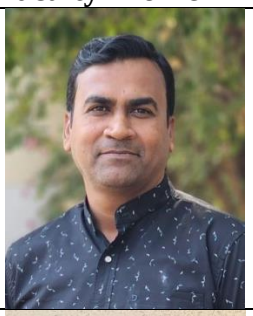
Department of Plant Pathology

S.N.	Faculty Profile	Name of Faculty	Qualification	Designation
1		Prof. Chandrashekhar V. Shende	M.Sc. Plant Pathology Specialization – Biofertilizers and Biocontrol agents	Assistant Professor
2		Prof. Amol S. Kumbhar	M.Sc. Plant Pathology, NET Specialization – Plant Virology and Mushroom Production Technology	Assistant Professor
3		Prof. Shital S. Dhawan	M.Sc. Plant Pathology, NET Specialization – Mycology and Seed Pathology	Assistant Professor

Semester Wise Subject List- B.Sc. (Hons.) Agriculture

Sr. No.	Semester	Course No.	Course Title	Credits
1.	II	PATH-121	Fundamentals of Plant Pathology	3 (2+1)
2.	II	SEC-123	Bio-fertilizers and Bio-pesticide Production	2 (0+2)
3.	III	SEC-235	Mushroom Production Technology	2 (0+2)
4.	V	PATH-352	Diseases of Field and Horticultural Crops and their Management	3 (2+1)
5.	VI	PATH-363	Agricultural Microbiology and Phyto-remediation	3 (2+1)

Course No: PATH-121 **Credits: 3 (2+1)**

Course Title: Fundamentals of Plant Pathology

SYLLABUS

Objectives:

1. To get acquainted with the role of different microorganisms in the development of plant disease.
2. To get general concepts and classification of plant diseases
3. To get knowledge of general characteristics of fungi, bacteria, virus, and other microorganisms causing plant diseases.
4. To acquaint the students with reproduction in fungi, and bacteria, causing plant diseases.
5. To get acquainted with various plant disease management principles and practices.

Theory-

Introduction to Plant Pathology: Concept of disease in plants; Different terms used in Plant Pathology, History of Plant Pathology with special references to India, Causes of plant disease: Inanimate and animate causes; Classification of plant disease; Parasitism and pathogenesis, Development of disease in plants: Disease Triangle, Disease cycle, Fungi and their morphology, reproduction and classification of fungi, Bacteria: Morphology, reproduction classification of phytopathogenic bacteria, Other plant pathogens: Mollicutes; Flagellant protozoa; FVB; Green algae and parasitic higher plants; Viruses and viroids, virus transmission, Principles of Plant disease management: Disease management with chemicals, Host resistance, cultural and biological method of Integrated Disease Management (IDM).

Practical-

Study of the microscope , Acquaintance with laboratory material and equipments, Study of different plant disease symptoms, Microscopic examination of general structure of fungi, Simple staining of bacteria: Direct and indirect staining, Gram staining of bacteria, Microscopic examination of fungal diseased specimen, Microscopic examination of bacterial diseased specimen, Preparation of culture media, Isolation of plant pathogens: Fungi, bacteria and viruses, Purification of plant pathogens, Study on plant disease diagnosis: Koch's Postulates, Characteristics, formulation, methods of application and calculation on fungicides.

Suggested Readings [PATH-121]:

1. Pathak V N. Essentials of Plant Pathology. Prakash Publ., Jaipur.
2. Agrios G N. 2010. Plant Pathology. Acad. Press.
3. Kamat M N. Introductory Plant Pathology. Prakash Pub, Jaipur.
4. Singh R S.2008.PlantDiseases. 8thEd.Oxford&IBHPubl.Co.
5. Singh R S.2013.Introduction to Principles of Plant Pathology. Oxford and IBH Publ. Co.
6. Alexopoulos, Mims and Blackwel. Introductory Mycology.
7. Mehrotra RS & Aggarwal A. 2007. Plant Pathology. 7thEd. Tata-Mc Graw Hill Publ. Co. Ltd.
8. Gibbs A & Harrison B.1976.PlantVirology-ThePrinciples.EdwardArnold, London.
9. HullR.2002. Mathews Plant Virology. 4th Ed. Academic Press, New York.
10. Verma J P. 1998. The Bacteria. Malhotra Publ. House, New Delhi.
11. Goto M. 1990. Fundamentals of Plant Bacteriology. Academic Press, New York.
12. Dhingra O D & Sinclair J B.1986.Basic Plant Pathology Methods. CRC Press, London, Tokyo.

13. Nene Y L& Thapliyal P N.1993.Fungicides in Plant Disease Control .3rd Ed. Oxford & IBH, N. Delhi.
14. Vyas S C.1993.Hand book of Systemic Fungicides. Vols. I-III. Tata McGraw Hill, New Delhi.
15. Rajeev K & Mukherjee R C. 1996. Role of Plant Quarantine in IPM. Aditya Books.
16. Rhower G G. 1991. Regulatory Plant Pest Management. In: Handbook of Pest Management in Agriculture. 2nd Ed. Vol. II. (Ed. David Pimental). CRC Press.

Course No: PATH-352 Credits: 3 (2+1)

Course Tile: Diseases of Field and Horticultural Crops and their Management

SYLLABUS

Objectives:

1. To study the symptoms produced on the host
2. To study the etiology of the diseases
3. To know about the disease cycle of the pathogens during pathogenesis
4. To study the epidemiological factors responsible for disease development
5. To study the management techniques for curbing the major diseases of field and horticultural crops

Theory:

Symptoms, etiology, disease cycle, epidemiology and management of major diseases of the following field and horticultural crops:

Fieldcrops- Rice (Blast, Brown Spot, Sheath Blight, False smut, Bacterial Leaf Blight, Bacterial Leaf Streak, Tungro, Khaira); Wheat (Rusts, Loose smut, Karnal Bunt); Maize (Banded Leaf and Sheath Blight, Southern and Northern blight, Downy mildew); Sorghum (Smuts, Grain mold, Anthracnose); Bajra (Downy mildew, Ergot) and Finger millet (Blast, Leaf Spot); Groundnut (Early and Late leaf spots, Rust, Wilt); Soybean (Rhizoctonia blight, Bacterial Spot, Seed and Seedling rot, Mosaic); Grams (Ascochyta blight, Wilt, Grey mold); Pea (Downy Mildew, Powdery Mildew, Rust); Black gram and Green gram (Web blight, Cercospora Leaf Spot, Anthracnose, Yellow Mosaic); Sugarcane (Red rot, Smut, Grassy Shoot, Ratoon Stunting, PokahBoeng); Mustard (Alternaria blight, White Rust, Downy Mildew, Sclerotinia Stem Rot) and Sunflower (Sclerotinia Stem Rot, Alternaria blight); Cotton (Anthracnose, Vascular wilts, Black Arm).

Horticultural crops: Citrus (Canker, Gummosis) and Guava (Wilt, Anthracnose); Banana (Sigatoka, Panama wilt, Bacterial wilt, Bunchy top); Papaya (Foot rot, Leaf Curl, Mosaic) and Pomegranate (Bacterial blight); Apple (Scab, Powdery Mildew, Fire Blight, Crown Gall) and Peach (Leaf Curl); Grapevine (Downy mildew, Powdery mildew, Anthracnose) and Strawberry (Leaf Spot); Coconut (Bud rot, Ganoderma Wilt), Tea (Blister blight) and Coffee (Rust); Mango (Anthracnose, Malformation, Bacterial blight, Powdery mildew); Potato (Early and Late blight, Black scurf, Leaf roll, Mosaic) and Tomato (Damping off, Wilt, Early and Late blight, Leaf curl, Mosaic); Brinjal (Phomopsis blight and fruit rot, Sclerotinia blight) and Chilli (Anthracnose and Fruit rot, Wilt, Leaf Curl); Cucurbits (Powdery and Downy mildew, Wilts) and Cruciferous vegetables (Alternaria leaf spot, Black rot, Cauliflower mosaic); Beans (Anthracnose, Bacterial blight) and Okra (Yellow vein mosaic); Ginger (Soft rot), Turmeric (Leaf Spot) and Coriander

(Stem gall); Rose (Dieback, Powdery mildew, Black Leaf Spot) and Marigold (Botrytis blight, Leaf spots).

Practical:

To study the symptoms of different diseases of field and horticultural crops: Blast and Brown spot of rice, Sheath blight and Bacterial leaf blight of rice, Downy mildew and Powdery of Cucurbits, Rhizoctonia and Cercospora leaf spot of Green gram / Black gram, Alternaria blight and Downy mildew of Mustard, Early blight of Late blight of Potato and Tomato, Phomopsis blight of Brinjal, Powdery mildew and rust of Pea, Stem Gall of Coriander, Anthracnose and Fruit rot of Chilli, Taphrina leaf spot of Turmeric, Red rot of Sugarcane, Acquaintance with fungicides, Antibiotics and Biopesticides and their use in management of diseases of horticultural crops. 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. Students should submit 50 pressed and well mounted specimens.

Suggested readings:

1. Plant Diseases (By: R. S. Singh)
2. Plant Disease Management: Principles and Practices (By: Hriday Chaube)
3. Integrated Plant Disease Management (By: R. C. Sharma)
4. Plant Pathology (By: G. N. Agrios, 2010)

Course No: PATH-363 Credits: 3(2+1)

Course Title: Agricultural Microbiology and Phyto-remediation

SYLLABUS

Objectives:

1. To get an introduction to microbiology with specific focus on its significance in agriculture science
2. To get acquainted with the bacterial structure and the function of the different bacterial components
3. To get highlights on different fields of microbiology
4. To get highlights on the Bioremediation of polluted soils using microbial mediators and phytoremediation
5. To get a concept of biological control and the role of biopesticides in plant disease management

Theory-

Introduction to Microbiology: Definition, applied areas of Microbiology and Importance of Microbiology. History of Microbiology: Discovery of microorganisms, spontaneous generation theory, Germ theory of diseases, Immunization, fermentation, and origin of life Bacteria: cell structure, chemoautotrophy, photo autotrophy, growth. Bacterial genetics: Genetic recombination-transformation, conjugation and transduction Genetic Engineering: Plasmids, episomes, and genetically modified organisms Air Microbiology: Phyllosphere microflora, Phylloplane microflora, microflora of floral parts etc. Food Microbiology: Microbial spoilage and principles of food preservations, Food poisoning Water Microbiology: Types of water, water microorganisms,

and microbial analysis of water e.g. coliform test, Purification of water. Industrial Microbiology: Microbial products, Biodegradation, Biogas production, Biodegradable plastics etc. Biological control: Microbial biopesticides for plant disease management. Concepts of rhizosphere microbiology- Rhizodeposits -biochemical nature, release mechanism in rhizosphere, function, Carbon flow in rhizosphere, Rhizosphere microbiome-residents and their roles Potential of plant growth promoting rhizobacteria (PGPR) and endophytes on soil health and sustainability Bioremediation of polluted soils using microbial mediators Phytoremediation of polluted soils

Practical:

Study of the microscope, Acquaintance with laboratory material and equipments, Microscopic observation of different groups of microorganisms: moulds (Fungi), Direct staining of bacteria by crystal violet, Negative or indirect staining of bacteria by nigrosin, Gram staining of bacteria, Study of phyllosphere and rhizosphere microflora, Measurement of microorganisms, Preparation of culture media, Isolation and purification of rhizospheric microbes, Isolation and purification of N-fixers, Isolation and purification of Nutrient solubilizers, Isolation and purification of Endophytes.

Suggested readings:

1. Pelczar, M.J., Chan, E.C.S. &Kreig, N.R. (2002) Microbiology. 5th Edition, Tata McGraw-Hill, New Delhi.
2. Rangaswami, G. &Bagyaraj, D. J. (2005) Agricultural Microbiology. Prentice-Hall of India Pvt. Ltd., New Delhi.
3. Mukherjee, N. & Ghosh, T. (2004). Agricultural Microbiology. Kalyani Publishers, Calcutta
4. Dubey, H.C. (2007). A Textbook of Fungi, Bacteria and Viruses. Vikas Publishing House Ltd., New Delhi – 10014
5. Salyers, A. A., & Whitt, D. D. (2001). Microbiology: diversity, disease, and the environment. Fitzgerald Science Press, Inc.
6. Prescott, L. M. (2002). Microbiology 5th Edition. Mc Graw-Hill Inc., US

Department of Plant Pathology

Semester Wise Subject List- B.Sc. (Hons.) ABM

Sr. No.	Semester	Course No.	Course Title	Credits
1.	I	PATH-111	Management of Plant Diseases	2 (1+1)
2.	II	SEC-123	Production Technology for Bio-Agents and Bio-fertilizers	2 (0+2)
3.	III	SEC-235	Mushroom Production Technology	2 (0+2)

Course No.- PATH-111 **Credits : 2 (1+1)**

Course Title: Management of Plant Diseases

Objectives:

1. To understand the biology, epidemiology, and ecology of plant diseases;
2. To learn effective strategies for disease prevention, diagnosis, and management in agricultural systems;
3. To explore integrated disease management approaches, including cultural, chemical, and biological control methods; and
4. To develop skills to mitigate the impact of plant diseases on crop yield, quality, and sustainability.

Theory:

Objectives, historical development and economic significance of post-harvest diseases and seed-borne diseases. Study of important Post-Harvest Diseases (transport, storage & market) of perishables and grains etc. Production of mycotoxins and their effects. Diagnosis and detection of plant pathogens carried through seeds, vegetatively propagated material. Harvesting, transportation, processing and methods of storage. Seed contamination, seed-borne infections and seed transmission. Packing and packaging, requirement of packing materials. Principles of plant disease management, viz., Avoidance, Exclusion, Eradication, Protection, Immunization-HPR and Biological control. Pesticides, Classification of fungicides. Mode of application. Biotechnological approaches of diseases management. IPR and related issues. IDM concepts and importance. Management of post-harvest diseases. IDM module for important post- harvest diseases.

Practical:

Study of post-harvest disease symptoms caused by fungi, bacteria, virus, nematodes etc. Diagnosis and Detection of various post-harvest diseases. Methods of detection and identification of seed-borne pathogens, isolation of biocontrol agents, Testing the efficacy of biocontrol agents by dual culture technique. Mass multiplication and methods of application of bio agents, Study of fungicides, bactericides, nematicides and their formulations. Study of pesticide compatibility and their safe-use.

Study of plant protection equipments, Bioassay of fungicides, Seed treatment techniques for the control of seed-borne diseases. Biocontrol of post-harvest diseases. Study of seed packaging and storage techniques. Visit to vegetable and fruit markets, bio-pesticide/ Pesticide firms. Visit to processing warehouse and testing laboratories.

Suggested Readings:

- Upadhyay, K.D and Dwivedi, K. 1997. A text book of plant nematology. Amman Publishing House Aman publishing house, Meerut
- Vasanth Raju David, B. 2001. Elements of economic entomology. Popular book Depot, Chennai.
- Gopal Swaroop and Das Gupta 1986.ICAR, New Delhi. Plant Parasitic Nematodes ofIndia Problems and Progress.
- Nair, M.R.G.K. 1975. Insects and Mites of Crops in India. ICAR, New Delhi
- Metcalf, R.L and Luckman, W.H. 1982. Introduction to Insect pest management. Wiley Inter Science Publishing, New York.
- Butani, D.K. 1984. Insects and Fruits. Periodical Expert Book Agency, New Delhi
- E. I. Jonathan, I. Cannayane, K. Devrajan, S. Kumar, S. Ramakrishan, AgriculturalNematology. TNAU, Coimbatore.

Course No.- SEC-123 Credits : 2 (0+2)

Course Title: Production Technology for Bio-Agents and Bio-fertilizers)

Objectives:

1. To understand the principles and methods of producing bio-agents and bio-fertilizers;
2. To learn techniques for mass production and formulation of beneficial microorganisms;
3. To explore the role of bio-agents and bio-fertilizers in sustainable agriculture and soil health management; and
4. To develop skills to integrate bio-agents and bio-fertilizers into crop production systems for enhanced yield and reduced environmental impact.

Practical:

A. Agricultural Microbiology: Relevance of Biofertilizer in Agriculture. Types of Biofertilizers [(a) Nitrogen fixers: *Rhizobium, Azotobacter, Azospirillum, Glucano-acetobacter, Cyanobacteria* and *Azolla;* (b) P- solubilizers: PSB, PSF; (c) K solubilizers; (d) Zn-solubilizers; (e) P-mobilizers: AM fungi; (f) Development of consortia]. Mass Production Techniques [(a) Carrier based; (b) Liquid Biofertilizers]. Methods of application. Quality Control (Standards as per FCO (1985) amended in 2009).

Suggested Readings:

- Handbook of Microbial Biofertilizers" by M K Rai
- The Complete Technology Book on Biofertilizer and Organic Farming. Dr. Himadri Panda.
- Biofertilizers for Sustainable Agriculture and Environment (Soil Biology Book 55). by Bhoopander Giri, Ram Prasad, et al.
- Hand Book Of Biofertilizers & Vermiculture. by Eiri Board | 1 January 2009.
- Recent Trends in Biofertilizers. by Bikas R. Pati and Santi M. Mandal
- Michael Madigan; John Martinko; David Stahl and David Clark, Brock- Biology of Microorganisms, Pearson (Thirteen Edition)
- Mark S. Coyne, Soil Microbiology-An Exploratory Approach, Delmar Publishers 2004
- Atlas Bartha, Microbial Ecology -Fundamentals and Application, Pearson (Fourth)
- J Nicklin, K Graeme-Cook, T. Paget and R. Killington, Instant Notes in Microbiology, Viva

B. Agricultural Entomology: Importance of biopesticides and other non-chemical approaches in pest management. Mass production of laboratory host, parasitoids and predators. Mass rearing techniques of rice moth, *Corcyra cephalonica* Stainton, *Trichogramma* Spp, *Goniozus nephantidis* (Muesebeck) and *Bracon bravicornins* Wesmael, predators, *Chrysoperla zastrowi sillemi* (Esben-Petersen), *Cryptolaemus montrouzieri* Mulsant, *Micromus igorotus* Banks, weed killers, *Zygogramma bicolorata* Pallister, aquatic weed killer, *Cyrtobagous salviniae* Calder, Preparation of culture media, culturing and spore counting of *Nomuraea rileyi* (Farl.) Samsonand *Beauveria bassiana* (Bals.) /*Metarhizium anisopliae* (Met.) and *Lecanicillium lecanii* (Zimmerman), Mass production of Ha NPV/Sl NPV, Estimation of spore load from microbial pesticides, Preparation of Neem Seed Kernel Extract (NSKE), Preparation and use of Bio digester, Panchagavvya, GCK, cow urine and cow dung, Conservation measures for Natural Enemies and Visit to Bio control Laboratories.

Suggested Readings:

- Biopesticides in Sustainable Agriculture Progress and Potential Hardcover – 1 January 2014 by O Koul (Author), G S Dhaliwal (Author), S Khokhar (Author)
- Veeresh GK, Shivashankar K & Suiglachar MA. 1997. Organic Farming & Sustainable Agri. Association for Promotion of Organic Farming, Bangalore.
- WHO. 1990. Public Health Impact of Pesticides Used in Agriculture. WHO.
- Woolmer PL & Swift MJ. 1994. The Biological Management of Tropical Soil Fertility. TSBF & Wiley.

C. Plant Pathology: Introduction about bio-pesticides/global scenario/advantages, disadvantages and mechanisms of action; Isolation and enumeration of fungal biocontrol agents from soil; Isolation and enumeration of bacterial biocontrol agents from soil; Purification of biocontrol agents; Hands on skills on mass production of *Trichoderma harzianum* and *Pacelomyces lilacinus* (isolation, preparation of mother culture, sterilisation, fermentation, quality analysis, mixing, packing and labelling); Characterization of fungal (*Trichoderma harzianum* and *Pacelomyces lilacinus*) antagonistic organisms (Morphological); Studies on antagonistic ability of fungal biocontrol agents through dual plate technique; Hands on skills on mass production of *Pseudomonas fluorescens* and *Bacillus subtilis* (isolation, preparation of mother culture, sterilization, fermentation, quality analysis, mixing, packing

and labelling); Characterization of bacterial (*Pseudomonas fluorescens* and *Bacillus subtilis*) antagonistic organisms (Morphological); Studies on antagonistic ability of bacterial biocontrol agents through dual plate technique; Field Evaluation of biocontrol agents; Evaluation of biocontrol agents against diseases of vegetables under protected cultivation; Evaluation of plant extracts (neem, tulsi, pongamia, etc) and liquid organic manures (panchagavya, beejamruta, Jeevamruta) against plant diseases; Registration procedures for biocontrol agents; Cost of production of various biocontrol agents.

Suggested Readings:

- Biopesticides- Use and Delivery, Franklin R. Hall, Julius J. Menn
- Advances in Plant Biopesticides- Dwijendra Singh
- Biopesticides- Pranab Dutta

PLANT PATHOLOGY

M.Sc. (Agri) Plant Pathology Course Structure

	Course No.	Title of Course	Credits
I	**Major Courses**		
	PL.PATH.501*	Mycology	2+1=3
	PL.PATH.502*	Plant Virology	2+1=3
	PL.PATH.505*	Principles of Plant Pathology	2+1=3
	Minor Courses		
	MICRO 504	Microbial Genetics	2+1=3
	Optional/Supporting Courses		
	BIOCHEM 501	Basic Biochemistry	3+1=4
	Common Courses (Non-Credit)		
	PGS.501	Library and information services	0+1=1
	PGS 504	Basic Concepts in Laboratory Techniques	0+1=1
II	**Major Courses**		
	PL.PATH.503*	Plant Pathogenic Prokaryotes	2+1=3
	PL.PATH.506*	Techniques in Detection & Diagnosis of Plant diseases	0+2=2
	PL.PATH.515*	Diseases of Field & Medicinal crops	2+1=3
	Minor Courses		
	MICRO-505	Soil Microbiology	2+1=3
	GPB-516	Breeding for Stress Resistance and Climate Change	2+1=3
	Optional/Supporting Courses		
	STAT 511	Experimental Designs	2+1=3
	Common Courses (Non-Credit)		
	PGS.502	Technical Writing and Communications Skills	0+1=1
	PGS 503	Intellectual Property and its management in Agriculture	1+0=1
III	**Major Courses**		
	PL.PATH.507*	Plant Nematology	2+1=3
	PL.PATH.591	**Master's Seminar**	0+1=1
	Common Courses (Non-Credit)		
	PGS.505	Agricultural Research, Research Ethics and Rural Development Programmes	1+0=1
IV	**Master Research**		
	PL.PATH.599	Master Research	0+30=30
	Total	Major-20, Minor-09, Optional/Supporting-07, Seminar-01 and Common courses-06, Thesis-30 # **Total-72**	72