
Biopesticides and Biofertilizers: **Concepts, Practices and Applications**

As per 6th Dean Committee Syllabus

Biopesticides and Biofertilizers: **Concepts, Practices and Applications**

Authors

Prof. (Dr.) Nirmal Mandal

Dr. Tanmoy Sarkar



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Head Office: 90, Sainik Vihar, Mohan Garden, New Delhi, India

Corporate Office: 7/28, Room No. 208-209, Vardaan House, Mahavir Lane, Ansari Road, Daryaganj, New Delhi, India

Branch Office: 216, Flat-GC, Green Park, Narendrapur, Kolkata, India

Tel: 011-23256188, 011-45130562, 9971676330, 9582248909

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Preface

The science and practice of sustainable agriculture have entered a decisive phase where biopesticides and biofertilizers are no longer considered as supplementary, but rather as integral components of modern crop management. The growing awareness about food safety, environmental health, and ecological resilience demands the adoption of inputs that are both scientifically validated and ecologically sound. Against this backdrop, this textbook on “**Biopesticides and Biofertilizers: Concepts, Practices and Applications**” has been prepared in strict conformity with the ICAR-prescribed syllabus of the Sixth Deans’ Committee for undergraduate education in agriculture.

The book has been systematically designed to provide a balanced integration of theory and field-level applications. It covers a wide spectrum of topics across 22 comprehensive chapters, ranging from the fundamental principles of microbial bio-inputs to their industrial production, regulatory frameworks, quality control standards, and future perspectives such as genetic engineering, nanotechnology, and climate-resilient agriculture. Each chapter is written with a clear pedagogical intent, and review questions ensuring that students gain conceptual clarity, applied understanding, and problem-solving skills required for academic excellence and practical competence.

Special emphasis has been given to:

- **Scientific rigor and clarity**, ensuring the content remains comprehensive yet student-friendly.
- **Integration of classical knowledge with modern trends**, including next-generation bio-inputs, microbial consortia, and policy frameworks.
- **Teaching support tools**, such as tables, case studies, illustrations, and appendices (covering FCO standards, ICAR guidelines, and quality control charts) for effective classroom and field teaching.
- **Skill orientation**, where laboratory methods, field protocols, and entrepreneurial opportunities in bio-inputs have been systematically detailed.

The objective of this book is not only to help students prepare for examinations but also to inculcate in them a deeper appreciation of the ecological and economic significance of biopesticides and biofertilizers. By bridging the gap between theory

and practice, this work aspires to empower students to apply their knowledge in real-world agricultural systems and contribute to the national agenda of sustainable farming.

It is hoped that this book will serve as a reliable reference for undergraduate students of B.Sc. (Hons.) Agriculture, and will also be of value to postgraduates, researchers, extension workers, and policymakers engaged in sustainable agricultural development.

I place on record my deep appreciation for the students and colleagues whose feedback and encouragement guided the development of this work. Any constructive suggestions for future improvement will be most welcome.

Authors

— **Prof. (Dr.) Nirmal Mandal**

— **Dr. Tanmoy Sarkar**

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We express our sincere gratitude to the Indian Council of Agricultural Research (ICAR) for formulating the model course structure, which served as the guiding framework for this work. We are thankful to our colleagues and students for their insightful feedback, which greatly enriched the content and clarity of the text.

We also acknowledge with deep appreciation the encouragement and cooperation received from our institutions, as well as the inspiration drawn from our research collaborators and fellow academicians across the country.

Finally, we remain indebted to our family for their constant support and patience throughout the preparation of this book.

Authors

— **Prof. (Dr.) Nirmal Mandal**

— **Dr. Tanmoy Sarkar**

Abbreviations and Acronyms

AFLP	Amplified Fragment Length Polymorphism
AMF	Arbuscular Mycorrhizal Fungi
APEDA	Agricultural and Processed Food Products Export Development Authority
BCA	Biological Control Agent
BOD	Biological Oxygen Demand
Bt	<i>Bacillus thuringiensis</i>
CAZy	Carbohydrate-Active Enzyme Database
CBF	Cold-Box Fermentation
CFU	Colony Forming Unit
CGWB	Central Ground Water Board
CMC	Carboxymethyl Cellulose
CRISPR	Clustered Regularly Interspaced Short Palindromic Repeats
DGCA	Directorate General of Civil Aviation (relevant in drone applications)
DNA	Deoxyribonucleic Acid
EIA	Environmental Impact Assessment
EPS	Exopolysaccharide
FAO	Food and Agriculture Organization
FRNA	Fluorescent Reporter Nucleic Acid (biosensor applications)
GAE	Gallic Acid Equivalents (for phenolic quantification in bioformulation analysis)
GIS	Geographic Information System
GMP	Good Manufacturing Practices
GOI	Government of India
GRAS	Generally Recognized as Safe
GST	Goods and Services Tax (in market/trade discussions)
HACCP	Hazard Analysis and Critical Control Points
HPLC	High-Performance Liquid Chromatography
ICAR	Indian Council of Agricultural Research

ICBR	Incremental Cost Benefit Ratio
ICT	Information and Communication Technology
ICM	Integrated Crop Management
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IFOAM	International Federation of Organic Agriculture Movements
IGR	Insect Growth Regulator
IITA	International Institute of Tropical Agriculture
ILRI	International Livestock Research Institute
INM	Integrated Nutrient Management
IPM	Integrated Pest Management
ISO	International Organization for Standardization
ITC	Information Technology and Communication
JSA	Joint Soil Amendment (in mixed biofertilizer strategies)
LC50	Median Lethal Concentration (toxicology studies)
LD50	Median Lethal Dose
MAPs	Medicinal and Aromatic Plants
MEA	Microbial Enzyme Activity
MNPs	Metallic Nanoparticles
MoA	Mechanism of Action
MoEF&CC	Ministry of Environment, Forest and Climate Change
MSSRF	M.S. Swaminathan Research Foundation
NAAS	National Academy of Agricultural Sciences
NABARD	National Bank for Agriculture and Rural Development
NAP	National Agroforestry Policy
NAPFFR	National Action Plan for Fertilizer and Fertilizer Regulation
NBAIM	National Bureau of Agriculturally Important Microorganisms
NBPGR	National Bureau of Plant Genetic Resources
NPOP	National Programme for Organic Production
NPK	Nitrogen, Phosphorus, Potassium
OECD	Organisation for Economic Co-operation and Development
OMRI	Organic Materials Review Institute
OPV	Open Pollinated Variety
PCR	Polymerase Chain Reaction

PGPR	Plant Growth-Promoting Rhizobacteria
PGR	Plant Growth Regulator
PHC	Primary Host Colonization
PHI	Pre-Harvest Interval
PIB	Press Information Bureau
PMFME	Pradhan Mantri Formalization of Micro Food Processing Enterprises
PM-KISAN	Pradhan Mantri Kisan Samman Nidhi
PMKSY	Pradhan Mantri Krishi Sinchai Yojana
PPP	Public-Private Partnership
PR	Pathogenesis Related (proteins)
PSB	Phosphate-Solubilizing Bacteria
QTL	Quantitative Trait Loci
R&D	Research and Development
RNAi	RNA interference
RWC	Relative Water Content (in climate resilience studies)
SCM	Supply Chain Management
SDGs	Sustainable Development Goals
SHC	Soil Health Card
SIDA	Swedish International Development Cooperation Agency
SOM	Soil Organic Matter
SPF	Specific Pathogen Free
TLC	Thin Layer Chromatography
TNC	The Nature Conservancy
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
USDA	United States Department of Agriculture
UV	Ultraviolet
WHO	World Health Organization
WTO	World Trade Organization
ZBNF	Zero Budget Natural Farming

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