

**Biofertilizers :
Commercial
Production
Technology &
Quality Control**

By Somani L.L

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Biofertilizers : Commercial Production Technology and Quality Control

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PREFACE

Biofertilizers refer to preparations containing live or latent cells of efficient strains of nitrogen-fixing and phosphate solubilizing microorganisms used for application to seed, soil or composting areas with the aims of increasing the numbers of such microorganisms and accelerating certain microbial processes to augment the extent of availability of nutrients in a form which can be easily assimilated by plants.

To feed the ever increasing population and shrinking agricultural land area it is mandatory to increase soil productivity. It is being observed all over the world that the soil productivity is declined due to harmful residual effects and excess application of chemical fertilizers and pesticides. Increasing ground water pollution due to toxic chemicals of these chemical fertilizers and pesticides is also reported throughout the world. These threats compel scientists to look again in the use of chemical fertilizers and to find safe alternates to it. Besides this the present production of chemical fertilizers failed to reach the need of these fertilizers due to accelerated agricultural development. This has in turn paved the way for integrated Plant Nutrient involving judicious and integrated use of chemical/synthetic sources of nutrients along with biofertilizers and nutrients through crop residue recycling, organic manures, green manuring and wastes etc.

Nitrogen fixation through industrial process requires high temperature and pressure and thus escalating its production cost which is ultimately beard by the end-user the farmer. This nitrogen is present in atmosphere in a great amount. Microorganisms can convert this nitrogen in plant available form free of cost and thus they become cheaper to the farmer. Further, among all non-mineral sources of nutrients, only biofertilizers are based on renewable energy sources. Biofertilizers can play a very significant role in improving soil fertility by fixing atmospheric nitrogen besides solubilizing/accessing phosphate not available/inaccessible to plants. They also produce growth substances in the rhizosphere.

Threats to human health and high costs of chemical fertilizers make compulsory to return toward organic farming. The current trend is to explore the possibility of supplementing chemical fertilizers with organic ones. Microbial processes are not only quick but they have advantages of being diversified into small units to meet the demands of specific problems of location which one is apt to come across in the agricultural practices of nations which have not taken to mechanization of farming. Besides these benefits biofertilizers failed to get such popularities as that of chemical fertilizers. A number of reasons are there for it.

In view of the immense potential of biofertilizers as a nutrient source this book **Biofertilizers: Production Technology and Quality Control** have been written to provide latest know-how on the production, quality control and marketing aspects of biofertilizers. The need for such a book has been felt by the authors through numerous inquiries by cultivators and scientists interested in the overall picture of the role of microorganisms in nutrient mobilization into plants.

Because of its wide coverage, up to date information and simple language, this book will be of use and interest to students, teachers, lecturers, libraries, researchers,

biotechnologists, entrepreneurs, planners, soil scientists, microbiologists, extension specialists, environmentalists and all those interested in energy conserving and eco-friendly plant nutrient in general and biofertilizer in particular.

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In spite of our best efforts, we do not claim that the information given is exhaustive. We therefore, crave the indulgence of our vary readers in the omissions and errors in which we must have fallen inadvertently and solicit their valued suggestions towards improving the contents.

- Authors

ABOUT THE AUTHORS

Prof (Dr.) Laxmi Lal Somani (b. 1945) took his Ph. D. degree in 1974 from Sukhadia University, Udaipur. All through he holds a brilliant academic record securing distinction/honours. He went to wait Agricultural Research Institute, Adelaide, Australia for undertaking post doctoral work (1975-77). He has served the prestigious IFFCO chair (1990-2005). Dr. Somani superannuated from the position of Director of Resident Instructions in the Maharana Pratap University of Agriculture & Technology in October, 2005.

He has published 80 books and over 270 research / review / technical articles in national and international Journals of repute. He has been honoured by university Merit Award, Dhuru Morarji Memorial Prize and Vijay Shree. The world development parliament also honoured him with honorary award *DOCTOR OF SCIENCE*.

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Mrs. Deepti Shilpkar has done M.Sc. (Botany) with specialization in Biotechnology from Jai Narain Vyas University, Jodhpur (Rajasthan) and is pursuing Ph.D. in the same university. She has written one book and several research papers.

ABOUT THE BOOK

The miracle of green revolution in India is now becomes static. No new targets of food grain production have being achieved in recent pasts. On the other hand soil productivity and quality of food produced is continuously decreasing. Complains about environmental and ground water pollution is also reported due to plentiful and injudicious application of chemical fertilizers and pesticides. All these factors compel us (particularly scientists) to search alternates. One such alternate is use of biofertilizers. Application of biofertilizers to soil not only supply essential nutrients to plant but also improves soil physical, chemical and microbial properties without harming environment and ground water quality. Biofertilizer is not a new term and a lot of work has done in this area. The literature on this aspect is not only voluminous but also varied and widely dispersed in journals and reports. Since biofertilizers are live microbial inoculants so their handling, mass production, storage and application requires knowledge about basic microbial techniques. Successful application of biofertilizers depends on the environmental conditions to be provided for better microbial action. The objective of this book is to provide basic knowledge about successful microbial cultivation techniques and also to bring together the dispersed knowledge about biofertilizers at a single platform. Isolation, cultivation and identification of microorganisms are explained in the book in a lucid way with the help of process diagrams.

Book starts with the background of fertilizers. **Chapter-1** gives a brief idea about fertilizer nutrients- its essentiality and functions in plant metabolism; fertilizer related terminology; chemical fertilizers and manures- their advantages and disadvantages; sources of fertilizer nutrients; calculation of fertilizer dose to be added to soil, its application time and method; and current status of soil organic matter- factors affecting it and management practices. **Chapter-2** deals with soil microorganisms. Covering the evolutionary history of present day microorganisms the chapter contains basic information about morphological and genetic groups of bacteria, actinomycetes, fungi, algae, protozoa, viruses and frankia, found in soil and their functions. The taxonomy of these microorganisms is presented in the chapter along with diagrams showing their identifiable morphological features. Basics of biological nitrogen fixation, microorganisms involved and range of nitrogen fixed by them is explained in **Chapter-3**. **Chapter-4** describes phosphate solubilizing microorganisms (PSMs) - their isolation, identification, maintenance, mass production and field inoculation; mineralization of organic P in soil- mechanisms and factors affecting it; and role of PSMs in solubilization of organic P. Study of microbiology requires sound knowledge about microscope. **Chapter-5** contains basic information about microscope and microscopy. Bright field, dark field, phase contrast and fluorescence microscopy is explained in detail with self explanatory diagrams. Microscopic measurement technique is also discussed. Microbial culture techniques are explained in **Chapter-6**. Starting with media-its types, the step-by-step procedures for bacterial smear preparation, staining and, isolation and culturing of pure microbial cultures are explained with the help of diagrams. Morphological, cultural and physiological characteristics of microorganisms, useful for identification of microorganisms, are also described in this chapter. Various enumeration techniques for free-living and symbiotic- nitrogen fixers, frankia, vesicular-arbuscular mycorrhiza (VAM), algae and cyanobacteria are explained in **Chapter-7**. **Chapter-8** describes basic microbial techniques used for isolation, identification, cultivation and storage of

rhizobium, frankia, VAM, ectomycorrhiza (ECM) and cyanobacteria. To judge the potentiality of biofertilizers applied to soil, it is essential to estimate the quantity of nitrogen fixed in plants by them. This estimation is done by various assays including acetylene reduction, nitrogen difference, total nitrogen, protein and non-protein assay and isotope techniques. These assay methods and techniques are described in step-by-step manner in **Chapter-9**. Inoculum production techniques for rhizobium, frankia, VAM and ECM biofertilizers along with their application methods are discussed in **Chapter-10**. To avoid malpractices in biofertilizer products it is essential to check their quality at different stages of manufacturing. Various quality tests procedures and Indian Standards of Specifications for rhizobium, PSMs, Azotobacter, Azospirillum, and cyanobacteria inoculants are explained in **Chapter-11**. Assessment of inoculation of rhizobia, frankia, VAM, algae and cyanobacteria is done by various methods explained in **Chapter-12**. Mycorrhiza is discussed in detail in **Chapter-13**. It includes classification of mycorrhiza, identification of mycorrhizal associations, and sources of mycorrhiza. Both VAM and ECM are described. **Chapter-14** explains mechanisms of dinitrogen fixation in rhizobium, Azotobacter and blue green algae. Crop responses and changes in soil physic-chemical properties due to biofertilizers application are presented in **Chapter-15**. It contains research findings of various workers on above aspects. Constraints to poor response of farmers to biofertilizers and effective marketing strategies for it are discussed in **Chapter-16**. Most probable number count technique is explained in Appendix A.

Authors strongly believe that the book will serve as milestone in the field of biofertilizer production technology and marketing. The book guides planners, industrialists, research scholars and farmers working in the field of biofertilizers. The book is equally useful for students of microbiology at graduate and post-graduate levels. The book is also useful for students appearing in entrance exams of different universities in India for higher studies in the fields of agriculture, microbiology, food and biotechnology.

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