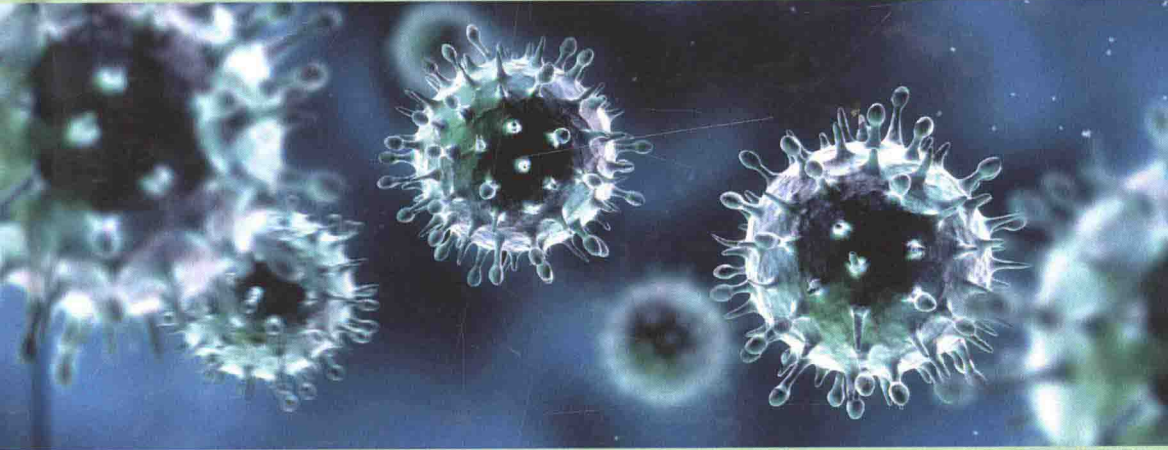


Recent Trends in

**MICROBIOLOGY
MYCOLOGY and
PLANT PATHOLOGY**



H.C. Lakshman



Recent Trends in Microbiology, Mycology and Plant Pathology

Editor

Dr. H.C. Lakshman

Professor and Formerly Chairman

P.G. Department of Studies in Botany

Karnatak University, Pavate Nagar, Dharwad – 580 003

Karnataka, India



2015

Daya Publishing House®

A Division of

Astral International Pvt. Ltd.

New Delhi – 110 002

© 2015 PUBLISHER

Publisher's note:

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Cataloging in Publication Data—DK

Courtesy: D.K. Agencies (P) Ltd. <docinfo@dkagencies.com>

Recent trends in microbiology, mycology and plant pathology /
editor, Dr. H.C. Lakshman.

pages cm

Includes bibliographical references and index.

ISBN 9788170359074 (Hardbound)

ISBN 9789351306542 (International Edition)

1. Microbiology. 2. Mycology. 3. Plant diseases. I. Lakshman,
H. C., 1954-, editor.

DDC 579 23

Published by

: **Daya Publishing House®**

A Division of

Astral International Pvt. Ltd.

– ISO 9001:2008 Certified Company –

4760-61/23, Ansari Road, Darya Ganj

New Delhi-110 002

Ph. 011-43549197, 23278134

E-mail: info@astralint.com

Website: www.astralint.com

Laser Typesetting

: **Classic Computer Services, Delhi - 110 035**

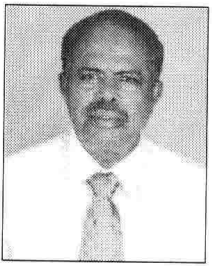
Digitally Printed at

: **Replika Press Pvt. Ltd.**

PRINTED IN INDIA

Recent Trends in Microbiology, Mycology and Plant Pathology

The Editor



Prof. H.C. Lakshman, born in Huskur, small village of Anekal taluk, Bangalore district in Karnataka on 20th December, 1954. Dr. Lakshman obtained his B.Sc. in 1975 and M.Sc., in 1977, from Bangalore University, Bangalore, Karnataka, Ph.D. in Botany, during 1996, from Karnatak University, Dharwad, Karnataka, India. Presently he is working as a senior Professor at P.G. Department of Studies in Botany, Karnatak University, Dharwad, Karnataka, 2004 to date.

He served as a Lecturer in Botany, K.L.E's S. Nijalingappa Science College, Bangalore 1978-1983; Senior Grade Lecturer in Botany, K.L.E's S.K. Arts and H.S.K. Institute of Science, Vidyanagar, Hubli, Karnataka, 1983-1996 and as a Reader in Botany, 1996-2004 and Professor in Botany, 2004 to till date at P.G. Department of Studies in Botany, Karnatak University, Dharwad, Karnataka and acted as a Chairman, P.G. Department of Studies in Botany, K.U. Dharwad, 2009-2011. Dr. Lakshman successfully guided 28 students for Ph.D. and M.Phil. He has to his credit 15 Books, 325 research articles published in various national and international scientific research journals. He received many prestigious awards to quote few Dr. C.V. Raman Literature Award-2006, Eminent Scientist Award of the year 2011, NESAI, New Delhi, Excellence in Research Award, Education ExpoTv, Noida. He is the Editorial Board member for Journal of Theoretical and Experimental Biology, Bulletin of Basic and Applied Plant Biology, Plant Sciences Feed, Bioscience Discovery, The Scientific Temper, International Journal of Biotechnology and Bioscience, International Journal of Environmental Sciences etc. He is the Fellow of Society of Environmental Sciences (F.S.E.Sc.) and Fellow of International Society of Ecological Communication (F.I.S.E.C.). Major research interest areas are Soil Microbiology, Mycology, Plant Pathology, Environmental Biology, Agricultural Sciences, Biofertilizers.

DR. M. KRISHNAPPA, M. Sc., M. Phil., Ph. D.
PROFESSOR
ExRegistrar, Kuvempu University
ExDean-Faculty of Biological Sciences
JNANA SAHYADRI
SHANAKARAGHATTA

Dept. of Post Graduate Studies & Research in
APPLIED BOTANY
Jnana Sahyadri, Shankaraghatta-577451
Shimoga Dist., Karnataka, INDIA

Foreword

Micro-organisms are useful in human welfare and also the plant microbial interactions. Utilization of these micro-organisms in all the fields beneficially according to human welfare. These micro-organisms causes harmful effect to the crop plants and causes yield loss. Some group of the micro-organisms boost the development of the plants in the symbiotic association as endophytic fungi. Some of the endophytic fungi enhances the medicinal value of plants.

It is pleasure to write few words about the book on "Recent Trends in Microbiology, Mycology and Plant Pathology". Many new informations are available regarding the microbiology and plant pathology. This book provides all information in the chapters. The book is divided into three divisions, *i.e.*, microbiology, mycology and plant pathology.

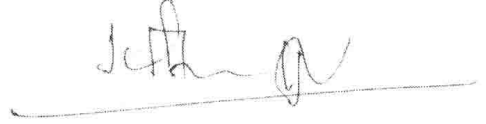
In the microbiology division, all the chapters dealt about the techniques, detection, procedures, extraction of secondary metabolites and applications of different microbes in the agriculture and other industrial usage. In all the chapters the authors have presented their original findings. The said procedures techniques and other information would help the other researchers, students for their academic and for their research work.

In the mycology and plant pathology division all the chapters dealt on the application of fungi and management of the plant diseases. The disease control by using fungicides and by integrated pest management. This method is more appropriate and ecofriendly. It deals with diseases of viruses and mycoplasma and non infections diseases of crop plants and their management.

In this division the authors have studied the viral and mycoplasmal diseases their transmission and their management. There is information on the non-infectious diseases of crop plants, induction of disease resistance against viral disease.

The book is very useful to the graduate, post graduate, research scholars and to the staff members. It provides lot of information on disease management, defence mechanism, industrial applications and bioprospecting of microbes.

I congratulate the author Prof. H.C. Lakshman for compiling all the chapters and brought in to a book format. I wish this book should useful to the academic fraternity. I am thankful to the Prof. H.C. Lakshman for providing this opportunity to write comments on this book.



Place: Shankaraghatta

Prof. M. Krishnappa

Preface

Microbiology, Mycology and Plant Pathology is in essence the deciphering and use of biological knowledge. It has multidisciplinary access, since; it has the foundation in many disciplines including bio-geology, ecology, chemistry, biochemistry, and genetics. It may be viewed as a series of enabling techniques to technologies that involve the practical application of micro-organisms. Today, the micro-organisms are the basic tools of genetic engineering and biotechnology. This has been partly due to the use of micro-organisms in the production of organic chemicals, antibiotics, wine, beer, cheeses, bio-fertilizers, pharmaceuticals and supplements in boosting production and yield in agriculture, horticulture and forestry. They also control insect, pests causing diseases in crop plants.

Undoubtedly modern biological knowledge can only maximise its full potential to benefit mankind through achieving basic research findings and awareness in modern society. Participating scientists must learn to communicate in scientific records, books, and journals. By doing so, they will generate a greater level of confidence and trust between the scientific community and the society at large. The present book brought a significant research and review articles contributed by researchers and scientists especially on Microbiology, Mycology and Plant pathology. The microbiology consists of eleven chapters, each chapter dealing with different facets of microbial applications. Second part of this book dealing mainly on fungal metabolites, production of antioxidants, pectinase, pharmaceuticals.

The success in chemical control of plant diseases causing pathogens accompanied by environmental pollution and this leads to ecological imbalance with application of various pesticides resulted in their accumulation in soil, water and plants. Therefore, the scientific endeavour is directed towards the elaboration and wide application of biological methods and thus, the third part of this book includes nine chapters dealing with different diseases caused by fungi, bacteria,

viruses and mycoplasma on leafy vegetables, horticultural crops. Similarly, each chapter gives the disease management techniques, biological control measures, and eco-friendly approaches. This book is aimed to give an integrated view of its complex in the subject for young students, researchers, scientists and teaching community as whole.

I am deeply indebted to Dr. M. Krishnappa, Ex-Registrar and Professor, Department of Studies and Research in Applied Botany, Kuvempu University, Shankarghatta, Shimoga, Karnataka, India, for encouraging me and writing foreword for this book. I am also thankful to Mr. Channabasava A., Research Scholar, P.G. Department of Studies in Botany, Karnatak University, Pavate Nagar, Dharwad for his help for completing this task. I extend my sincere thanks to Astral Publishing Company, New Delhi for timely printing and publishing this book.

Dr. H.C. Lakshman

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SECTION I

MICROBIOLOGY

Chapter 1

Beneficial Microbial Life in Soil: The Basis for Sustainable Plant Life on Earth

H.C.Lakshman

*Microbiology Laboratory, P.G. Department of Studies in Botany,
Karnatak University, Pavate Nagar, Dharwad – 580 003, Karnataka, India
E-mail: dr.hclakshman@gmail.com*

Introduction

Soil is the nature gift to mother earth. The soil mainly consists of sand, silt and clay particles with gaseous and mineral elements such as oxygen (O₂), silicon (Si), aluminum (Al), potassium (K), calcium (Ca), magnesium (Mg) etc and soil solution contains dissolved materials. Air in the soil contact with air above ground aerates the roots with oxygen and help to remove excess of carbon dioxide (CO₂) from respiring roots. Organic matter, the soul of soil is a major consideration in organic farming. Its presence or absence makes the soil living or dead. The India National Programme for Organic Production (NPOP) recognizes that “The fertility of soil is to be maintained and increased with the biological activity of the soil held intact”. From the point of view of farming, soil can be considered having four important parts; solid minerals, water, air and organic matter (Foster, 1988). Soil contains the required mineral elements and nutrients for the growth and multiplication of several lower forms of plants and animals. These biological species could be broadly divided into microflora and microfauna. The number and kinds of micro-organisms present in soil depend on many environmental factors, such as pH, temperature, moisture, aeration and nutrients available. Soil is medium for growth, reproduction, respiration, nutrition and even decomposition after death for most micro-flora and fauna. They complete their life

cycles and later provide the bio-mass for decomposition in the soils. Similarly, soil is also medium for physical anchorage, growth and proliferation of roots of all plants and thereby facilitates absorption of water and nutrients. The roots also provide large biomass for decomposition after completion of life cycle of plants. The whole environment in the soil provides production and recycling of biomass from lives of plant roots, animals and micro-organisms by closer integration of their life cycles.

Soil micro-flora plays a pivotal role in evaluation of soil conditions and in stimulating plant growth (Singh *et al.*, 2009). Micro-organisms are beneficial in increasing the soil fertility and plant growth as they are involved in several biochemical transformation and mineralization activities in soil. Type of cultivation and crop management practices found to have greater influence on the activity of soil micro-flora (Godfrey *et al.*, 2005). Continuous use of chemical fertilizers over a long period may cause imbalance in soil micro-flora and thereby indirectly affect biological properties of soil leading to soil degradation (Hawksworth and Colwell, 1992). The activity of soil microflora is comparatively more in surface than in subsurface horizons and decrease with depth due to decrease in organic matter (Roy, 2007). Soil micro-flora also plays fundamental roles in many ecosystem processes including decomposition and nutrient cycling and affects many important soil hydrological and chemical properties (Lynch, 1987a). Hence change in the soil microbial community may lead to changes in the structure and function of the overall ecosystem, and ultimately determine ecosystem sustainability (Richards, 1987). Soil management in Organic Farming centers on management of organic matter to sustain soil organic carbon, the key to production and productivity. In this process the basic and important methods is to increase the microbial activity in the soil by carefully managing and improving the quantity and quality of humus in it.

The soil organisms vary in number from a few per hectare to many millions per gram of soil. The density of population is determined by food supply, moisture, temperature, physical condition and the reaction of the soil. In neutral soils, bacteria dominate over types of microscopic life on the other hand; fungi predominate in acidic and organic matter such soil. Algae abound on the soil in constantly moist or shady situation. Under favourable conditions, the bacteria multiply enormously. In sandy desert soils and under water logged conditions they are very scarce.

Table 1.1: Distribution of Micro-organisms in Soil

Soils	Number/g of Soil in 15 cm Depth (x10,00,000)		
	Bacteria	Actinomycetes	Fungi
Deep black soil	1.29	0.10	0.03
Medium black soil	14.94	0.29	0.009
Alluvial soil	20.11	0.26	0.03
Latertic soil	1.06	0.47	0.12
Red sandy soil	1.34	0.62	0.008

Micro-organisms Associated with Rhizosphere and their Importance

The rhizosphere is considered to be that zone of the soil environment influenced by plant roots and it represents a highly complex ecosystem, which is influenced by a number of biotic and abiotic factors. It is widely believed that this zone will be variable in extent and be directly influenced by root physiology and by soil environment factors. Available evidence suggests that plants and rhizosphere organisms function in an interdependent fashion. Rhizosphere studies have shown that bacterial numbers are greatly increased in rhizosphere soils. Dilution plate count indicates that the ratio of bacterial numbers in rhizosphere compared to non-rhizosphere soil varies from 10:1 to 50:1 (Richards, 1987; Lynch, 1990). Comparison of rhizosphere and non-rhizosphere soil indicates that significant qualitative shift occurs in bacterial and fungal species detected (Farrar, 2003). Rhizosphere species composition is influenced by numerous factors, including plant species and genotype, plant nutrient status, presence and type of mycorrhiza, soil type, soil moisture, light supply and other factors. The continued maintenance of a normal rhizosphere is mediated by the release of a wide variety of organic carbon compounds. Available data, obtained from crops and tree seedlings suggest that 40-50 per cent of the net carbon fixed may be exuded or rapidly released to the rhizosphere (Rovira, 1965). More complex carbon compounds may enter the rhizosphere more slowly resulting from root aging. The rhizosphere contains diverse array of metabolic substrates such as exudates, secretions, plant mucilage, mucigel and lysates (Whipps, 2001). The diversity and complexity of released compounds is likely to be an important factor contributing to the high species diversity of rhizosphere micro-organisms.

The bacterial/cyanobacterial communities of the rhizosphere have strong influence on the growth and health of the plant as well as on their ability to adapt to changed environmental conditions. The enhanced degradation of pesticides in soil sections close to the root surface is related to the rhizosphere-induced co-metabolism of pesticides. The actively growing plant roots provide an excellent environment for intensive microbial activity, resulting in enhanced biodegradation of organic contaminants. Selective enrichment of micro-organisms is likely to have a significant impact on the rhizoremediation, rhizoextraction or rhizofiltration of recalcitrant organic contaminants in soils. Attempts would be given to provide nutrient and plant growth – promoting substances through micro-organisms for sustainable crop production.

Rhizosphere controls the transformation of nutrient ions and contaminants through changes in pH, redox potential, microbial population and mycorrhizal association. Changes in pH are brought about by the excretion of protons (H^+), hydroxyl (OH^-) or bicarbonate (HCO_3^-) ions due to cation/anion imbalance in the plant, the evolution of CO_2 by respiration, and the excretion of low-molecular-weight organic acids. Plants taking excess cation over anion (cation charge surplus) tend to balance the charge by releasing H^+ , resulting in acidification of rhizosphere. Conversely, plants taking excess anion over cation (anion charge surplus) tend to balance the charge by releasing OH^- or HCO_3^- ions, resulting in alkalization. This paper deals