



BIODIVERSITY AND ENVIRONMENTAL BIOTECHNOLOGY

Editors

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By the same author

- Environmental Pollution and Environmental Management
- Plant Tissue Culture

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SCIENTIFIC PUBLISHERS (INDIA)

P. O. BOX 91

JODHPUR

Published by:
Pawan Kumar
Scientific Publishers (India)
5-A, New Pali Road, P.O. Box 91
Jodhpur - 342 001
www.scientificpub.com

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ISBN: 81-7233-467-2

eISBN: 978-93-87741-36-2

Cover Page (Photographs)

- *Oroxylum indicum*: Shoot multiplication in WPM supplemented with BAP and NAA (Photograph from Padmanabh Dwivedi's Laboratory)
- Root hair infection showing thread-like structure by *Rhizobium* in *Trifolium alexandrinum* L. (Courtesy: Dr. R.S. Dwivedi, Retd. Professor of Botany, BHU, Varanasi)
- Genetically Modified (Bt) cotton from India (Courtesy: Biosafety Newsletter vol. 1(3) published by MoEF in association with BCIL).
- Conidia of *Cylindrocarpon* Wollenw (Fungus)
(Courtesy: Dr. R.S. Dwivedi, Retd. Professor of Botany, BHU, Varanasi)
- DNA Fingerprinting of Indian *Brassica* species and varieties
(Courtesy: Dr. M.C. Kalita).

Laser typeset: Rajesh Ojha
Printed in India

PREFACE

The applied aspects of microbiology and biotechnology with reference to environmental issues including biodiversity are now the frontier areas of research focus among researchers. Biodiversity refers to study of distribution of the natural habitats of plants, animals and microbes and their climate conditions. Today, biodiversity has assumed enormous commercial importance and requires management on scientific lines. It is important for biosphere's health, stability and proper functioning. However, biodiversity built up by nature over billions of years is now under threat. Very large areas in the world that were previously covered by forests, water bodies and the like, have been taken over. Anthropogenic activities have caused tremendous damage to biodiversity. An understanding and identification of biodiversity, its conservation and characterization have all become crucial. One of the roles of environmental biotechnology is lifting up of socio-economic conditions of human beings, and this is possible when environmental biotechnology deals with issues like biodiversity, health and hygiene, productivity, environmental pollution and addresses alternative bio-energy resources. Recent developments and advances in molecular biology have opened up new avenues for use of microbes in preserving and better management of the environment.

The importance of biodiversity and environmental biotechnology has tremendously increased in recent years, and these have become an integral part of Botany/ Life Sciences/ Environmental Science/ Biotechnology/ Medical Sciences/ Microbiology, and constitute a bulk of the course in Undergraduate and Postgraduate classes of most of the Universities. This book is an attempt to furnish students and teachers the information at one place in consolidated and precise manner, covering a wide range of topics related to biodiversity and environmental biotechnology, which will serve as a great help to them. Further, research students engaged in the relevant topics will find this book quite useful, as research highlights with updated latest references have been provided in all the chapters. This book will fulfill the need for a one-volume scientific discussion on the major aspects of biodiversity and environmental biotechnology.

This book embodies twenty four chapters. The methodology of tools and techniques has been given due place in these chapters. Figures, illustrations and examples are presented to elucidate the topics making the subject more interesting and knowledge-rich. The book covers a wide range of topics like phyto- and microbial diversity; medical microbiology; application of plant tissue culture techniques, bioinformatics, bioprospecting and synthetic seed technology, etc in the study of biodiversity and its management. Further, topics such as transgenics, bioremediation, waste utilization and role of single cell proteins, biopesticides, organic farming, scope of genetically modified organisms (GMOs), biotechnological approach of curbing air pollutants, air pollution biomonitoring, sericulture, pharmacognosy, characterization of biodiversity through molecular approach, etc have also been covered in this book.

Biodiversity and its management have roots in cultural practices and diversity, besides traditional knowledge. These along with gender issue vis-à-vis biodiversity are discussed in the chapter-1. Chapter-2 deals with lichens as an indicator species for biomonitoring of air pollution. Sericulture in India forms one of the promising income generation for rural population, and chapter-3 presents an overall picture of sericulture biotechnology in India. The emerging area of environmental biotechnology presents new opportunities for defining novel approaches in mitigating some of the critical environmental problems like green house gas effect and ozone depletion, and all these are highlighted in chapter-4. Chapter-5 discusses application of DNA fingerprinting for characterization of biodiversity highlighting various tools and techniques involved in molecular approach of studying biodiversity. The intense pressure due to ever increasing population, urbanization, land degradation, decrease in available land for cultivation and unpredictable weather conditions, pose threat to food security. Productivity gains in future is possible through better natural resource management and development of high yielding crop varieties resistant to biotic and abiotic stresses; this will also ensure sustainable utilization and conservation of bioresources. This can be achieved by transgenic technology. Chapter-6 deals mostly with implication of transgenic technology in improvement of crop plants highlighting plant transformation systems and transgene integration and expression improvement. The sustainable management of phytodiversity is possible through application of plant tissue culture techniques thereby helping in conservation of plant germplasm and reducing the loss of biodiversity. Various such plant tissue culture techniques have been presented and their applications discussed in the chapter-7. Further, synthetic seed technology also helps in conserving the biodiversity and

this has been nicely presented in Chapter-8, with the mention of methodology, importance, advantages and applications.

The importance of phytochemical research and pharmacognosy in the field of medicinal plants has been adequately discussed in chapter-9. There are two chapters-10 and 11 dealing with scope and application of bioinformatics in biodiversity and biotechnological studies. Status and importance of microbial diversity and bioprospecting has been elaborated in the chapter-12. Microbial technology finds its application in degradation of hazardous pesticides and other xenobiotics. Manipulated genes of microbes with degradative ability are vital for biodegradation of toxic chemicals. Microbial degradation of nitroaromatic compounds, microbial metabolism of hydrocarbons along with microbial enhanced oil recovery are presented in two separate chapters-13 and 14. Chapter-15 deals exclusively on the role of phytoremediation of heavy metals for environmental decontamination. Role of biopesticides (microbial pesticides) in augmenting effective management for control of phytopathogenic microbes is highlighted in the chapter-16. Further, role of plant growth promoting rhizobacteria in disease control has been specifically discussed in detail in the chapter-17. Chapter-18 touches upon the role of microbes in traditional fermented foods, particularly in Manipur (North Eastern state in India).

Disposal of different kinds of wastes like straw, bagasse, molasses, sewage, animal manures has been a problem for long time. Utilization and recycling of such wastes are preferred alternatives as these help in reducing environmental pollution. These have been presented in chapter-19, mentioning how such wastes utilization can be endeavoured for production of microbial protein sources. Microbial proteins can serve as alternative sources of food, as microbes have untapped source of feed and food. Understanding of the diversity of microbes related to human health is an important component in the study of biodiversity. Knowledge of medical microbial diversity and application of biotechnology are two wings in highest attainment of human health. Chapter-20 forms the basis of medical microbial diversity and human health, where the topic has been addressed adequately. Importance of bio-energy production and resource availability along with its utilization has been presented in chapter 21. Chapter-22 deals with impact of GMOs on environment and biodiversity, touching aspects like methods of genetic modification, uses and abuses of GMOs, their impact on ecosystems, biodiversity, etc. Organic farming has been depicted as an alternative for sustainable and eco-friendly agriculture, and this aspect is presented in great depth in chapter-23. Further, vermicomposting, in

particular, finds mention in chapter-24, where its role along with methods involved is highlighted.

We gratefully thank all the authors for their sincere efforts in preparing manuscript with interest. Their co-operation is greatly appreciated. We thank the Publisher, M/s Scientific Publishers, Jodhpur for taking interest in the publication of this book.

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