

Preface

Microbes are recognized for their ubiquitous presence, diverse metabolic activity, and unique survival strategies under extreme conditions. The diversity and abundance of microorganisms in various environments are poorly explored. However, rapid and continuous increase in global human population combined with rapid industrialization has resulted in environmental pollution with heavy metals, pesticides, and other toxic substances. Such impacts have adversely impacted crop production, the environment, and human health. Developing methods for sustaining crop production and environmental health are of prime importance in feeding global populations on a sustainable basis.

Molecular biology has revolutionized the study of microorganisms in the environment and improved our understanding of the composition, phylogeny, and physiology of microbial communities. The current molecular toolbox encompasses a range of DNA-based technologies, and new methods for the study of RNA and proteins extracted from environmental samples. Currently, there is a major emphasis on the application of “omics” approaches such as genomics, proteomics, functional genomics, etc. to determine the identities and functions of microbes inhabiting different environments. Recent molecular-based developments will be of significant value in discovering new microbes and microbial genes and to exploit them in solving the urgent challenges facing the environment, agriculture, and human health.

Emerging disciplines such as bioremediation, biofilms, microbial quorum sensing, and microbial nanoparticles require greater attention by researchers. Molecular techniques in tracking and monitoring microbial inoculants both in bulk soil and in rhizosphere are of critical value for bioinoculant efficacy monitoring. Therefore, exploring novel microbes and technologies are prerequisites for addressing the challenges of crop production and protection and environmental health management.

Considerable work has been carried out on the use of microbes in solving many agricultural and environmental pollution problems. A huge bank of data has already been generated on various practical aspects; however, the information is scattered and not available to all readers. There is a lack of concerted effort to publish edited books in this area and to address common agricultural and environmental problems where microbes could be efficiently applied to their management.

In recent years, the use of microbes and microbial technology has been considered for solving environmental pollution problems from heavy metals, pesticide contamination, etc. On the other hand, agricultural application to plant growth promotion and crop protection is not new; however, greater enthusiasm has appeared in recent years due to the urgency of maintaining sustainable crop productivity and the detection of deterioration of soil health. New dimensions such as probiotics, quorum sensing (i.e., cell-to-cell signaling), biofilms, and nanobiotechnology and their significance in environmental and agricultural issues embrace some of the recent trends of microbial technology.

The content of this book is divided into three main topic areas: microbial diversity exploration, new trends in research, and applications in the management of environmental pollution and protection of plant health. The book is divided into 18 chapters, with each focused on a specific topic to cover, diverse perspective topics. Topics include the exploration of microbial diversity and detection of microbial pathogens in food, concepts and applications of microbial biofilms, genetic exchange in bacterial populations in the natural environment, and classical and modern techniques for studying and tracking plant growth-promoting rhizobacteria. Recent developments in bioremediation of contaminated soil and water using microbial surfactants, bioaugmentation-assisted phytoremediation, degradation of agricultural pesticides by soil bacteria, biosorption of heavy metals and radionuclides by microbial biomass, recent trends in the role of baculoviruses and fungal-based agents in controlling plant pests and disease management, and production technology of mycorrhizal fungi are described. Current trends in the new frontiers of microbiology such as quorum sensing, biosensors, nanobiotechnology, and probiotics are also discussed in detail.

With contributions from a broad range of leading researchers, this book focuses on current trends in microbial diversity, detection, and microbial technology applications. Although aimed primarily at research scientists and graduate students in environmental and agricultural microbiology, the topics and techniques are equally applicable to all branches of microbial biotechnology.

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Aligarh, India
Uttaranchal, India
Muncie, IN

Iqbal Ahmad
Farah Ahmad
John Pichtel

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