

## **B. Sc. (Hons) Agriculture**

### **Plant Pathology**

- **Syllabus**
- **Teaching Schedule**
- **Suggested Reading**

## Plant Pathology

<b>Sr. No.</b>	<b>Semester</b>	<b>Course No.</b>	<b>Credits</b>	<b>Course Title</b>
1	I	MIBO 111	2(1+1)	Introductory Microbiology
2	II	PATH 121	3(2+1)	Fundamentals of Plant Pathology
3	II	PATH 232	2(1+1)	Principles of Integrated Disease Management
4	IV	ELE PATH 243	3(2+1)	Biofertilizers, Biocontrol Agents and Biopesticides
5	V	PATH 354	3(2+1)	Diseases of Field and Horticultural Crops and their Management – I
6	VI	PATH 365	3(2+1)	Diseases of Field and Horticultural Crops and their Management-II
7	VIII	ELM PATH 486	10(0+10)	Mushroom Cultivation Technologies

<b>Course :</b>	MIBO 111		<b>Credit:</b>	2(1+1)	<b>Semester-I</b>
<b>Course title:</b>	Introductory Microbiology				

## Syllabus

### Theory

Introduction. Microbial world: History of Agril. Microbiology, Prokaryotic and eukaryotic microbes. Bacteria: cell structure, chemoautotrophy, photo autotrophy, growth. Bacterial nutrition: classification of nutrients Macroelements, Microelements, growth factors, culture media, nutritional classification of microorganisms Bacterial genetics: Genetic recombination- transformation, conjugation and transduction, plasmids, transposon.

Role of microbes in soil fertility and crop production: Carbon, Nitrogen, Phosphorus and Sulphur cycles. Biological nitrogen fixation- symbiotic, associative and asymbiotic. Azolla, blue green algae and mycorrhiza. Rhizosphere and phyllosphere. Microbes in human welfare: silage production, biofertilizers, biopesticides, biofuel production and biodegradation of agro-waste. **Mushrooms- edible and poisonous types, nutritive values, Culturing and production techniques.**

### Practical

Introduction to microbiology laboratory and its equipments; Microscope- parts, principles of microscopy, resolving power and numerical aperture. Methods of sterilization. Nutritional media and their preparations. Enumeration of microbial population in soil- bacteria, fungi, actinomycetes. Methods of isolation and purification of microbial cultures. Isolation of *Rhizobium* from legume root nodule. Isolation of *Azotobacter* from soil. Isolation of *Azospirillum* from roots. Isolation of BGA. Staining and microscopic examination of microbes. Simple Staining, Negative staining and Gram Staining. Isolation of P and silicon Solubilizing Microbes, Mycorrhiza, Isolation of cellulose and Pectin degrading microbes for agro waste management

## Teaching Schedule

### a) Theory

Lecture	Topic	Weightages (%)
1	Microbiology: Introduction, Scope in Agriculture and allied fields.	5
2	History of Agricultural Microbiology, development of Microbiology. Development of Microscope	5
3	Microbial World: Prokaryotic and eukaryotic microorganisms.	6
4	Bacteria: cell structure, morphology, cytology and other characters, functions of external and internal parts.	6
5	Bacteria: Nutrients required for growth of bacteria, chemoautotrophy, photo autotrophy, Microbial growth	6
6	Bacterial genetics: Genetic recombination- Gene transfer by transformation, conjugation and transduction, Plasmids,	8
7	Role of microbes in soil fertility and crop production. Microbial transformation of Nitrogen, Biological nitrogen fixation- symbiotic, asymbiotic and associative, Azolla, blue green algae.	8
8	Microbial transformation of phosphorus, sulphur and carbon, decomposition of organic matter	11
9	Mycorrhiza: structure, types, merits, demerits	5
10	Rhizosphere and Phylloshere: Rhizosphere concept, microbes of Rhizosphere, Phylloshere: Phyllospheric microflora	6
11	Silage production, single cell protein, Bio-fuel production- concept	8
12	Biofertilizers: definition, types of biofertilizers,	6
13	Bio-pesticides- Microbial insecticides	4
14	Biodegradation of agro-waste	5
15	Mushrooms- edible and poisonous, culturing and production	6
16	Microbes in human welfare:	5
	<b>Total</b>	<b>100</b>

### b) Practical

Experiment	Topic
1	Acquaintance with microscope and other lab equipments
2	Methods of sterilization
3	Nutritional media and their preparations.
4	Enumeration of microbial population in soil- bacteria, fungi, actinomycetes.
5	Methods of isolation and purification of microbial cultures.
6	Isolation of <i>Rhizobium</i> from legume root nodule.
7	Isolation of <i>Azotobacter</i> from soil.
8	Isolation of <i>Azospirillum</i> from roots.
9	Isolation of BGA
10	Simple staining of bacteria

Experiment	Topic
11	Gram staining of bacteria
12	Isolation of P and silicon Solubilizing Microbes
13	Isolation of Potash solubilising Microbes
14	Isolation of Mycorrhiza
15	Isolation of cellulolytic microbes for agro waste management
16	Isolation of Pectin degrading microbes for agro waste management

### Suggested Readings

1. M T Madigan, and J M Martinko, 2014. *Biology of Microorganisms* 14<sup>th</sup>Edn.
2. Pearson.M J Pelczer, 1998. *Microbiology* 5<sup>th</sup>Edn. Tata McGraw Hill Education Pvt. Ltd.
3. Strainer, R, 1987. *General Microbiology*. Palgrave Macmillan.EdwardAlchano, 2002. *Introduction to Microbiology*.Jones and Bartlett hearing.
4. R P Singh, 2007. *General Microbiology*. Kalyani Publishers.
5. J Heritage, E G V Evans, R A Killington, 2008. *Introductory Microbiology*. Cambridge University press P. date.
6. Pelczar, jr.M.J.E.C.S.Chan and Krieg, N.R. 1996. *Microbiology*. McGraw Hill Publishers, Newyork.
7. Prescott, L.M. Harley, J.P. and Klein, D.A (5ed) 2002. *Microbiology*. McGraw Hill Publishers, Newyork.
8. Jamaluddin, M. Malvidya, N. and Sharma, A. 2006. *General Microbiology*. Scientific Publishers, Washington.
9. Sullia, S.B, and Shantaram 1998. *General Microbiology*. Oxford and IBH.
10. Borkar,S,G, and Patil N.M. 2016.Mushroom,A nutritive food and its cultivation. Astral International Pvt.Ltd,New Delhi
11. Borkar,S.G. 2015.Beneficial Microbes as Biofertilizers and its Production Technology Woodhead Publisher,I ndia,New Delhi
12. Madigan, M. Martinkoj, M. and Parker (10 ed.) 2003. *Biology of Microorganisms*. Prentice Hall of India Pvt. Ltd., New Delhi.

<b>Course :</b>	PATH 121		<b>Credit:</b>	3(2+1)	<b>Semester-II</b>
<b>Course title:</b>	Fundamentals of Plant Pathology				

## Syllabus

### Theory

Introduction: Importance of plant diseases, scope and objectives of Plant Pathology. History of Plant Pathology with special reference to Indian work. Terms and concepts in Plant Pathology. Pathogenesis. Cause and classification of plant diseases. Important plant pathogenic organisms, different groups: fungi, bacteria, fastidious vesicular bacteria, Phytoplasmas, spiroplasmas, viruses, viroids, algae, protozoa, phanerogamic parasites and nematodes with examples of diseases caused by them. Diseases and symptoms due to abiotic causes. Fungi: general characters, definition of fungus, somatic structures, types of fungal thalli, fungal tissues, modifications of thallus, reproduction (asexual and sexual). Nomenclature, Binomial system of nomenclature, rules of nomenclature, classification of fungi. Key to divisions, sub-divisions, orders and classes. Bacteria and mollicutes: general morphological characters. Basic methods of classification and reproduction. Viruses: nature, architecture, multiplication and transmission. Study of phanerogamic plant parasites. Nematodes: General morphology and reproduction, classification, symptoms and nature of damage caused by plant nematodes (*Heterodera*, *Meloidogyne*, *Anguina* etc.) Principles and methods of plant disease management. Nature, chemical combination, classification, mode of action and formulations of fungicides and antibiotics.

### Practical

Acquaintance with various laboratory equipments and microscopy. Preparation of media, isolation and Koch's postulates. General study of different structures of fungi. Study of symptoms of various plant diseases. Study of representative fungal genera. Staining and identification of plant pathogenic bacteria. Transmission of plant viruses. Study of phanerogamic ant parasites. Study of morphological features and identification of plant parasitic nematodes. Extraction of nematodes from soil. Study of fungicides and their formulations. Methods of pesticide application and their safe use. Calculation of fungicide sprays concentrations.

## Teaching Schedule

### a) Theory

Lecture	Topic	Weightage (%)
1	Importance of plant diseases, scope and objectives of Plant Pathology.....	3
2	History of Plant Pathology with special reference to Indian work	3
3,4	Terms and concepts in Plant Pathology, Pathogenesis	6
5	classification of plant diseases	5
6,7, 8	Causes of Plant Disease Biotic (fungi, bacteria, fastidious vesicular bacteria, Phytoplasmas, spiroplasmas, viruses, viroids, algae, protozoa, and nematodes ) and abiotic causes with examples of diseases caused by them	10
9	Study of phanerogamic plant parasites.	3
10, 11	Symptoms of plant diseases	6
12,13, 14	Fungi: general characters, definition of fungus, somatic structures, types of fungal thalli, fungal tissues, modifications of thallus,	7
15	Reproduction in fungi (asexual and sexual).	4
16, 17	Nomenclature, Binomial system of nomenclature, rules of nomenclature,	6
18, 19	Classification of fungi.Key to divisions, sub-divisions, orders and classes.	6
20, 21, 22	Bacteria and mollicutes: general morphological characters. Basic methods of classification and reproduction in bacteria	8
23,24, 25	Viruses: nature, architecture, multiplication and transmission	7
26, 27	Nematodes: General morphology and reproduction, classification of nematode Symptoms and nature of damage caused by plant nematodes (Heterodera, Meloidogyne, <i>Anguina</i> etc.)	6
28, 29, 30	Principles and methods of plant disease management.	6
31, 32, 33	Nature, chemical combination, classification of fungicides and antibiotics.	7
34, 35, 36	Mode of action and formulations of fungicides and antibiotics.	7
<b>Total</b>		<b>100</b>

### b) Practical

Experiment	Topic
1.	Acquaintance with various laboratory equipments and microscopy
2.	General study of different structures of fungi.
3.	Study of symptoms of various plant diseases.
4.	Study of representative fungal genera
5.	Staining and identification of plant pathogenic bacteria
6	Study of phanerogamic plant parasites
7	Transmission of plant viruses
8	Study of morphological features and identification of plant parasitic

Experiment	Topic
	nematodes.
9	Preparation of media
10	Isolation and purification of fungi and bacteria
11	Extraction of nematodes from soil
12	Koch's postulates
13	Study of fungicides and their formulations
14	Methods of pesticide application and their safe use
15	Calculation of fungicide sprays concentrations.
16	Collection and preservation of disease specimen

### Suggested Readings

- 1) Pathak, V. N. Essentials of Plant Pathology. Prakash Pub., Jaipur
- 2) Agrios, GN. 2010. *Plant Pathology*. Acad. Press.
- 3) Kamat, M. N. Introductory Plant Pathology. Prakash Pub, Jaipur
- 4) Singh RS. 2008. *Plant Diseases*. 8<sup>th</sup> Ed. Oxford & IBH.Pub.Co.
- 5) Singh RS. 2013. *Introduction to Principles of Plant Pathology*. Oxford and IBH Pub.Co.
- 6) Alexopoulos, Mims and Blackwel. Introductory Mycology
- 7) Mehrotra RS & Aggarwal A. 2007. *Plant Pathology*. 7<sup>th</sup> Ed. Tata McGraw Hill Publ. Co. Ltd.
- 8) Gibbs A & Harrison B. 1976. *Plant Virology - The Principles*. Edward Arnold, London.
- 9) Hull R. 2002. *Mathew.s Plant Virology*. 4th Ed. Academic Press, New York.
- 10) Verma JP. 1998. *The Bacteria*. Malhotra Publ. House, New Delhi.
- 11) Goto M. 1990. *Fundamentals of Plant Bacteriology*. Academic Press, New York.
- 12) Dhingra OD & Sinclair JB. 1986. *Basic Plant Pathology Methods*. CRC Press, London, Tokyo.
- 13) Nene YL & Thapliyal PN. 1993. *Fungicides in Plant Disease Control*. 3rd Ed. Oxford & IBH, New Delhi.
- 14) Vyas SC. 1993. *Handbook of Systemic Fungicides*. Vols. I-III. Tata McGraw Hill, New Delhi.
- 15) Rajeev K & Mukherjee RC. 1996. *Role of Plant Quarantine in IPM*. Aditya Books.
- 16) Rhower GG. 1991. *Regulatory Plant Pest Management*. In: *Handbook of Pest Management in Agriculture*. 2nd Ed. Vol. II. (Ed. David Pimental). CRC Press.
- 17) Singh RS & Sitaramaiah K. 1994. *Plant Pathogens – Nematodes*. Oxford & IBH, New Delhi.
- 18) Thorne G. 1961. *Principles of Nematology*. McGraw Hill, New Delhi.
- 19) Walia RK & Bajaj HK. 2003. *Text Book on Introductory Plant Nematology*. ICAR, New Delhi.



<b>Course :</b>	PATH 232		<b>Credit:</b>	2(1+1)	<b>Semester-III</b>
<b>Course title:</b>	Principles of Integrated Disease Management				

## Syllabus

### Theory

IPM: Introduction, history, importance, concepts, principles and tools of IPM. Economic importance of diseases and pest risk analysis. Methods of detection and diagnosis of diseases. Measurement of losses caused due to diseases. Methods of control: Host plant resistance, cultural, mechanical, physical, legislative, biological and chemical control. Ecological management of crop environment. Introduction to conventional pesticides for the disease management. Survey surveillance and forecasting of plant diseases. Development and validation of IPM module. Implementation and impact of IPM (IPM module for diseases). Safety issues in pesticide uses. Political, social and legal implication of IPM. Case histories of important IPM programmes.

### Practical

Methods of diagnosis and detection of various plant diseases, Methods of plant disease measurement, Assessment of crop yield losses, calculations based on economics of IPM, Identification of biocontrol agents, Mass multiplication of *Trichoderma*, *Pseudomonas*, NPV etc. identification of diseases and their management. Crop (agro-ecosystem) dynamics of selected diseases. Plan & assess preventive strategies (IPM module) and decision making. crop monitoring attacked by diseases . Awareness campaign at farmers' fields.

### Teaching Schedule

#### a) Theory

Lecture	Topic	Weightage (%)
1	IPM: Introduction, history, importance, concepts.	8
2	Principles and tools of IPM	8
3	Economic importance of diseases	6
4	Pest risk analysis	6
5	Methods of detection and diagnosis of diseases	6
6	Measurement of losses caused due to diseases	6
7	Methods of control: Host plant resistance, cultural, mechanical, physical,	6
8	Legislative, biological and chemical control	6
9	Ecological management of crop environment	6
10	Introduction to conventional pesticides for the disease management	6
11	Survey surveillance and forecasting of plant diseases	6
12	Development and validation of IPM module	6
13	Implementation and impact of IPM (IPM module for diseases)	6
14	Safety issues in pesticide uses	6
15	Political, social and legal implication of IPM	6
16	Case histories of important IPM programmes	6
	<b>Total</b>	<b>100</b>

**b) Practical**

Experiment	Topic
1	Methods of diagnosis various plant diseases,
2,3	Methods of detection of various plant diseases
4,5	Methods of plant disease measurement
6	Assessment of crop yield losses
7	calculations based on economics of IPM
8	Identification of biocontrol agents
9	Mass multiplication of <i>Trichoderma</i> ,
10	Mass multiplication of <i>Pseudomonas</i> ,
11	Mass multiplication of NPV
12	Identification of diseases and their management
13	Crop (agro-ecosystem) dynamics of selected diseases
14	Plan & assess preventive strategies (IPM module) and decision making
15	Crop monitoring attacked by diseases
16	Awareness campaign at farmers fields.

**Suggested Readings**

- 1) Singh RS. 2013. *Introduction to Principles of Plant Pathology*. Oxford and IBH Co., New Delhi.
- 2) Pathak, V. N. *Essentials of plant pathology*. Prakash Pub., Jaipur
- 3) Agrios, G. N. *Plant Pathology*. 5<sup>th</sup> edition, Published by a division of Reed Elsevier India Pvt., Ltd., New Delhi (2005)
- 4) Kamat, M. N. *Introductory Plant Pathology*. Prakash Pub, Jaipur
- 5) Stakman EC & Harrar JG. 1957. *Principles of Plant Pathology*. Ronald Press, USA.
- 6) Tarr SAJ. 1964. *The Principles of Plant Pathology*. McMillan, London.
- 7) Vander Plank, JE. 1975. *Principles of Plant Infection*. Acad. Press
- 8) Verma JP, Varma A & Kumar D. (Eds). 1995. *Detection of Plant Pathogens and their Management*. Angkor Publ., New Delhi
- 9) Mehrotra RS & Aggarwal A. 2003. *Plant Pathology*. 2nd Ed. Oxford & IBH,
- 10) Dhingra OD & Sinclair JB. 1986. *Basic Plant Pathology Methods*. CRC Press
- 11) Fox RTV. 1993. *Principles of Diagnostic Techniques in Plant Pathology*. CAB International & Thapliyal PN. 1993. *Fungicides in Plant Disease Control*. Oxford & IBH, New Delhi.
- 12) Palti J. 1981. *Cultural Practices and Infectious Crop Diseases*. Springer-Verlag, New York.
- 13) Vyas SC. 1993 *Handbook of Systemic Fungicides*. Vols. I-III. Tata McGraw
- 14) Rajeev K & Mukherjee RC. 1996. *Role of Plant Quarantine in IPM*. Aditya Books.
- 15) Rhower GG. 1991. *Regulatory Plant Pest Management*. In: *Handbook of Pest Management in*
- 16) *Agriculture*. 2nd Ed. Vol. II. (Ed. David Pimental). CRC Press.

<b>Course :</b>	ELE PATH 243		<b>Credit:</b>	3(2+1)	<b>Semester-IV</b>
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<b>Course title:</b>	Biofertilizers, biocontrol agents and biopesticides
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## Syllabus

### Theory

Biofertilizers: Introduction and types and importance of biofertilizers, Biopesticides and bioagents in agriculture and organic farming system, History of biofertilizers production Classification of biofertilizers microorganisms used in biofertilizers production. A study of growth characteristics of various microbes used in biofertilizers production. Nitrogen cycle in Nature. Process of nodule formation ,Role of Nif and Nod gene in Biological Nitrogen fixation, Enzyme nitrogenase and its component, Biochemistry of nitrogen fixation, Cross inoculation groups amongst *Rhizobium*, Methods used for the studying selection of efficient strain of *Rhizobium* .Quality standard for biofertilizers different methods of application of biofertilizers, role of microorganisms in decomposition of organic farm wastes, methods of quality control assessment in respect of biofertilizers, Strategies of Mass multiplication and packing Registration of biofertilizers. Strategies of marking and Registration with CIB of bioagents and biopesticides

Importance of *Trichoderma*spp., *Pseudomonas* spp. and *Bacillus* spp. as a biocontrolagents,Mechanism of disease control by thses organisms bioagents .Types of diseases controlled bioagentsformulations, Effectiveness of bioagentsagainst seed borne and soil borne plant pathogens, Mass multiplication and packing , Strategies of marking, and Registration with CIB and organic farming institute

Importance of *Trichogramma*, *Cryptolaemus*, *Chrysoperla*, NPV and entomofungal pathogens. Establishing insectary for host insects and natural enemies, Mass production of *Verticillium/Beauveria/Metarhizium/Nomuraea/Paecilomyces/Hirsutella thompsoni/Trichoderma,/Pseudomonas/Bacillus/Potash Mobilizers/Sulphuroxidizers /organic matter decomposers*

### Practical

Equipment, machinery and tools used for biofertilizers,Biopesticides and bioagents production. Preparation of media used for isolation and culturing of biofertilizers : Jensen's agar, NFb medium, Yeast extract manitol agar, BGA-medium, Pikovaskaya's medium ; Isolation of *Rhizobium* from root nodulesIsolation*Azotobacter* from rhizosphere of cereal crops, *Beijernickia*,*Acetobacter*from soil,*Azospirillum*from roots of graminicious plants, BGA from soil, Mycorrhizae from the roots,PSMsulphur oxidizing microorganisms, ion chealator, potash mobilizers ,organic matter decomposers and their isolation in pure culture form. Estimating the efficiency of *Rhizobium* through pot culture experiments and through nodulation tests in test tubes and Leonard jar.. Preservation of cultures of these organisms. Production of commercial biofertilizersviz. *Rhizobium*, *Azotobacter*, *Azospirillum*and *Acetobacter* : selection of efficient strains, carriers and their sterilization, mother culture preparation, mass multiplication using shake culture method, mixing of culture and carriers and preparation of packets. Production of carrier based and grain based phosphate solubilizing biofertilizers.

Methods of mass multiplication of BGA and *Azolla*. A large scale production of decomposing cultures. VA-mycorrhiza : growth on Guinea grass roots and observations for root colonization. Preparation of VA-mycorrhizal inoculum.

Methods of application of *Rhizobium*, *Azotobacter*, *Azospirillum* and phosphate solubilizing biofertilizers. Methods of application of *Azolla* and blue green algal biofertilizers in paddy farming. Production of compost cultures.

Quality control of biofertilizers : ISI standards specified and estimating the viable bacterial count in carrier based biofertilizers. Storage of biofertilizer packets. Visit to biofertilizer plants. Preparation of plan of biofertilizer production unit and proposal of loan.

Biopesticide and bioagents : Mass production of *Trichogramma*, *Cryptolaemus*, *Cryosperla*, MassHaNPV, and EPN. Importance of *Verticillium/Beauveria/Metarhizium/Nomuraea/Paecilomyces/Hirsutellathompsoni/Trichoderma/Pseudomonas/Bacillus* organic matter decomposers. Testing of quality parameters and standardization of biopesticides.

## Teaching Schedule

### a) Theory

Lecture	Topic	Weightage (%)
1	Introduction and types and importance of biofertilizers, Biopesticides and bioagents in agriculture and organic farming system	3
2	History of biofertilizers production	5
3,4	Classification of biofertilizers microorganisms used in biofertilizers production	4
5	A study of growth characteristics of various microbes used in biofertilizers production	4
6	Nitrogen cycle in Nature and its importance	5
7	Process of nodule formation ,Role of Nif and Nod gene in Biological Nitrogen fixation	3
8	Enzyme nitrogenase and its component	3
9	Biochemistry of nitrogen fixation,	4
10	Cross inoculation groups amongst <i>Rhizobium</i> ,	3
11	Methods used for the studying selection of efficient strain of <i>Rhizobium</i>	5
12	Quality standard for biofertilizers, ,	3
13	Different methods of application of biofertilizers, biopesticides and bioagents	5
14	Methods of quality control assessment in respect of biofertilizers	3
15	Strategies of Mass multiplication and packing Registration of biofertilizers	4
16,17	Strategies of marking and Registration with CIB of bioagents and biopesticides	4
18	Role of microorganisms in decomposition of organic farm wastes	4
19,20	Importance of <i>Trichoderma</i> spp., <i>Pseudomonas</i> spp. and <i>Bacillus</i> spp. as a biocontrol agent.	4

Lecture	Topic	Weightage (%)
21	Mechanism of disease control by these organisms bioagents	3
	Types of diseases by controlled bioagentsformulations	3
22	Factors responsible for effectiveness of bioagentsagainst seed borne and soil borne plant pathogens	4
23	Mass multiplication and packing	2
24,25	Strategies of marking, and Registration with CIB and organic farming institute	4
26,27	Importance of <i>Trichogramma</i> , <i>Cryptolaemus</i> , <i>Chrysoperla</i> , NPV and entomofungal pathogens.	4
28	Establishing insectary for host insects and natural enemies	3
29	Mass production of bioagents <i>Trichoderma</i> , <i>Bacillus</i> , <i>Pseudomonas</i>	4
30	Quality parameters as per CIB specifications, Registration of biopesticides and case	3
31,32	Importance of <i>Verticillium/Beauveria/ Metarhizium/Nomuraea/ Paecilomyces/Hirsutellathompsonias</i> biopesticides and their mass production	4
	<b>Total</b>	<b>100</b>

### b) Practical

Experiment	Topic
1	Equipment, machinery and tools used for biofertilizers, Biopesticides and bioagents production.
2	Media used for biofertilizers, Biopesticides and bioagents production.
3	Isolation of <i>Rhizobium</i> from root nodules. Isolation of <i>Azotobacter</i> , <i>Acetobacter</i> , <i>Beijernickia</i> , <i>Azospirillum</i> . I. By dilution pour plate technique and II. By enrichment culture technique
4	Isolation of <i>BGA</i> , <i>PSB</i> , sulphur oxidizing microorganisms, ion chealator, potash mobilizers ,organic matter decomposers I. By dilution pour plate technique and II. By enrichment culture technique
5	Estimating the efficiency of <i>Rhizobium</i> through pot culture experiments and through nodulation tests in test tubes and Leonard jar.
6	Production of <i>Rhizobium</i> commercial biofertilizers of <i>Azotobacter</i> , <i>Azospirillum</i> , <i>Acetobacter</i> , organic matter decomposers
7	Production of carrier biofertilizers of sulphur oxidizing microorganisms, ion chealator, potash mobilizers
6	Study of VA-mycorrhiza: growth on Guinea grass roots and observations for root colonization. Methods of preparation and application of VA-mycorrhizal inoculum
7	Mass production of <i>Trichogramma</i> , <i>Cryptolaemus</i> , <i>Crysoperla</i>
8	Mass production of HaNPV, SINPV and EPN
9	Mass production of <i>Verticillium/Beauveria/ Metarhizium/Nomuraea/ Paecilomyces/Hirsutellathompsoni/Trichoderma</i>
10	Mass multiplication of BGA and <i>Azolla</i> and its application in paddy field
11	Methods of application of biofertilizers, Biopesticides and bioagents
12	Quality control of biofertilizers: ISI standards specified and estimating the viable bacterial count in carrier based biofertilizers, Biopesticides and bioagents
13	Quality control tests for the biofertilizers, Biopesticides and bioagents

Experiment	Topic
14	Preparation of plan of biofertilizers, Biopesticides and bioagents production unit and proposal of loan.
15	CIB Registration for Biopesticides and bioagents
16	Visits to Commercial biocontrol units and KrishiSeva Kendra.

## Suggested Readings

- Alexander M. 1977. Soil Microbiology. John Wiley.
- Bergerson FJ. 1980. Methods for Evaluating Biological Nitrogen Fixation. John Wiley and Sons.
- Motsara, I.M.R., Bhattacharyya, P. and Srivastava, B. 1995. Biofertilizer Technology, Marketing and Usage- A Source Book-cum-glossary. FDCO, New Delhi.
- SubbaRao, N.S. Biofertilizers in Agriculture and Forestry. 1993. Oxford and IBH. Publ. Co., New Delhi.
- Burges, H.D. and Hussey, N.W. (1971). Microbial Control of Insects and mites. Academic Press, New York.
- Burges, H.D. Formulation of microbial pesticides – Kluwersep, ACB, Dordrecht-ISBN. 0412 625 202.
- Coppel H.C. and J.W. Martin. (1977). Biological control of insect pest suppression. Springail.
- De Bach P. 1964. Biological control of Insect Pest and Weeds Chapman and Hall, New York.
- Gautam, R.D. ( 2006). Biological suppression of insect pests. Kalyani Publisher, New Delhi.
- Huffaker, C.B. and Messenger, P.S. (1976). Theory and Practice of Biological control. Academic Press, New York.
- Ignacimuthu, S.S. and Jayaraj, S. (2003). Biological Control of Insect Pests. Phoenix Publ. New Delhi.
- Saxena, A.B. (2003). Biological Control of Insect Pests. Anmol Publ. New Delhi.
- Huffaker, C.B. and Messenger, P.S. (1976). Theory and Practice of Biological control. Academic Press, New York.
- Pepper HJ and Perlman D. 1979. Microbial Technology. 2<sup>nd</sup> Ed. Academic Press.
- A century of Nitrogen Fixation Research Present status and Future projects. 1987. F.J. Bergersen and J.R. Postgate The Royal Soc., London.
- Biology and Biochemistry of Nitrogen fixation. 1991. M.J. Dilworth, and A.R. Glenn, Elsevier, Amsterdam. .
- Nitrogen Fixation in plants. 1986. R.O.D. Dixon, and C.T. Wheeler, Blackie USA, Chapman and Hall, New York.
- A treatise on dinitrogen Fixation Section IV. Agronomy and Ecology 1977. R.W.F Hardy, and A.H. Gibson John Wiley & Sons, New York..
- Bioresearches technology for sustainable agriculture. 1999. S. Kannaiyan, Assoc. Pub. Co., New Delhi.

20. Biofertilizer Technology, Marketing and usage- A source Book -cum-glossary 1995. Motsara, I. M.R., P. Bhattacharyya and BeenaSrivastava, FDCO, New Delhi.
21. Symbiotic nitrogen fixation in plants, 1976. P.S. Nutman, Cambridge Univ. Press, London.
22. Hand book for Rhizobia; Methods in legume Rhizobium Technology, 1994. P. Somasegaran and H.J. Hoben Springer-Verlag, New York.
23. Biofertilizers in Agriculture and Forestry 1993. N.S. SubbaRao Oxford and IBH Publ. Co., New Delhi.

<b>Course :</b>	PATH 354		<b>Credit:</b>	3(2+1)	<b>Semester-V</b>
<b>Course title:</b>	Diseases of Field and Horticultural Crops and their Management – I				

## Syllabus

### Theory:

Symptoms, etiology, disease cycle and management of major diseases of following crops:

**Field Crops:** Rice: blast, brown spot, bacterial blight, sheath blight, false smut, Khaira and tungro; Maize: stalk rots, downy mildew, leaf spots; Sorghum: smuts, grain mold and anthracnose, Bajra: downy mildew and ergot; Finger millet: Blast and leaf spot  
Groundnut: early and late leaf spots, wilt. Soybean: Rhizoctonia blight, bacterial spot, seed and seedling rot and mosaic; Pigeonpea: Phytophthora blight, wilt and sterility mosaic; Black & green gram: Cercospora leaf spot and anthracnose, web blight and yellow mosaic; Castor: Phytophthora blight; Tobacco: black shank, black root rot and mosaic.

**Horticultural Crops:** Guava: wilt and anthracnose; Banana: Panama wilt, bacterial wilt, Sigatoka and bunchy top; Papaya: foot rot, leaf curl and mosaic, Pomegranate: bacterial blight;

**Cruciferous vegetables:** Alternaria leaf spot and black rot; Brinjal: Phomopsis blight and fruit rot and Sclerotinia blight; Tomato: damping off, wilt, early and late blight, buck eye rot and leaf curl and mosaic; Okra: Yellow Vein Mosaic; Beans: anthracnose and bacterial blight; Ginger: soft rot; Colocasia: Phytophthora blight; Coconut: wilt and bud rot; Tea: blister blight; Coffee: rust

### Practical

Identification and histopathological studies of selected diseases of field and horticultural crops covered in theory. Field visit for the diagnosis of field problems. Collection and preservation of plant diseased specimens for Herbarium;

**Note: Students should submit 50 pressed and well-mounted specimens.**

## Teaching Schedule

### a) Theory

Lecture	Topic	Weightage (%)
	Symptoms, etiology, disease cycle and management of major diseases of following crops	
	<b>Field crops</b>	
1,2,3	Rice	6
4,5	Maize	5
6,7	Sorghum	5
8	Bajara	3
9	Finger millet	3
	<b>Oilseed</b>	
10	Groundnut	5
	<b>Pulses</b>	
11,12,13	Soybean , Black & green gram	8
14	Pigeonpea	5



Lecture	Topic	Weightage (%)
	<b>Cash Crop</b>	
15	Caster	5
16	Tobacco	5
	<b>Horticultural Crops</b>	
17	Guava	5
18,19	Banana	5
20,21	Papaya	5
22,23	Pomegranate	5
	<b>Cruciferous vegetables:</b>	
24,25	Cruciferous vegetables	6
26,27	Brinjal, Tomato , Okra	9
28,29	Beans Ginger, Colocasia	6
	<b>Plantation Crops</b>	
30,31,32	Coconut, Tea, Coffee	9
	<b>Total</b>	<b>100</b>

b) **Practical**

Experiment	Topic
	Identification and histopathological studies of selected diseases of field and horticultural crops covered in theory. Collection and preservation of disease specimen (Note: Students should submit 50 pressed and well-mounted specimens)
1.	Rice: blast, brown spot, bacterial blight, sheath blight, false smut, Khaira and tungro
2.	Maize: stalk rots, downy mildew, leaf spots, Sorghum: smuts, grain mold and anthracnose, Bajra: downy mildew and ergot;
3.	Finger millet: Blast and leaf spot, Groundnut: early and late leaf spots ,wilt.
4.	Soybean: Rhizoctonia blight, bacterial spot, seed and seedling rot and mosaic, Pigeonpea: Phytophthora blight, wilt and sterility mosaic
5.	Black & green gram: Cercospora leaf spot and anthracnose, web blight and yellow mosaic,.
6	Castor: Phytophthora blight; Tobacco: black shank, black root rot and mosaic
7	Guava: wilt and anthracnose; Papaya: foot rot, leaf curl and mosaic, Papaya ring spot,
8	Banana: Panama wilt, bacterial wilt, Sigatoka and bunchy top
9	Pomegranate: bacterial blight ,wilt
10	Cruciferous vegetables: Alternaria leaf spot and black rot,
11	Tomato: damping off, wilt, early and late blight, buck eye rot and leaf curl and mosaic
12	Brinjal: Phomopsis blight and fruit rot and Sclerotinia blight,
13	Okra: Yellow Vein Mosaic, Beans: anthracnose and bacterial blight
14	Ginger: soft rot; Colocasia: Phytophthora blight;
15	Coconut: wilt and bud rot; Tea: blister blight; Coffee: rust
16	Field visit for the diagnosis of field problems

## Suggested Readings

- 1) Agrios, GN. 2010. *Plant Pathology*. Acad. Press
- 2) Diseases of Horticultural Crops fruits (1999) By Verma L.R and Sharma R.c, Indus Publishing company, New Delhi
- 3) Diseases of fruit crops (1986) By V.N.Pathak ,Oxford & IBH publication, New Delhi
- 4) Diseases of fruit crops (1986) By R.S.Singh ,Oxford & IBH publication, New Delhi
- 5) Diseases of Fruits and vegetables (2007) S.A.M.H. Naqvi, Springer Science & Business Media
- 6) Diseases of Plantation Crops (2014) By P.Chowdappa, Pratibha Sharma IPS 263pp
- 7) Diseases of Horticulture Crops and their management ,ICAR e-book for B.Sc.(Agri) & B.Tech (Agri) By TNAU pp172
- 8) Advances in the diseases of Plantation crops & spices (2004) P.SanthaKumari, International Book Distributing Company , 247 pp
- 9) Mehrotra RS & Aggarwal A. 2007. *Plant Pathology*. 7<sup>th</sup> Ed. Tata McGraw Hill Publ. Co. Ltd
- 10) Vegetable Diseases : A Colour full Hand book (2006) by Steven T.Koike ,Peter Gladders and Albert Paulus ,Academic Press, pp448
- 11) Diseases of Vegetables crops by R.S.Singh (1987) Oxford & IBH publication, New Delhi
- 12) Plant Diseases.(2008) Singh RS. 2008<sup>th</sup> Ed. Oxford & IBH. Pub. Co.
- 13) Diseases of Crops Plants in India (2009) By PHI learning Pvt. Ltd, pp 548
- 14) Diseases of Vegetable crops (2005) by Alferd Steferud ,Biotech Books ,New Delhi
- 15) Mehrotra RS & Aggarwal A. 2007. *Plant Pathology*. 7<sup>th</sup> Ed. Tata McGraw Hill Publ.Co. Ltd
- 16) Diseases of Vegetable Crops ,Diagnosis and Management (2014) Dinesh Singh and P.Chodappa, Today and Tomorrow Printers ,pp734
- 17) Singh H. 1984. *House-hold and Kitchen Garden Pests - Principles and Practices*. Kalyani Publishers.

<b>Course :</b>	PATH 365		<b>Credit:</b>	3(2+1)	<b>Semester-VI</b>
<b>Course title:</b>	Diseases of Field and Horticultural Crops and their Management – II				

## Syllabus

### Theory

#### Symptoms, etiology, disease cycle and management of following diseases:

**Field Crops:**Wheat: rusts, loose smut, karnal bunt, powdery mildew, alternaria blight, and ear cockle;Sugarcane: red rot, smut, wilt, grassy shoot, ratoon stunting and PokkahBoeng;Sunflower: Sclerotinia stem rot and Alternaria blight; Rust, Downy mildewMustard: Alternaria blight, white rust, downy mildew and Sclerotinia stem rot;Gram: wilt, grey mould and Ascochytablight;Lentil: rust and wilt;Cotton: anthracnose, vascular wilt, and black arm;Pea: downy mildew, powdery mildew and rust

**Horticultural Crops:**Mango: anthracnose, malformation, bacterial blight and powdery mildew;Citrus: canker and gummosis,Grape vine: downy mildew, Powdery mildew and anthracnose;Apple: scab, powdery mildew, fire blight and crown gall;Peach: leaf curl,Strawberry: leaf spot Potato: early and late blight, black scurf, leaf roll, and mosaic;

**Cucurbits:** Downy mildew, powdery mildew, wilt;Onion and garlic: purple blotch, and Stemphylium blight;Chillies: anthracnose and fruit rot, wilt and leaf curl;Turmeric: leaf spot, Coriander: stem gall,Marigold: Botrytis blight; Rose: dieback, powdery mildew and black leaf spot.

### Practical

Identification and histopathological studies of selected diseases of field and horticultural crops covered in theory. Field visit for the diagnosis of field problems.Collection and preservation of plant diseased specimens for herbarium.Note: Students should submit 50 pressed and well-mounted specimens.

## Teaching Schedule

### a) Theory

Lecture	Topic	Weightage (%)
	Symptoms, etiology, disease cycle and management of major diseases of following crops	
	<b>Field crops</b>	
1,2,3	Wheat: Rusts, loose smut, Karnal bunt, powdery mildew, Alternaria blight, and ear cockle	5
4,5	Sugarcane: Red rot, Smut, Wilt, Grassy shoot, Ratoon stunting and Pokka Boeng	5
	<b>Oilseed</b>	
6,7	Sunflower: Sclerotinia stem rot and Alternaria blight, Rust, Downy mildew	3
8,9	Mustard: Alternaria blight, White rust, Downy mildew and Sclerotinia stem rot	3
	<b>Pulses</b>	
10	Gram: wilt, grey mould and Ascochyta blight	5
	Lentil: rust and wilt	4
11	Linseed :Alternaria bud blight, Rust ,Powdery mildew	2
12	Pea: Downy mildew, Powdery mildew and Rust, wilt	5

Lecture	Topic	Weightage (%)
	<b>Cash Crop</b>	
13,14	Cotton: Root rot, Wilt, Anthracnose, and black arm, Dahiya diseases, leaf curl of cotton, 2-4-D injury	7
	<b>Horticultural Crops</b>	
15,16,17	Mango: Die back, Anthracnose, Mango-malformation, bacterial blight and powdery mildew, Spongy tissue, Red rust, Pink diseases, Loranthus, Stone graft Mortality, Lime induced chlorosis	6
18,19	Citrus : Citrus canker, Gummosis, Fruit rot, Citrus greening, Anthracnose, Tristeza, Citrus Exocortis, Scab of citrus, Mottle leaf of citrus	6
20,21	Grape vine: Downy mildew, Powdery mildew, Anthracnose, Bacterial Canker, Grape fan-leaf virus	6
22	Apple: Scab, Powdery mildew, Fire blight and Crown gall, Mosaic	3
23	Peach: leaf curl	2
23	Strawberry: Leaf spot	3
	<b>Vegetables</b>	
24	Potato: Early and late blight, black scurf, leaf roll, and Mosaic	5
25,26	Cucurbits: Downy mildew, powdery mildew, wilt, Angular leaf spot, Mosaic, TOSPO virus	5
27	Onion: Purple blotch, and Stemphylium blight, Downy mildew, Smut, Smudge, Erwinia rot	6
28	Garlic : Neck and bulb rot, and Stemphylium blight, Blemish, Black mould	3
29	Chilli : Anthracnose and fruit rot, Wilt and leaf curl	5
30	Coriander : Stem gall, Powdery mildew, Wilt	2
30	Turmeric: leaf spot	3
	<b>Ornamental Crops</b>	
31	Marigold :Botrytis blight, Alternaria blight	3
32	Rose: Dieback, Powdery mildew and Black leaf spot	3
	<b>Total</b>	<b>100</b>

### Practical

Experiment	Topic
	Identification and histopathological studies of selected diseases of field and horticultural crops covered in theory. Collection and preservation of disease specimen (Note: Students should submit 50 pressed and well-mounted specimens)
	<b>Field crops</b>
1	Wheat: Rusts, loose smut, Karnal bunt, powdery mildew, Alternaria blight, and ear cockle
2	Sugarcane: Red rot, Smut, Wilt, Grassy shoot, Ratoon stunting and Pokka Boeng
	<b>Oilseed</b>
3	Sunflower: Sclerotinia stem rot and Alternaria blight, Rust, Downy mildew
4	Mustard: Alternaria blight, White rust, Downy mildew and Sclerotinia stem rot
	<b>Pulses</b>
5	Gram: wilt, grey mould and Ascochyta blight, Pea: Downy mildew, Powdery mildew and Rust, wilt
6	Lentil: rust and wilt, Linseed :Alternaria bud blight, Rust ,Powdery mildew

Experiment	Topic
	<b>Cash Crop</b>
6	Cotton: Root rot, Wilt, Anthracnose, and black arm, Dahiya diseases, leaf curl of cotton, 2-4-D injury
	<b>Horticultural Crops</b>
7	Mango: Die back, Anthracnose, Mango-malformation, bacterial blight and powdery mildew, Spongy tissue, Red rust, Pink diseases, Loranthus, Stone graft Mortality, Lime induced chlorosis
8	Citrus : Citrus canker, Gummosis, Fruit rot, Citrus greening, Anthracnose, Tristeza, Citrus Exocortis, Scab of citrus, Mottle leaf of citrus
9	Grape vine: Downy mildew, Powdery mildew, Anthracnose, Bacterial Canker, Grape fan-leaf virus
10	Peach: leaf curl, Apple: Scab, Powdery mildew, Fire blight and Crown gall, Mosaic. Strawberry: Leaf spot
	<b>Vegetables</b>
11	Potato: Early and late blight, black scurf, leaf roll, and Mosaic
12	Cucurbits: Downy mildew, powdery mildew, wilt, Angular leaf spot, Mosaic, TOSPO virus
13	Onion: Purple blotch, and Stemphylium blight, Downy mildew, Smut, Smudge, Erwinia rot
14	Garlic : Neck and bulb rot, and Stemphylium blight, Blemish, Black mould
15	Chilli :Anthracnose and fruit rot, Wilt and leaf curl. Coriander : Stem gall, Powdery mildew, Wilt. Turmeric: leaf spot
	<b>Ornamental Crops</b>
16	Marigold :Botrytis blight, Alternaria blight, Rose: Dieback, Powdery mildew and Black leaf spot
17	Field visit for the diagnosis of field problems

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- 1) Agrios, GN. 2010. *Plant Pathology*. Acad. Press
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