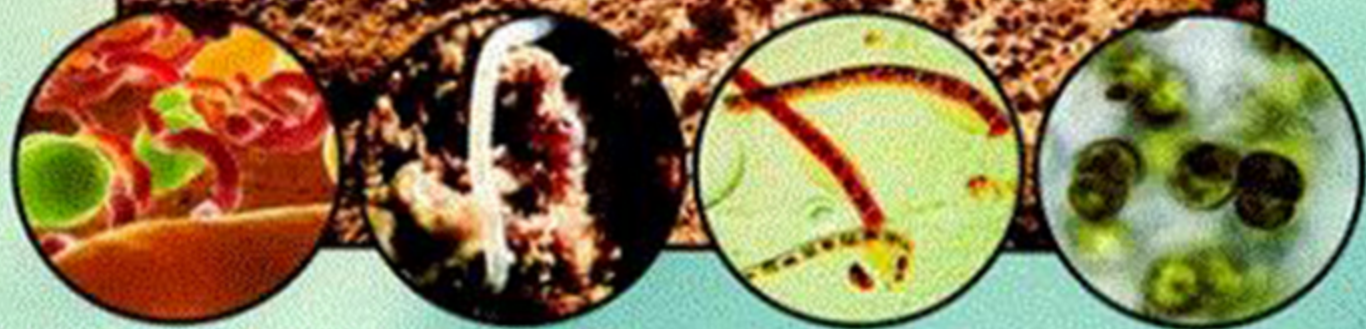


SOIL MICROBIOLOGY



SINGH, PUROHIT, PARIHAR

Soil Microbiology

Tanuja Singh

*Department of Botany
B.M.D. College,
Dayalpur, Vaishali (Bihar)*

S. S. Purohit

*Ex-Head
PG Department of Botany
Dungar College, Bikaner*

Pradeep Parihar

*Department of Biotechnology
Lovely Professional University
Jalandhar-Ludhiana G. T. Road
Phagwara, Punjab (India) - 144402*



Published by:

AGROBIOS (INDIA)

Agro House, Behind Nasrani Cinema

Chopasani Road, Jodhpur 342 002

Phone: 91-0291-2642319, Fax: 2643993

E. mail: agrobios@sify.com; info@agrobiosindia.com

Web Site: agrobiosindia.com



Agrobios (India)

© All Rights Reserved (2010)

All rights reserved. No part of the book or part thereof, including the title of the book, be reprinted in any form or language without the written permission of the author and the publishers. The copyists shall be prosecuted.

ISBN No. (10): 81-7754-390-3

ISBN No. (13): 978-81-7754-390-2

Price: Rs. 1200.00 / US\$ 60.00

Published by: Dr. Updesh Purohit for Agrobios (India), Jodhpur

Lasertypeset at: Yashee Computers & Printers, Jodhpur

Cover Design by: Reena

Printed at: Bharat Printers, Jodhpur

Preface

Soil is nature's gift to mankind let us nurture it. The soil performs a variety of key functions: (i) provides food, fuel, and fiber needs of the world's population, (ii) regulates the quality of the air and water, (iii) decomposes organic wastes, (iv) recycles nutrients, and (v) acts as a sink for pollutants (including global gases), etc. A soil usually containing more than 20 per cent of organic matter, or have more than half of the upper 80 cm as organic material. Also, if organic soil material of any thickness rests on rock or fragmental (rocky or gravelly) material, it is considered as organic soil. The organic residues of plants and animals (both macro and micro), decay with time and become an integral part of the soil. The main source of soil organic matter is the plant tissue. The animals consume the plants, excrete their waste products and contribute their own bodies after death. Thus they are subsidiary source of soil organic matter. The decomposed organic residues present in soil are called humus. It is amorphous and dark coloured fraction of soil organic matter which remains after the major portion of added residues have decomposed.

The soil is a complex environment colonized by an immense diversity of microorganisms. Soil microbiology focuses on the soil viruses, bacteria, actinomycetes, fungi, algae and protozoa, but it has traditionally also included investigations of the soil animals such as the nematodes, mites, and other microarthropods. These organisms, collectively referred to as the soil biota, function in a belowground ecosystem based on plant roots and litter as food sources. Modern soil microbiology represents an integration of microbiology with the concepts of soil science, chemistry, and ecology to understand the functions of microorganisms in the soil environment. The surface layers of soil contain the highest numbers and variety of microorganisms, because these layers receive the largest amounts of potential food sources from plants and animals. The soil biota form a belowground system based on the energy and nutrients that they receive from the decomposition of plant and animal tissues. The primary decomposers are the bacteria and fungi.

Microorganisms help soil development by slowly decomposing organic matter and forming weak acids that dissolve minerals faster than pure water. Some of the first plants to grow on weathering rocks are crust like lichens, which are a beneficial (symbiotic) combination of algae and fungi.

Soil microorganisms play key roles in the nitrogen cycle. The atmosphere is approximately 80% nitrogen gas (N_2), a form of nitrogen that is available to plants only when it is transformed to ammonia (NH_3) by either soil bacteria (N_2 fixation) or by humans (manufacture of fertilizers). Soil bacteria also mediate denitrification, which returns nitrogen to the atmosphere by transforming NO_3^- to N_2 or nitrous oxide (N_2O)

gas. Microorganisms are crucial to the cycling of sulfur, phosphorus, iron, and many micronutrient trace elements.

Present book has been designed to provide overall information to the readers about soil, soil microflora and their activities in chapters like, The Soil, Soil ecosystem and soil microbes, Taxonomy of Microorganisms, Microbial Biodiversity: The Natural Biological Capital of the Earth, Growth patterns of mixed population, Bacteria, Archaeobacteria and Actinomycetes, Actinoplanetes, Fungi, Algae, Nematodes, Protozoa in soil, The Rhizosphere, Chemical Interactions in Soil of biological origin, The Biofilm, Humus and Humic Substances, Soil microbes and Nitrogen fixation, Carbon Cycle and Microbes, Sulphur Cycle and Microbes, Iron cycle, Microbial Inoculants for Nitrogen Fixation, *Rhizobium* Biofertilizer, Application of Microbial Biofertilizers in Field Crops, Production of *Rhizobium* Biofertilizer, *Azospirillum* Biofertilizer, *Azotobacter* Biofertilizer, Blue Green Algae and *Azolla* as Biofertilizer, Estimation of Nitrogen Fixation, Biological Mobilization of Phosphorus, Vesicular-Arbuscular Mycorrhizae (VAM), The Cyclic System of Nutrient Management, Laboratory Culture of Microbial Biofertilizers, Mass Production of Biofertilizers, Quality Control in Bioinoculants, Perspectives and Selected Bibliography.

We hope that the information in this book would be valuable to all those concerned with the soil and its microbiology. We deeply value the efforts made by Dr. Updesh Purohit, Agrobios (India) to publish this book in time.

We express our gratitude to the researchers who have done tremendous job to develop the concepts of soil microbiology with new applications. Healthy criticisms for further improvement of the book are solicited.

Authors

Contents

1	The Soil	1
	Historical.....	2
	Soils	3
	<i>Parent Material</i>	3
	<i>Regolith</i>	4
	<i>Composition of Soil</i>	5
	<i>Soil Separates (Mineral Matter)</i>	5
	<i>Soil Organic Matter</i>	7
	Soil Formation	8
	<i>Materials for Soil Formation</i>	9
	<i>Soil Forming Minerals</i>	9
	<i>Weathering of Rocks and Minerals</i>	10
	<i>Soil Formation: Factors</i>	12
	<i>Changes during Soil Formation or Types of Soil Forming Processes</i>	15
	<i>Soil Forming or Pedogenic Processes</i>	15
	The Soil Profile and its Layers.....	18
	Physical Properties of Soil.....	19
	<i>Soil Texture</i>	19
	<i>Soil Structure</i>	21
	<i>Soil Density</i>	23
	<i>Soil Porosity and Permeability</i>	23
	<i>Soil Air</i>	24
	<i>Soil Temperature</i>	24
	<i>Soil Colour</i>	25
	<i>Soil Water</i>	25
	<i>Other Soil Physical Properties</i>	28
	Soil Colloids and Chemical Properties.....	29
	<i>Organic Colloids (Humus)</i>	29
	The Soil Reaction (pH)	31
	Soil Classification and Soil Survey	31
	<i>Soil Survey</i>	33
2	Soil Ecosystem and Soil Microbes	35
	The Soil Ecosystem	35

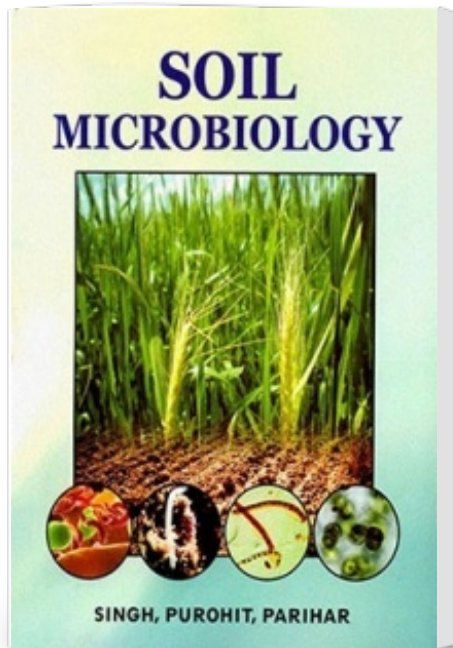
Soil Life	38
Soil Microbes.....	39
The Microbial Community of the Soil Ecosystem.....	41
Soil Food Web.....	43
<i>Interaction of Organisms in Soil Food Web</i>	44
<i>Habitat of Soil Organisms</i>	45
Ecological Significance of Soil Microorganisms	47
<i>Microbiological Products which Influence Plant Growth</i>	48
<i>Factors Affecting Rates of Changes in Soil Bacterial Communities</i>	50
<i>Techniques</i>	50
Microbial Biodiversity in the Soil	50
Microbial Diversity and Soil Health	52
<i>Beneficial Microbes Improve Soil Health</i>	52
Interactions with other Competing Organisms.....	53
<i>Soil Microbes Encountering Hosts</i>	54
Pollution Effects (mainly Heavy Metals) on the Soil Microbial Community	55
3 Taxonomy of Microorganisms	57
Lower Protists (Prokaryota)	57
Taxonomy and Classification of Prokaryotes.....	58
What is Taxonomy?.....	60
<i>Systematics</i>	60
<i>Taxonomic Ranks</i>	60
Binomial System	61
Major Characteristics Used in Taxonomy.....	62
<i>Morphological Characteristics</i>	62
<i>Physiological and Metabolic Characteristics</i>	62
<i>Genetic Analysis</i>	63
<i>Molecular Characteristics</i>	63
<i>Comparison of Proteins</i>	63
<i>Antibody-antigen Reactions in Vitro</i>	63
<i>Nucleic Acid Base Composition</i>	63
<i>Nucleic Acid Hybridization</i>	64
<i>Nucleic Acid Sequencing</i>	64
Classification Systems	64
<i>Natural Classification</i>	64
<i>Phyletic Classification</i>	65
<i>Numerical Taxonomy</i>	65
Applications of Molecular Biology to Taxonomy.....	65
<i>DNA Hybridization</i>	66
<i>DNA-Ribosomal RNA Hybridization</i>	66
<i>Ribosomal RNA in Microbial Taxonomy</i>	67
<i>Methods Used to Study the Molecular Architecture of the Prokaryotic Cell</i>	68
Phenetic Classification and Bergey's Manual.....	69
A New Kingdom of Organisms?	70
The Kingdoms of Organisms	70

<i>Demerits of Five-kingdom System</i>	71
The Six-Kingdom System	72
<i>Cavalier-Smith's Eight-kingdom System</i>	72
Prochloron	73
Monstrous Microbe (<i>Epulopiscium fishelsoni</i>)	73
4 Microbial Biodiversity: The Natural Biological Capital of the Earth	74
Factors Affecting Microbial Diversity	75
Soil, Microbial Diversity, and Community Structure	75
Biodiversity at Different Levels	77
Ecosystem Diversity in India	78
<i>Species Diversity</i>	78
Microbial Biodiversity and Environment	78
Variations Found in Bacteria	79
<i>Groups of Bacterial Diversity</i>	79
Archaeal Diversity	80
Biodiversity of Eukaryotic Microorganisms (Fungi, Algae and Protozoa)	81
Evolution, Adaptability and Biodiversity	81
<i>Bacterial Progenitor</i>	82
<i>Microorganisms from Cell Organelle</i>	82
<i>Mitochondria are the Descended form of Bacteria?</i>	83
Evolution of Mitochondria in Protozoa	83
<i>The Endosymbiotic Hypothesis</i>	83
<i>Cytoplasmic Membrane and Adaptability and Diversity</i>	83
<i>Radiation Resistant Bacteria</i>	84
5 Growth Patterns and Interactions of Mixed Populations	85
Neutralism	85
Competition	86
Mutualism	86
Synergism	88
Commensalism	89
Ammensalism	89
Parasitism and Predation	91
Enrichment Culture	92
<i>Selective Media</i>	92
<i>Media with the Minimal Requirements</i>	92
<i>Media with Selective Inhibitors</i>	92
Enrichment of Microbes in the Soil	93
<i>Enrichment of Nitrogen-Fixing Microbes</i>	93
<i>Enrichment of Clostridium</i>	93
<i>Enrichment of Some Other Chemoheterotrophs</i>	93
<i>Enrichment of Phototrophs</i>	93
<i>Winogradsky Column and Kobayashi-Okuda's Model</i>	94
<i>Kobayashi-Okuda's Model</i>	95

<i>Enrichment of Microbes in Continuous Culture</i>	95
Soil Percolation	95
<i>A Concept of Soil Saturated with Bacteria</i>	96
Other Factors	98
<i>Predaceous Fungi</i>	98
<i>The Protozoan Hypothesis of the Microbial Equilibrium in the Soil</i>	98
6 Chemical Interactions of Biological Origin in Soil	99
Interactions among Organisms.....	100
<i>Secondary Metabolites in Soil</i>	100
Seed Exudates	101
<i>Chemical Composition of Seed Exudates</i>	101
Root Exudates	108
<i>Functions of Root Exudates</i>	108
<i>Chemical Composition of Root Exudates</i>	109
Soil Protein	115
<i>Glomalin</i>	116
<i>Bt Protein</i>	116
Soil Enzymes.....	116
<i>Factors Affecting Soil Enzyme Activity</i>	117
Microbial Interactions in The Soil	119
<i>Antibiotics</i>	119
<i>Vitamins</i>	119
<i>Mycostasis</i>	120
<i>Mycolysis</i>	120
Soil Contaminants and Microbial Growth.....	121
7 The Biofilm.....	123
Formation of Biofilm on glass	124
Biochemistry and Interactions in Biofilms.....	125
8 Humus and Humic Substances.....	126
Mechanism of Humus Formation	127
Humic Substances	129
Types of Humic Substances.....	130
9 Soil Bacteria	134
Characteristics of Bacteria.....	135
Types of bacteria.....	135
Management of Bacteria	139
Number of Bacteria in Soil.....	139
How Much Space is Occupied by Bacteria in Soil	140
10 Archaeobacteria, Actinomycetes, and Actinoplanetes in Soil	142
Archaeobacteria	142
<i>General Characteristics</i>	143

<i>Extremely Thermophilic and Hyperthermophilic S^o-Metabolizers</i>	147
<i>Extremely Halophilic, Aerobic Archaeobacteria (Halobacteria)</i>	148
<i>Archaeal Sulfate Reducers</i>	148
<i>Cell Wall-less Archaeobacteria</i>	148
Actinomycetes	149
<i>Actinomycetes: General Characteristics</i>	149
<i>Actinomycetes: Practical Significance</i>	151
<i>Nocardioform Actinomycetes</i>	152
<i>Genus Nocardia</i>	152
<i>Actinomycetes with Multilocular Sporangia</i>	153
Actinoplanetes.....	153
<i>Streptomyces and Related Genera</i>	154
<i>Ecological Significance</i>	155
Actinobacteria in Soil	155
11 Algae in Soil	158
Introduction	158
Benefits of Soil Algae	159
Green Algae	159
<i>Chlamydomonas mexicana</i>	160
Blue Green Algae	160
<i>Nostoc</i>	161
<i>Anabaena</i>	162
<i>Tolypothrix</i>	162
<i>Scytonema</i>	163
Soil Diatoms	164
12 Fungi in Soil.....	166
Distribution of Soil Fungi	166
Groups of Fungi	167
<i>Decomposers</i>	167
<i>Mutualists</i>	167
<i>Mycorrhizal fungi</i>	167
<i>Pathogens</i>	168
Lifestyles of Soil Fungi	168
<i>Ruderals</i>	168
Common Genera of Soil Fungi.....	171
Benefits of Soil Fungi	173
<i>Fungal Associations</i>	176
13 Nematode in Soil.....	177
Distribution in soil.....	177
Types of Nematodes	179
<i>Herbivores</i>	179
<i>Bacterivores</i>	179
<i>Fungivores</i>	179

Soil Microbiology



Publisher : Agrobios
Publications

ISBN : 9788177543902

Author : T Singh, S S
Purohit And P Parihar

Type the URL : <http://www.kopykitab.com/product/6884>



Get this eBook