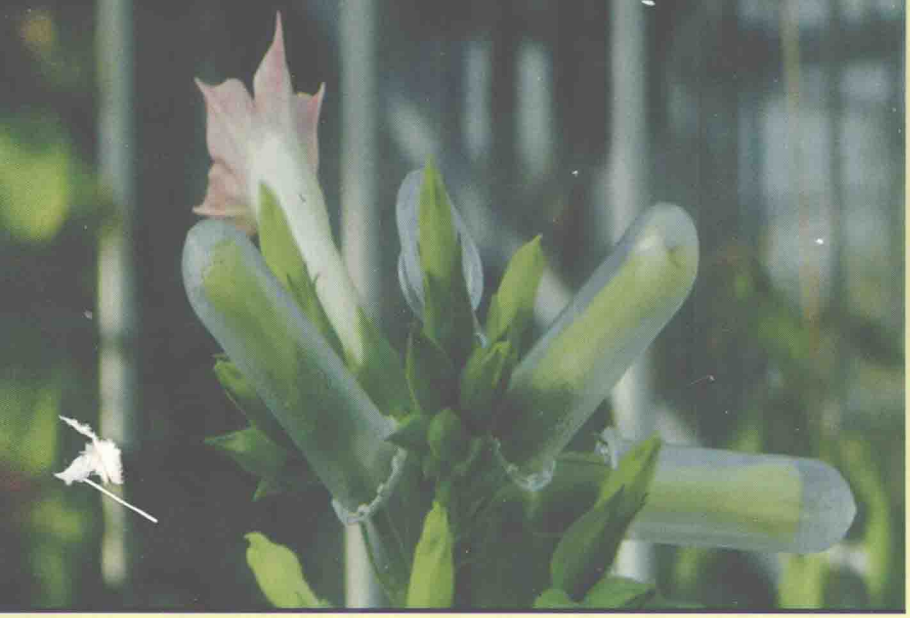

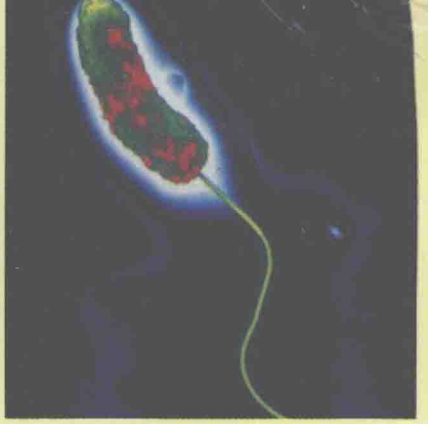

# MICROBIAL BIOTECHNOLOGY


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- RAJNI GUPTA
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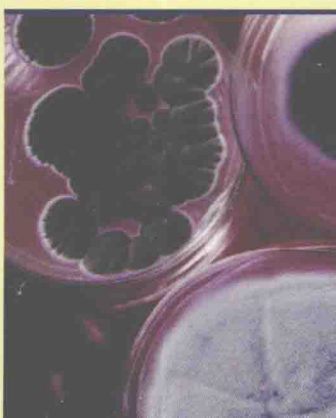

# MICROBIAL BIOTECHNOLOGY

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# Preface

This book entitled "Advances in Microbial Biotechnology" is being published to honour an outstanding scientist/mycologist and human being Professor Krishna Gopal Mukerji for his endless endeavour in mycology, plant pathology, microbial ecology and microbial biotechnology.

This book contains a wide ranging articles on microbial biotechnology, microbial ecology and mycology which emphasises the need for research in this direction and use of microbes in biotechnology. We have tried to synthesize all the informations which will be useful for researchers and students alike.

This volume contains 32 articles contributed by 62 authors and covers various aspects of microbial biotechnology. Chapter 1 describes a genus named after Professor K.G. Mukerji. Chapter 2-10 deals with various biochemical and molecular aspects of different microbes. Chapter 11 gives a very exhaustive data on aflatoxins and their effects on human health. Chapter 12 discusses a very recently advanced technology on protoplast fusion in certain fungi. Chapter 13 explains the microbial health hazards inside the buildings and palaces. Chapter 14 and 15 deals with mycoherbicides. Chapter 16 and 17 deals with dry rot fungi and their control. Chapter 18 and 19 deals with biocontrol. Chapter 20 deals with rhizosphere biology and chapter 21 deals with plant surfaces biology. Chapter 22 deals with management of soil borne diseases. Chapter 23-28 deals with various aspects of mycorrhizal biology. Chapter 29 deals with nematophagous fungi. Chapter 30 describes head smut of *Paspalum* and its management. Chapter 31 gives a monographic account of the genus *Morchella*. The last chapter gives a very interesting account on taxonomy, ecology and development of very rearly known fungi the Laboulbeniomycetes.

We are grateful to all authors for their contributions to this book. We would like to thank Mr. Sanjeev Hasija of M/s New Apcon for his excellent computer typesetting of this book in stipulated time. We are also thankful to all members associated with Applied Mycology Laboratory (# 15), Department of Botany, University of Delhi, who encouraged and helped us in various ways in completing this volume.

Many technical hands have helped us in the completion of this uphill task. We are grateful to Professor N.N. Bhandari and Professor K.M.M. Dakshini, Department of Botany, University of Delhi for their active cooperation and valuable suggestions during preparetion of this volume. We are also grateful to Professor K.R. Shivanna, Head, Department of Botany for releasing the book.

It is possible that in a work of this nature, some mistakes might have crept in text inadvertently and for these we own undiluted responsibility.

The editors are also thankful to Shri S.B. Nangia, the publisher for his enthusiastic cooperation in publishing this book in stipulated time using the latest printing technology.

We take great pleasure in presenting this Festschrift Volume to Professor K.G. Mukerji as a token of affection and regards. We wish him many more happy and fruitful years of research and a peaceful and prosperous life with his family members.

J.P. Tewari
T.N. Lakhanpal
Jagjit Singh
Rajni Gupta
B.P. Chamola

**May 4, 1999**

# Prof. K.G. Mukerji and his Contributions

B.P. Chamola, J.P. Tewari and I. Tewari

Professor Dr. Krishna Gopal Mukerji was born on 4th May, 1934 at Lucknow as fourth child of Mr. Davendra Nath Mukerji and Mrs. Leela Mukerji. He received his early education in Lucknow. He obtained his B.Sc. and M.Sc. degree from Lucknow University in 1953 and 1955 respectively. He started his teaching career as Lecturer in Botany at Lucknow University in 1955, from where he also obtained his Ph.D. Degree in Botany (Soil Microbiology) for his thesis entitled "Microfungi of Usar Soil of India" in 1962. Professor Mukerji was appointed Lecturer in Botany at Banaras Hindu University (BHU) in 1962, where he worked for two years. He joined Department of Botany, University of Delhi, Delhi - 110 007 as Lecturer in 1964. Professor Mukerji was appointed as Reader and Professor in the years 1969 and 1982 respectively. Professor Mukerji shouldered the responsibility of the Head, Department of Botany, University of Delhi during the years 1985 to 1988.

In 1970 Professor Mukerji married Abha Mukerji, who stood by him all through his career and has been virtually the backbone for his academic and professional achievements. Their son Amit pursued the career of his own choice and he is doing Ph.D. in Plant Molecular Biology from University of Alberta, Canada after doing his B.Sc. (Hons.), M.Sc. and M.Phil. in Botany from University of Delhi.

Professor Mukerji is actively engaged in research since September, 1957 on different aspects of Microbial Ecology with particular reference to fertility of soil and increase in productivity of plants. The publications of Professor Mukerji shows the significant contribution made by him in different areas of Mycology, Plant Pathology, Microbial Ecology and Microbial Biotechnology. During his research he investigated/discovered/reported several species and genera of fungi and mycorrhizal fungi from Indian soils.

Professor Mukerji has keen interest in culture collection and received advanced training in Taxonomy of Fungi at the Commonwealth Mycological Institute (CMI), Kew, Surrey, England (from Jan.-April, 1968), where he was also offered a permanent post of Mycologist in 1968. He also worked at Institute of Seed Pathology at Copenhagen, Denmark (from Jan.-August, 1974); Institute of Meeresforschung, Bremerhaven, Am Handelshafen, Bremen, West Germany (December, 1973) and Centrralblureau voor Schimmelcultures, Baarn, Netherlands (September, 1974).

Professor Mukerji, visited various Institutes, Culture Collections and Laboratories in Australia, Austria, Canada, Denmark, England, France, Germany, Hong Kong, Italy, Japan, Malaysia, Netherland, New Zealand, Philippines, Sweden, Switzerland, Thailand and USA as visiting Professor/Scientist. During his visit he was visiting Professor at the Department of Botany, University of Basel, Switzerland (August, 1985); Institute of Biotechnology and Microbiology, Glasgow University, Stratethclyde; Commonwealth Mycological Institute, Ferry Lane, Kew, Surrey; Berkbeck College, London; Biotechnology Department, Portsmouth Polytechnic, Portsmouth, U.K. (September, 1985; British Council Senior Visitor); Department of Soil Science and Geology, University of Laval, Quebec, Canada (August, 1986); Biotechnology Research Centre, Dhaka University, Dhaka, Bangladesh (February, 1987;

UNESCO Expert); Department of Plant Sciences, Faculty of Agriculture and Forestry, University of Alberta, Edmonton, Alberta, Canada (April, 1987 and September, 1991); Department of Botany, University of Florida, Gainesville, Florida, USA (May, 1987); Department of Soil Science and Microbiology, University of Torino, Torino, Italy (July, 1987); Department of Biological Sciences, Faculty of Education, Shizuoka University, Shizuoka, Japan (September, 1990) and Department of Biology, the Chinese University of Hong Kong, Shatin, N.T. Hong Kong (May, 1993).

Professor Mukerji has about 40 years of research experience on Taxonomy and Ecology of fungi from soil, rhizosphere, root including mycorrhiza, plant surface, dung and seeds. About 50 and more than 100 students have been already awarded their Ph.D. and M.Phil. degrees respectively of Delhi University on various aspects of mycology, plant pathology, microbial ecology and microbial biotechnology under supervision of Professor Mukerji.

Professor Mukerji is a widely travelled botanist and has attended several International, National Conferences and Symposia and presented several key note adresses and invited papers of which the important ones are :

**International** : First International Mycological Congress (8-15 September, 1971) Exeter, UK; First National Congress of Ecology (8-14 September, 1974) Hague, Netherlands; First International Symposium on Microbial Ecology (21-26 August, 1977) Dunedin, New Zealand; Third International Symposium on the Microbiology of Leaf Surfaces (1-15 September, 1981) University of Aberdeen, Aberdeen, Scotland, U.K.; Second International Symposium on Microbial Ecology (7-12 September, 1981) University of Warwick, Warwick, U.K.; Sixth North American Conference on Mycorrhiza (24-29 June, 1984) Oregon, USA; Fourth International Symposium on the Microbiology of the Phyllosphere (2-6 September, 1985) Wageningen, Netherlands; International Symposium on Root in Forest Soils : Biology and Symbiosis (4-8 August, 1986) Victoria, Canada; International Workshop on "Managed Forest Land" (August 8-11, 1986) Parksville BC, Canada; Biotechnology Symposium (February 2-5, 1987), Dhaka University, Bangla Desh, Dhaka; 7th North American Conference on Mycorrhiza (May 3-8, 1987) Gainesville, Florida, USA; XIV International Botanical Congress (July 24 August 2, 1987) West Berlin, Fed. Rep. Germany; International conference on Integrated Management and Rural Development of Arid and Semi Zones (September 17-22, 1987) Yangling, Shaanxi, China; First Asian Conference on Pharmaceutical Education, Research and Drug Industry (May 26-29, 1988) National Unviersity, Singapore, Symposium on Plant Roots and their Environment (August 21-28, 1988), Agriculture University, Uppsala, Sweden; Regional Symposium on Recent Development in Tree Plantations of Humid/Subhumid Tropics of Asia (June 5-9, 1989) Selangor, Malaysia; Regional Seminar on Microbial Research (December 1-5, 1989) Royal Nepal Academy of Science and Technology, Kathmandu, Nepal; Fourth Mycorrhiza Seminar of Japan - Japan Mycorrhizal Research Society (September 16 to 22, 1990) Osaka, Japan; Asian Conference on Mycorrhizae (March 12-17, 1991) Chiang Mai, Thailand; Third International Society of Root Research Symposium on "Root Ecology and its Practical Application" (September 2-7, 1991), Vienna, Austria; International Symposium on "Rehabilitation of Tropical Rainforest Ecosystems : Research and Development Priorities" (September 2-7, 1992); Kuching, Sarawak, Malaysia; International Symposium on "MPTS for Rural Livelihood" (May 3-6, 1993), Holiday Inn, Manila, Phillippines; Third International Conference on Biodeterioration of Cultural Property (July 4-7, 1995) Bangkok, Thailand and Asian Conference on Lichenology (Dec. 27, 1996 to 3rd Jan., 1997) Kathmandu, Nepal.

**National** : National Symposium on Fungal Ecology in Relation to Human Welfare (November 28-30, 1987) Osmania University, Hyderabad; Biotechnology in Forestation, (January 14-16, 1988) TERI, Delhi; First Asian Conference on Mycorrhiza, (January 27-30, 1988) Madras; National Symposium (April 12-14, 1990), Osmania University, Hyderabad.

Following conference/seminars were organised under chairman and co-chairmanship of Professor Mukerji.

1. Mycorrhiza Round Table (March 13-15, 1987), J.N.U., New Delhi-Chairman.
2. First Asian Conference on Mycorrhiza (January 27-30, 1988), Madras, India–Co-chairman.
3. International Conference on Research in Plant Sciences and its Relevance to Future (March 7-11, 1988), Delhi–Chairman.

Professor Mukerji is a member of numerous societies and associations and also associated with these societies as :

Treasurer, Mycological Society of India, 1973-76; Member, Editorial Board, Kavaka, The Transactions of the Mycological Society of India, 1979-81; Vice-President, Mycological Society of India, 1980-81; Vice-President, Association of Tropical Microbial Ecology, 1980-84; President, Society for Advancement of Botany, 1987; President, Society for Environment Scientists, 1988-91; Member Editorial Board, Phytologia, Jour. Indian Bot. Soc. and Jour. Phytol. Research (since 1988); Chief Editor, Jour. Rec. Adv. Appl. Science (since 1988); Member, Advisory Committee, Indian J. Microbial. Ecol. (1991 - to date); Editor, Frontiers in Applied Microbiology (1985-1994); Member Advisory Board (Board of Editors) CRC Critical Reviews on Biological Control of Plant Pests, Diseases and Weeds, USA (since 1990); Councillor, International Society of Root Research (1988-91, Sweeden; 91-94, U.S.A.); Associate, Nitrogen Fixing Tree Association, U.S.A. (NFTA) (since 1990); Vice President, Council on Biodeterioration of Cultural Property (1992-1998).

Professor Mukerji has already authored or co-authored more than 400 research papers on various aspects of Mycology, Plant Pathology, Microbial Ecology and Microbial Biotechnology. He has co-authored, edited and co-edited more than 35 books on various aspects of Microbial Ecology and Microbial Biotechnology.

Professor Mukerji will complete 65 years of age on 4, May 1999. This does not mean that he has retired on this date, instead he has started a new phase of his career. A lot of credit for Professor Mukerji's success goes to his family. First and foremost of all credit goes to his mother and father, the late Mrs. Leela Mukerji and late Mr. D.N. Mukerji, his wife Mrs. Abha Mukerji and their son, through their unswering support and affection has also moulded Professor Mukerji's career.

It is a privilege to know Professor Mukerji as distinguished mycologist and microbial ecologist, a person of repute for his research contributions all over the world.

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