Rengel



Nutrient Use Efficiency From Basics To Advances:

Nutrient Use Efficiency: from Basics to Advances Amitava Rakshit, Harikesh Bahadur Singh, Avijit Sen, 2014-12-26 This book addresses in detail multifaceted approaches to boosting nutrient use efficiency NUE that are modified by plant interactions with environmental variables and combine physiological microbial biotechnological and agronomic aspects. Conveying an in depth understanding of the topic will spark the development of new cultivars and strains to induce NUE coupled with best management practices that will immensely benefit agricultural systems safeguarding their soil water and air quality. Written by recognized experts in the field the book is intended to provide students scientists and policymakers with essential insights into holistic approaches to NUE as well as an overview of some successful case studies. In the present understanding of agriculture NUE represents a question of process optimization in response to the increasing fragility of our natural resources base and threats to food grain security across the globe. Further improving nutrient use efficiency is a prerequisite to reducing production costs expanding crop acreage into non competitive marginal lands with low nutrient resources and preventing environmental contamination. The nutrients most commonly limiting plant growth are N P K S and micronutrients like Fe Zn B and Mo. NUE depends on the ability to efficiently take up the nutrient from the soil but also on transport storage mobilization usage within the plant and the environment. A number of approaches can help us to understand NUE as a whole. One involves adopting best crop management practices that take into account root induced rhizosphere processes which play a pivotal role in controlling nutrient dynamics in the soil plant atmosphere continuum. New technologies from basic tools like leaf color charts to sophisticated sensor based systems and laser land leveling can reduce the dependency on laboratory assistance and manual labor. Another approach concerns the development of crop plants through genetic manipulations that allow them to take up and assimilate nutrients more efficiently as well as identifying processes of plant responses to nutrient deficiency stress and exploring natural genetic variation. Though only recently introduced the ability of microbial inoculants to induce NUE is gaining in importance as the loss immobilization release and availability of nutrients are mediated by soil microbial processes.

Sustainable Horticulture Musa Seymen, Ertan Sait Kurtar, Ceknas Erdinc, Ajay Kumar, 2022-04-21 Sustainable Horticulture Microbial Inoculants and Stress Interaction gives insights into the applications and formulations of microbial inoculants. In recent years the optimum yields of horticultural plants largely influenced by rising global temperature biotic stress attack of pathogens and abiotic stresses has created extra pressure for the horticulturalist to meet the need of optimum yield production for the burgeoning global population. However the challenges of biotic and abiotic stress factors mitigated by traditional physical or chemicals methods include high application cost and adverse impact on quality limit the frequent use hence the solutions in this book create new avenues for progress. This book covers those challenges and how microbial based bio inoculants are broadly used in horticulture to mitigate the challenges of biotic and abiotic stresses. It provides an important contribution on how to apply efficient

beneficial microbes microbial inoculants for a sustainable society Provides quality chapters from the leading academicians and researchers from the different parts of the world Gives insights on the applications and formulations of microbial inoculants Covers the challenges of biotic and abiotic stress factors mitigated by traditional physical or chemical methods that are costly

Achieving sustainable crop nutrition Prof Zed Rengel, 2020-02-18 Focus on integrating research on nutrient cycling crop nutrient processing and the environmental impact of fertiliser use to identify ways of improving nutrient use efficiency NUE in the use of particular fertilisers Includes research on a range of secondary macronutrients and micronutrients including calcium magnesium zinc boron manganese and molybdenum Reviews a wide range of options for reducing optimising current levels of fertiliser use

Climate Change and Soil-Water-Plant Nexus Md. Mizanur Rahman, Jatish Chandra Biswas, Ram Swaroop Meena, 2024-11-09 The edited book provides a comprehensive and up to date overview of scientific developments in agricultural sustainability under changing climate conditions It focuses on the linkages among soil water and crops and their management options to maintain soil health and ensure a sustainable crop production environment The book addresses the scenarios and challenges of agricultural sustainability in the face of climatic change With increasing pressure on our limited land and water resources to produce higher crop yields for a growing global population the efficient use of soil water and fertilizers is crucial for achieving most of the United Nations Sustainable Development Goals SDGs The book presents climate change mitigation and adaptation options to help achieve these SDGs It highlights the impact of climate variability on agricultural production and the functions of ecosystems emphasizing the importance of developing climate resilient agriculture to sustain food production and reduce greenhouse gas emissions The book explores the soil water plant nexus and its response to changing climate characterizing seasonal and inter annual climatic variability in crop growth and yield Different chapters evaluate the effects of climate change on soil health degradation depletion of soil nutrients and carbon contents and crop responses to climate variability This book is of interest to academicians researchers scientists capacity builders and policymakers Extension personnel will benefit from its insights and it serves as valuable supporting material for graduate students of agriculture forestry ecology soil science and environmental sciences in understanding and designing their own research

Biodiversity, Functional Ecosystems and Sustainable Food Production Charis M. Galanakis, 2022-10-12 In recent decades practices like the cultivation of a few high yielding crop varieties on a large scale the application of heavy machinery and continued mechanization of agriculture the removal of natural habitats and the application of pesticides and synthetics have resulted in the simplification of agro ecosystems This has enabled a substantial increase in food production but has at the same time transformed landscapes Indeed there is a concern that a decline in biodiversity has affected microbiome activities that support processes across soils plants animals the marine environment and humans Although they have increased food production the above practices cannot be considered sustainable in long term applications Biodiversity Functional Ecosystems and Sustainable Food

Production explore ecosystems in terms of crop and animal production pest and disease control nutrient cycling and soil fertility Chapters range from agro biodiversity to antimicrobial use in animal food production to microbiome applications for sustainable food systems and the impacts of environment friendly unit operations on the functional properties of bee pollen By examining such topics about each other the text emphasizes how food production ecosystem function food quality and consumer health are all interconnected

Input Use Efficiency for Food and Environmental Security Rajan Bhatt,Ram Swaroop Meena,Akbar Hossain,2022-01-11 Ending hunger achieving food security and promoting sustainable development are at the top of the list of United Nations UN sustainable global development priorities In the times of high population growth and increasing pressure of agricultural systems efficiency in use of natural resources has been at the epicenter of sustainable agricultural The concept of Input efficiency implies production of high quantity and quality of food from using only finite natural resources as inputs in the form of mainly land water nutrients energy or biological diversity In this book editors provide a roadmap to the food nutritional and environmental security in the agricultural systems They share insight into the approaches that can be put in practice for increasing the input use efficiency in the cropping systems and achieve stability and sustainability of agricultural production systems This book is of interest to teachers researchers climate change scientists capacity builders and policymakers Also the book serves as additional reading material for undergraduate and graduate students of agriculture agroforestry agroecology and environmental sciences National and international agricultural scientists policymakers will also find this to be a useful read

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

Sustainable Agriculture Reviews Eric Lichtfouse,2017-07-13 This book deals with a rapidly growing field aiming at producing food and energy in a sustainable way for humans and their children It is a discipline that addresses current issues climate change increasing food and fuel prices poor nation starvation

rich nation obesity water pollution soil erosion fertility loss pest control and biodiversity depletion This series gathers review articles that analyze current agricultural issues and knowledge then proposes alternative solutions Exogenous Priming and Engineering of Plant Metabolic and Regulatory Genes Manish Kumar Patel,Lam-Son Phan Tran,Sonika Pandey,Avinash Mishra,2025-01-30 Exogenous Priming and Engineering of Plant Metabolic and Regulatory Genes Stress Mitigation Strategies in Plants provides insights into metabolic adjustment their regulation and the regulatory networks involved in plants responding to stress situations It contains comprehensive information combining mechanistic priming and engineering approaches from the conventional to those recently developed In addition the book addresses seed priming tolerance mechanisms pre and post treatment as well as sensory response and genetic manipulation From basic concepts to modern technologies and prevailing policies readers will find this book useful in enhancing their understanding of the area as well as helping in identifying approaches for future research Provides detailed information on developing stress tolerant crop varieties using two distinct approaches Highlights advancements in OMICS approaches for different crops Assists readers in designing and evaluating plan for future research *Nanotechnology and Nanomaterials in the Agri-Food Industries* Pardeep Singh,Puja Khare,Disha Mishra,Muhammad Bilal,Mika Sillanpää,2023-09-16 Nanotechnology and Nanomaterials in the Agri Food Industries Smart Nanoarchitectures Technologies Challenges and Applications brings together the latest advances in the utilization of advances nanotechnology nanoarchitectures and nanomaterials in the agricultural and food sectors The book begins by discussing recent trends towards sustainable synthesis and application covering green nanomaterials and biodegradable nanomaterials and composites Subsequent chapters focus on key application areas of engineered nanomaterials in both agriculture and food processing such as crop production and protection delivery vehicles detection of contaminants nanobionic and genetic engineering in plants active food packaging and preservation enhanced food formulations and nutrients nanoscale additives for freshness and nanosensors This is followed by a section that addresses key challenges relating to the application of nanostructures and nanodevices in these sectors including global market considerations health and environmental concerns and intellectual property and socio economic issues Finally policy implications and future perspective for the field are reviewed in detail Presents cutting edge applications of nanotechnology across agriculture and food processing Highlights the latest developments in green or biodegradable nanomaterials for increased sustainability Considers key challenges relating to market health and environment regulations and policy Environment, Climate, Plant and Vegetation Growth Shah Fahad,Shah Saud,Taufiq Nawaz,Liping Gu,Mushtaq Ahmad,Ruanbao Zhou,2024-09-26 The book provides currently available information on the changing climate and its impact on functional and adaptive features of plants The book also cover cutting edge research on key determinants of plant growth that provides a direction towards execution of programs and practices that will assist resilience of crop production systems to the changing climate This book will represent the updated scientific information regarding soil and plant productivity under

changing climate which will be beneficial to academics and researchers working on climate change agronomy stress physiology biotechnology It provides an in depth discussion on the latest techniques to enhance plant responses to new environmental conditions that can be directly applied on field *Biotechnological Intervention in Production of Bioactive Compounds* Jyoti Devi,2025-02-25 This book provides an overview of the state of our understanding regarding the biosynthesis of bioactive compounds from plant and microbial sources Additionally examples of how these compounds have been used in food agriculture and human health are provided as well as the biotechnological approach for screening and characterizing bioactive compounds In the pharmaceuticals nutraceuticals and agrochemicals industries bioactive molecules are crucial to the production of high value products The discovery of bioactive chemicals from diverse sources has supported their use as medications functional food ingredients herbicides and insecticides due to their medicinal advantages nutritional importance and protective impacts in healthcare and agriculture The systematic investigation of biologically active products and the prospective biological activities of these bioactive compounds comprising their medical uses standardization quality control mode of action and possible biomolecular interactions are among the greatest sensational expansions in modern natural medication and healthcare This book is a useful resource for graduate and undergraduate biomedical chemistry and agriculture students who are interested in learning more about the possibilities of bioactive natural products This book is useful to researchers in a variety of scientific domains where natural products are important *Phytomicrobiome and Stress Regulation* Azam Khan,Ken D. Mix,Noshin Ilyas,Riyaz Sayyed,2025-08-01 Phytomicrobiome and Stress Regulation a volume in the Microbiome Research in Plants and Soil series provides an in depth examination of how plant associated microbial communities mitigate various stresses The book explores the complexities of abiotic and biotic stresses faced by plants emphasizing the importance of the phytobiome in stress alleviation This comprehensive overview sheds light on the significant role that microbial composition and diversity play in driving ecological functions and enhancing plant resilience In addition to addressing stress mitigation the book highlights advances in applied crop microbiology and the dynamic responses of microbial communities to environmental changes It underscores the impact of these communities on soil functioning and ecosystem health making it a critical resource for understanding future climate change scenarios and their implications for plant health Through detailed studies and evidence based insights the book aims to foster a more complete understanding of the intricate relationship between plants and their microbial allies Highlights current research into the resilience of phytomicrobiomes to biotic and abiotic stresses and the related benefit to plants Explains the benefits to agricultural productivity by improving soil structure increasing ecosystem nutrient availability and developing new intervention for insect pests Presents the dynamisms of below and above ground microbiome in stress mitigation **Recent Advances on Nitrogen Use Efficiency in Crop Plants and Climatic Challenges** Hamada AbdElgawad,2023-08-25 Nitrogen N is a mineral nutrient that is essential for the normal growth and development of plants that is required in the

highest quantity It is an element of nucleic acids proteins and photosynthetic metabolites therefore crucial for crop growth and metabolic processes Recently it was estimated that N fertilizers could meet the 48% demand of the world's population However overuse and misuse of N fertilizers raised environmental concerns associated with N losses by nitrous oxide N₂O emissions ammonia NH₃ volatilization and nitrate NO₃ leaching For instance NH₃ is a pollutant in the atmosphere N₂O is a greenhouse gas that has a warming potential 298 times higher than CO₂ and contributes to ozone depletion and NO₃ causes eutrophication of water bodies Agricultural practices account for about 90% of NH₃ and 70% of N₂O anthropogenic emissions worldwide The efficient use of N chemical fertilizers can be attained through cultural and agronomic practices Nitrogen use efficiency NUE is an important trait that has been studied for decades in different crops The grain production or economic return from the per unit supply of N fertilizer simply explained the NUE Several definitions were suggested by different researchers NUE can be defined as the product of N uptake efficiency NUpE and N utilization efficiency NUtE An increase in NUE increases the yield biomass quality and quantity of crops N is generally applied as chemical fertilizer to the soil whereas a small amount is added to some crops like grain legumes through the fixation process On the other hand crop plants take N through the root system in the form of nitrate or ammonium which is thereby used in different metabolic processes A number of studies have been conducted to increase the NUE in different crops and it has been indicated that NUE can be improved by agronomic physiological biochemical breeding as well as molecular approaches Nitrogen is the main limiting nutrient after carbon hydrogen and oxygen for the photosynthetic process phyto hormonal and proteomic changes and the growth development of plants to complete their lifecycle Excessive and inefficient use of N fertilizer results in enhanced crop production costs and atmospheric pollution Atmospheric nitrogen 71% in the molecular form is not available for the plants For the world's sustainable food production and atmospheric benefits there is an urgent need to upgrade nitrogen use efficiency in the agricultural farming system Nitrogen losses are too high due to excess amount low plant population poor application methods etc which can go up to 70% of total available nitrogen These losses can be minimized up to 15-30% by adopting improved agronomic approaches such as optimal dosage of nitrogen application of N by using canopy sensors maintaining plant population drip fertigation and legume based intercropping Therefore the major concern of modern days is to save economic resources without sacrificing farm yield as well as the safety of the global environment i.e greenhouse gas emissions ammonium volatilization and nitrate leaching

Metabolomics, Proteomics and Gene Editing Approaches in Biofertilizer Industry Sukhminderjit Kaur,Vagish Dwibedi,Pramod Kumar Sahu,2024-06-26 Biofertilizer refers to the live or latent microbial inoculants capable of enhancing plant growth through direct and indirect mechanisms This book covers strategies for harnessing the integrated technologies omics proteomics and metabolomics for the development of potential novel biofertilizers Modern techniques for enhancing the efficacy and quality of biofertilizers has been discussed in detail Increasing crop productivity poses a great challenge due to increasing global

population and researchers are looking for solutions to this using sustainable approaches Biofertilizers play an imperative role in enhancing yield production in crops and this book covers detailed account of biofertilizers on a single platform It also provides guidance on sustainable ways of increasing crop production and helps in generating ideas to formulate collaboration between public and private sectors for future innovation in the field of biofertilizers This book is especially designed for the research graduates young researchers and scholars who are directly involved in the research related activities of the biofertilizers It can also be useful to professors lecturers biotechnologists biofertilizer production specialists and other stakeholders associated with strain improvement for biofertilizer development

The Molecular and Physiological Basis of Nutrient Use Efficiency in Crops Malcolm J. Hawkesford, Peter Barraclough, 2011-06-20 Efforts to increase efficient nutrient use by crops are of growing importance as the global demand for food fibre and fuel increases and competition for resources intensifies *The Molecular and Physiological Basis of Nutrient Use Efficiency in Crops* provides both a timely summary of the latest advances in the field as well as anticipating directions for future research *The Molecular and Physiological Basis of Nutrient Use Efficiency in Crops* bridges the gap between agronomic practice and molecular biology by linking underpinning molecular mechanisms to the physiological and agronomic aspects of crop yield These chapters provide an understanding of molecular and physiological mechanisms that will allow researchers to continue to target and improve complex traits for crop improvement Written by leading international researchers *The Molecular and Physiological Basis of Nutrient Use Efficiency in Crops* will be an essential resource for the crop science community for years to come Special Features coalesces current knowledge in the areas of efficient acquisition and utilization of nutrients by crop plants with emphasis on modern developments addresses future directions in crop nutrition in the light of changing climate patterns including temperature and water availability bridges the gap between traditional agronomy and molecular biology with focus on underpinning molecular mechanisms and their effects on crop yield includes contributions from a leading team of global experts in both research and practical settings

Microbial Interventions in Agriculture and Environment Dhananjaya Pratap Singh, Ratna Prabha, 2019-11-09 Microbial communities and their multi functionalities play a crucial role in the management of soil and plant health and thus help in managing agro ecology the environment and agriculture Microorganisms are key players in N fixation nutrient acquisition carbon sequestration plant growth promotion pathogen suppression induced systemic resistance and tolerance against stresses and these parameters are used as indicators of improved crop productivity and sustainable soil health Beneficial belowground microbial interactions in the rhizosphere help plants combat abiotic challenges in the unfavourable environmental conditions of native soils These microorganisms and their products offer potential solutions for agriculture in problematic areas since they are able to degrade xenobiotic compounds pesticides and toxic chemicals and help remediate heavy metals in the rhizosphere and so make deteriorated soils suitable for crop production This book compiles the latest research on the role of microbes in the rhizosphere and agro ecology covering

interaction mechanisms microbe mediated crop production plant and soil health management food and nutrition nutrient recycling land reclamation clean water systems agro waste management biodegradation bioremediation biomass and bioenergy sanitation and rural livelihood security It is a comprehensive reference resource for agricultural activists policymakers environmentalists and advisors working for governments non governmental organizations and industries helping them update their knowledge of this important but often neglected research area **Encyclopedia of Soil Science** Rattan Lal,2006 Upholding the high standard of quality set by the previous edition this two volume second edition offers a vast array of recent peer reviewed articles It showcases research and practices with added sections on ISTIC World Soil Information root growth and agricultural management nitrate leaching management podzols paramos soils water repellent soils rare earth elements and more With hundreds of entries covering tillage irrigation erosion control ground water and soil degradation the book offers quick access to all branches of soil science from mineralogy and physics to soil management restoration and global warming Publisher s website **Priming and Pretreatment of Seeds and Seedlings** Mirza Hasanuzzaman,Vasileios Fotopoulos,2019-10-15 This book introduces readers to both seed treatment and seedling pretreatments taking into account various factors such as plant age growing conditions and climate Reflecting recent advances in seed priming and pretreatment techniques it demonstrates how these approaches can be used to improve stress tolerance and enhance crop productivity Covering the basic phenomena involved mechanisms and recent innovations the book offers a comprehensive guide for students researchers and scientists alike particularly Plant Physiologists Agronomists Environmental Scientists Biotechnologists and Botanists who will find essential information on physiology and stress tolerance The book also provides a valuable source of information for professionals at seed companies seed technologists food scientists policymakers and agricultural development officers around the world Environmental extremes threatening food crops Nasim Ahmad Yasin,Tanveer Alam Khan,Aamir Ali, Mukhtar Ahmed,2023-05-08

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