

M.Sc. (Ag) PLANT PATHOLOGY Course Structure

S.No.	CODE	COURSE TITLE	CREDITS
Semester I			
1	PL PATH 501	MYCOLOGY	3(2+1)
2	PL PATH 502	PLANT VIROLOGY	3(2+1)
3	PL PATH 503	PLANT BACTERIOLOGY	3(2+1)
4	PL PATH 504	PRINCIPLES OF PLANT PATHOLOGY	3(3+0)
5	PL PATH 505	DETECTION AND DIAGNOSIS OF PLANT DISEASES	2(0+2)
6	PL PATH 517	MUSHROOM PRODUCTION TECHNOLOGY	3(2+1)
7	COMP 705	Computer Orientation	3(2+1)
8	MAS 711	Statistics I	3(2+1)
Total Credit			23
Semester II			
1	PL PATH 506	PRINCIPLES OF PLANT DISEASE MANAGEMENT	3(2+1)
2	PL PATH 519	POST HARVEST DISEASES	3(2+1)
3	PL PATH 508	DISEASES OF FRUITS, PLANTATION AND ORNAMENTAL CROPS	3(2+1)
4	PL PATH 509	DISEASES OF VEGETABLE AND SPICES CROPS	3(2+1)
5	PL PATH 510	SEED HEALTH TECHNOLOGY	3(2+1)
6	PL PATH 521	PHYTO NEMATOLOGY	2(1+1)
7	PL PATH 514	INSECT VECTORS OF PLANT VIRUSES AND OTHER PATHOGENS	2(1+1)
8	MAS 715	Statistics I	3(2+1)
Total Credit			22
Semester III			
1	PL PATH 511	CHEMICALS IN PLANT DISEASE MANAGEMENT	3(2+1)
2	PL PATH 512	ECOLOGY OF SOIL-BORNE PLANT PATHOGENS	3(2+1)
3	PL PATH 513	DISEASE RESISTANCE IN PLANTS	2(2+0)
4	PL PATH 515	BIOLOGICAL CONTROL OF PLANT DISEASES	3(2+1)
5	PL PATH 516	INTEGRATED DISEASE MANAGEMENT	3(2+1)
6	PL PATH 518	EPIDEMIOLOGY AND FORECASTING OF PLANT DISEASES	3(2+1)
7	PL PATH 507	DISEASES OF FIELD AND MEDICINAL CROPS	3(2+1)
8	PL PATH 520	PLANT QUARANTINE	2(2+0)
Total Credit			22
Semester IV			
1	PL PATH 591	MASTER'S SEMINAR	1(1+0)
2	PL PATH 599	MASTER'S RESEARCH	20
Total Credit			21

Ph.D. (Ag) PLANT PATHOLOGY Course Structure

1	PL PATH 601	ADVANCED MYCOLOGY	3(2+1)
2	PL PATH 602	ADVANCED VIROLOGY	3(2+1)
3	PL PATH 603	ADVANCED BACTERIOLOGY	3(2+ 1)
4	PL PATH 604	MOLECULAR BASIS OF HOST-PATHOGEN INTERACTION	3(2+1)
5	PL PATH 605	PRINCIPLES AND PROCEDURES OF CERTIFICATION	1(1+0)
6	PL PATH 606	PLANT BIOSECURITY AND BIOSAFETY	2(2+0)
7	PL PATH 691	DOCTORAL SEMINAR I	1(1+0)
8	PL PATH 692	DOCTORAL SEMINAR II	1(1+0)
9	PL PATH 699	DOCTORAL RESEARCH	45

COMPULSORY NON-CREDIT COURSES

(Compulsory for Master's programme in all disciplines; Optional for Ph.D. scholars)

CODE COURSE TITLE CREDITS

S.No.	CODE	COURSE TITLE	CREDIT S
1	PGS 501	LIBRARY AND INFORMATION SERVICES	1(0+1)
2	PGS 502	TECHNICAL WRITING AND COMMUNICATIONS SKILLS	1(0+1)
3	PGS 503 (e- Course)	INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE	1(1+0)
4	PGS 504 (e-Course)	BASIC CONCEPTS IN LABORATORY TECHNIQUES	1(0+1)
5	PGS 505	AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES	1(1+0)
6	PGS 506 (e-Course)	DISASTER MANAGEMENT	1(1+0)

M.Sc. (Ag) PLANT PATHOLOGY
Semester I
Course Contents
MYCOLOGY

PL PATH 501

(32+1)

Objective

To study the nomenclature, classification and characters of fungi.

Theory

Introduction, definition of different terms, basic concepts. Importance of mycology in agriculture, relation of fungi to human affairs, history of mycology. Concepts of nomenclature and classification, fungal biodiversity, reproduction in fungi. The comparative morphology, ultrastructure, characters of different groups of fungi up to generic level: (a) Myxomycota and (b) Eumycota- i) Mastigomycotina ii) Zygomycotina, iii) Ascomycotina, iv) Basidiomycotina, v) Deuteromycotina. Lichens types and importance, fungal genetics and variability in fungi.

Practical

Detailed comparative study of different groups of fungi; collection, identification and preservation of specimens. Isolation and identification of plant pathogenic fungi.

PL PATH 502

PLANT VIROLOGY

3(2+1)

Objective

To acquaint with the structure, virus-vector relationship, biology and management of plant viruses.

Theory

History of plant viruses, composition and structure of viruses. Symptomatology of important plant viral diseases, transmission, chemical and physical properties, host virus interaction, virus vector relationship. Virus nomenclature and classification, genome organization, replication and movement of viruses. Isolation and purification, electron microscopy, protein and nucleic acid based diagnostics. Mycoviruses, phytoplasma arbo and baculoviruses, satellite viruses, satellite RNAs, phages, viroids, prions. Principles of the working of electron-

microscope and ultra-microtome. Origin and evolution, mechanism of resistance, genetic engineering, ecology, and management of plant viruses.

Practical

Study of symptoms caused by viruses, transmission, assay of viruses, physical properties, purification, method of raising antisera, serological tests, electron microscopy and ultratome, PCR.

PL PATH 503**PLANT BACTERIOLOGY****3(2+1)****Objective**

To acquaint with plant pathogenic prokaryote (procarya) and their structure, nutritional requirements, survival and dissemination.

Theory

History and introduction to phytopathogenic procarya, viz., bacteria, MLOs, spiroplasmas and other fastidious procarya. Importance of phytopathogenic bacteria. Evolution, classification and nomenclature of phytopathogenic procarya and important diseases caused by them. Growth, nutrition requirements, reproduction, preservation of bacterial cultures and variability among phytopathogenic procarya. General biology of bacteriophages, L form bacteria, plasmids and bdellovibrios. Procaryotic inhibitors and their mode of action against phytopathogenic bacteria. Survival and dissemination of phytopathogenic bacteria. 68

Practical

Isolation, purification, identification and host inoculation of phytopathogenic bacteria, staining methods, biochemical and serological characterization, isolation of plasmid and use of antibacterial chemicals/antibiotics.

PL PATH 504**PRINCIPLES OF PLANT PATHOLOGY****3(3+0)****Objective**

To introduce the subject of Plant Pathology, its concepts and principles.

Theory

Importance, definitions and concepts of plant diseases, history and growth of plant pathology, biotic and abiotic causes of plant diseases. Growth, reproduction, survival and dispersal of important plant pathogens, role of environment and host nutrition on disease development. Host parasite interaction, recognition concept and infection, symptomatology, disease development- role of enzymes, toxins, growth regulators; defense strategies- oxidative burst; Phenolics, Phytoalexins, PR proteins, Elicitors. Altered plant metabolism as affected by plant pathogens.

Genetics of resistance; 'R' genes; mechanism of genetic variation in pathogens; molecular basis for resistance; marker-assisted selection; genetic engineering for disease resistance. Disease management strategies.

PL PATH 505 DETECTION AND DIAGNOSIS OF PLANT DISEASES

2(0+2)

Objective

To impart training on various methods/techniques/instruments used in the study of plant diseases/pathogens.

Practical

Methods to prove Koch's postulates with biotroph and necrotroph pathogens, pure culture techniques, use of selective media to isolate pathogens. Preservation of plant pathogens and disease specimens, use of haemocytometer, micrometer, centrifuge, pH meter, camera lucida. Microscopic techniques and staining methods, phase contrast system, chromatography, use of electron microscope, spectrophotometer, ultracentrifuge and electrophoretic apparatus, disease diagnostics, serological and molecular techniques for detection of plant pathogens. Evaluation of fungicides, bactericides etc.; field experiments, data collection and preparation of references.

PL PATH 517 MUSHROOM PRODUCTION TECHNOLOGY

3(2+1)

Objective

To develop mushroom cultivation skills for entrepreneurial activity. Historical development of mushroom cultivation and present status of mushroom industry in India.

Theory

Historical development of mushroom cultivation and present status, taxonomy, classification, food, medicinal value, uses of mushroom, edible and poisonous mushrooms. Life cycle of cultivated mushrooms, reproduction and strain improvement, maintenance of pure culture, preparation of spawn and facilities required for establishing commercial spawn lab. Preparation of substrate for

mushroom cultivation, long, short and indoor composting methods, formulae for different composts and their computation, qualities and testing of compost, uses of spent mushroom compost/substrate. Facilities for setting up mushroom farm for seasonal and environmentally control cultivation, requirement and maintenance of temperature, relative humidity, CO₂, ventilation in cropping rooms, cultivation technology of *Agaricus bisporus*, *Pleurotus* sp., *Calocybe indica*, *Lentinus edodes* and *Ganoderma lucidum*. Insect pests, diseases and abnormalities of cultivated mushroom and their management, post harvest processing and value addition, economics of mushroom cultivation, biotechnology and mushroom cultivation.

Practical

Preparation of spawn, compost, spawning, casing, harvesting and postharvest handling of edible mushroom; identification of various pathogens, competitors of various mushroom.

Semester II

PL PATH 506 PRINCIPLES OF PLANT DISEASE MANAGEMENT

3(2+1)

Objectives

To acquaint with different strategies for management of plant diseases. 70

Theory

Principles of plant disease management by cultural, physical, biological, chemical, organic amendments and botanicals methods of plant disease control, integrated control measures of plant diseases. Disease resistance and molecular approach for disease management. Foliage, seed and soil application of chemicals, role of stickers, spreaders and other adjuvants, health vis-a-vis environmental hazards, residual effects and safety measures. History of fungicides, bactericides, antibiotics, concepts of pathogen, immobilization, chemical protection and chemotherapy, nature, properties and mode of action of antifungal, antibacterial and antiviral chemicals.

Practical

In vitro and *in vivo* evaluation of chemicals against plant pathogens; ED and MIC values, study of structural details of sprayers and dusters.

PL PATH 519 POST HARVEST DISEASES

3(2+1)

Objective

To acquaint with post harvest diseases of agricultural produce and their ecofriendly management.

Theory

Concept of post harvest diseases, definitions, importance with reference to environment and health, principles of plant disease management as preharvest and post-harvest, merits and demerits of biological/phytoextracts in controlling post-harvest diseases. Types of post harvest problems both by biotic and abiotic causes, rhizosphere colonization, competitive, saprophytic ability, antibiosis, induced resistance, microbial associations, concept, operational mechanisms

and its relevance in control. Factors governing post harvest problems both as biotic and abiotic, role of physical environment, agro-ecosystem leading to quiescent infection, operational mechanisms and cultural practices in perpetuation of pathogens, pathogens and antagonist and their relationship, role of biocontrol agents and chemicals in controlling post-harvest diseases, comparative approaches to control of plant pathogens by resident and introduced antagonists. Isolation, characterization and maintenance of pathogens, role of different storage. Integrated approach in controlling diseases and improving the shelf life of produce, control of aflatoxigenic and mycotoxigenic fungi, application and monitoring for any health hazard, knowledge of Codex Alimentarius for each product and commodity.

Practical

Isolation characterization and maintenance of pathogens, role of different storage conditions on disease development, application of antagonists against pathogens *in vivo* and *in vitro* conditions. Comparative efficacy of different chemicals, fungicides, phytoextracts and bioagents.

PL PATH 508 DISEASES OF FRUITS, PLANTATION AND ORNAMENTAL CROPS 3(2+1)

Objective

To acquaint with diseases of fruits, plantation, ornamental plants and their management.

Theory

Introduction, symptoms and etiology of different fruit diseases. Factors affecting disease development in fruits like apple, pear, peach, plum, apricot, cherry, walnut, almond, strawberry, citrus, mango, grapes, guava, *ber*, banana, pineapple, papaya, fig, pomegranate, date palm and management of the fruits diseases. Symptoms, mode of perpetuation of diseases of plantation crops such as tea, coffee, rubber and coconut and their management. Symptoms and life cycle of pathogens. Factors affecting disease development of ornamental plants such as roses, gladiolus, tulip, carnation, orchids, marigold, chrysanthemum and their management.

Practical

Detailed study of symptoms and host parasite relationship of representative diseases of plantation crops. Collection and dry preservation of diseased specimens of important crops.

PL PATH 509 DISEASES OF VEGETABLE AND SPICES CROPS**3(2+1)****Objective**

To impart knowledge about symptoms, epidemiology of different diseases of vegetables and spices and their management. 72

Theory

Nature, prevalence, factors affecting disease development of bulb, leafy vegetable, crucifers, cucurbits and solanaceous vegetables. Diseases of protected cultivation. Symptoms and management of diseases of different root, bulb, leafy vegetables, crucifers, cucurbits and solanaceous vegetable crops. Symptoms, epidemiology and management of diseases of different spice crops such as black pepper, saffron, cumin, coriander, turmeric, fennel, fenugreek and ginger.

Practical

Detailed study of symptoms and host pathogen interaction of important diseases of vegetable and spice crops.

PL PATH 510 SEED HEALTH TECHNOLOGY**3(2+1)****Objective**

To acquaint with seed-borne diseases, their nature, detection, transmission, epidemiology, impacts/loses and management.

Theory

History and economic importance of seed pathology in seed industry, plant quarantine and SPS under WTO. Morphology and anatomy of typical monocotyledonous and dicotyledonous infected seeds. Recent advances in the establishment and subsequent cause of disease development in seed and seedling. Localization and mechanism of seed transmission in relation to seed

infection, seed to plant transmission of pathogens. Seed certification and tolerance limits, types of losses caused by seed-borne diseases in true and vegetatively propagated seeds, evolutionary adaptations of crop plants to defend seed invasion by seed-borne pathogens. Epidemiological factors influencing the transmission of seed-borne diseases, forecasting of epidemics through seed-borne infection. Production of toxic metabolites affecting seed quality and its impact on human, animal and plant health, management of seed-borne pathogen/diseases and procedure for healthy seed production, seed health testing, methods for detecting microorganism.

Practical

Conventional and advanced techniques in the detection and identification of seed-borne fungi, bacteria and viruses. Relationship between seed-borne infection and expression of the disease in the field.

PL PATH 514 INSECT VECTORS OF PLANT VIRUSES AND OTHER PATHOGENS

2

(1+1)

Objective

To teach the students about the different groups of insects that vector plant pathogens, vector-plant pathogen interaction, management of vectors for controlling diseases.

Theory

History of developments in the area of insects as vectors of plant pathogens. Important insect vectors and their characteristics; mouth parts and feeding processes of important insect vectors. Efficiency of transmission. Transmission of plant viruses and fungal pathogens. Relation between viruses and their vectors. Transmission of plant viruses by aphids, whiteflies, mealy bugs and thrips. Transmission of mycoplasma and bacteria by leaf hoppers and plant hoppers. Transmission of plant viruses by psyllids, beetles and mites. Epidemiology and management of insect transmitted diseases through vector management.

Practical

Identification of common vectors of plant pathogens- aphids, leafhoppers, whiteflies, thrips, beetles, nematodes; culturing and handling of vectors; demonstration of virus transmission through vectors- aphids, leafhoppers and whiteflies.

Semester III

PL PATH 511

CHEMICALS IN PLANT DISEASE MANAGEMENT

3(2+1)

Objective

To impart knowledge on the concepts, principles and judicious use of chemicals in plant disease management.

Theory

History and development of chemicals; definition of pesticides and related terms; advantages and disadvantages of chemicals. Classification of chemicals used in plant disease control and their characteristics. Chemicals in plant disease control, viz., fungicides, bactericides, nematocides, antiviral chemicals and botanicals. Formulations, mode of action and application of different fungicides; chemotherapy and phytotoxicity of fungicides. Handling, storage and precautions to be taken while using fungicides; compatibility with other agrochemicals, persistence, cost-benefit ratio, factor affecting fungicides. General account of plant protection appliances; environmental pollution, residues and health hazards, fungicidal resistance in plant pathogens and its management.

Practical

Acquaintance with formulation of different fungicides and plant protection appliances. Formulation of fungicides, bactericides and nematocides; *in vitro* evaluation techniques, preparation of different concentrations of chemicals including botanical pesticides based on active ingredients against pathogens; persistence, compatibility with other agro-chemicals; detection of naturally occurring fungicide resistant mutants of pathogen; methods of application of chemicals.

PL PATH 512

ECOLOGY OF SOIL-BORNE PLANT PATHOGENS

3(2+1)

Objective

To provide knowledge on soil-plant disease relationship.

Theory

Soil as an environment for plant pathogens, nature and importance of rhizosphere and rhizoplane, host exudates, soil and root inhabiting fungi. Types of biocontrol agents. Inoculum potential and density in relation to host and soil variables, competition, predation, antibiosis and fungistasis. Suppressives soils, biological control- concepts and potentialities for managing soil borne pathogens.

Practical

Quantification of rhizosphere and rhizoplane microflora with special emphasis on pathogens; pathogenicity test by soil and root inoculation techniques, correlation between inoculum density of test pathogens and disease incidence, demonstration of fungistasis in natural soils; suppression of test soil-borne pathogens by antagonistic microorganisms. Isolation and identification of different biocontrol agents.

PL PATH 513

DISEASE RESISTANCE IN PLANTS

2(2+0)

Objective

To acquaint with disease resistance mechanisms in plants. 75

Theory

Introduction and historical development, dynamics of pathogenicity, process of infection, variability in plant pathogens, gene centres as sources of resistance, disease resistance terminology. Disease escapes, disease tolerance, disease resistance, types of resistance, identification of physiological races of pathogens, disease progression in relation to resistance, stabilizing selection pressure in plant pathogens. Host defence system, morphological and anatomical resistance, preformed chemicals in host defence, post infectious chemicals in host defence, phytoalexins, hypersensitivity and its mechanisms. Gene-for-gene concept, protein-for-protein and immunization basis, management of resistance genes. Strategies for gene deployment.

PL PATH 515

BIOLOGICAL CONTROL OF PLANT DISEASES

3(2+1)

Objective

To study principles and application of ecofriendly and sustainable management strategies of plant diseases.

Theory

Concept of biological control, definitions, importance, principles of plant disease management with bioagents, history of biological control, merits and demerits of biological control. Types of biological interactions, competition, mycoparasitism, exploitation for hypovirulence, rhizosphere colonization, competitive saprophytic ability, antibiosis, induced resistance, mycorrhizal associations, operational mechanisms and its relevance in biological control. Factors governing biological control, role of physical environment, agroecosystem, operational mechanisms and cultural practices in biological control of pathogens, pathogens and antagonists and their relationship, biocontrol agents, comparative approaches to biological control of plant pathogens by resident and introduced antagonists, control of soil-borne and foliar diseases. Compatibility of different bioagents. Commercial production of antagonists, their delivery systems, application and monitoring, biological control in IDM, IPM and organic farming system, biopesticides available in market. Quality control system of biocontrol agents.

Practical

Isolation, characterization and maintenance of antagonists, methods of study of antagonism and antibiosis, application of antagonists against pathogen *in vitro* and *in vivo* conditions. Study of cfu/g.

PL PATH 516

INTEGRATED DISEASE MANAGEMENT

3(2+1)

Objective

To emphasize the importance and need of IDM in the management of diseases of important crops.

Theory

Introduction, definition, concept and tools of disease management, components of integrated disease management- their limitations and implications. Development of IDM- basic principles, biological, chemical and cultural disease

management. IDM in important crops- rice, wheat, cotton, sugarcane, chickpea, rapeseed/mustard, pearl millet, *kharif* pulses, vegetable crops and fruit crops.

Practical

Application of biological, cultural, chemical and biocontrol agents, their compatibility and integration in IDM; demonstration of IDM in certain crops as project work.

PL PATH 507 DISEASES OF FIELD AND MEDICINAL CROPS 3(2+1)

Objective

To educate about the nature, prevalence, etiology, factors affecting disease development and control measures of field and medicinal crop diseases.

Theory

Diseases of Cereal crops- wheat, barley, rice, pearl millet, sorghum and maize. Diseases of Pulse crops- gram, urdbean, mungbean, lentil, pigeonpea, soybean. Diseases of Oilseed crops- rapeseed and mustard, sesame, linseed, sunflower, groundnut, castor. Diseases of Cash crops- cotton, sugarcane. Diseases of Fodder legume crops- berseem, oats, guar, lucerne, cowpea. Medicinal crops- plantago, liquorice, *mulathi*, rosagrass, sacred basil, mentha, *ashwagandha*, *Aloe vera*. 71

Practical

Detailed study of symptoms and host parasite relationship of important diseases of above mentioned crops. Collection and dry preservation of diseased specimens of important crops.

PL PATH 518 EPIDEMIOLOGY AND FORECASTING OF PLANT DISEASES 3(2+1)

Objective

To acquaint with the principles of epidemiology and its application in disease forecasting.

Theory

Epidemic concept and historical development, pathometry and crop growth stages, epidemic growth and analysis. Common and natural logarithms, function fitting area under disease progress curve and correction factors, inoculum

dynamics, population biology of pathogens, temporal spatial variability in plant pathogens. Survey, surveillance and vigilance, crop loss assessment and models. Principles and pre-requisites of forecasting, systems and factors affecting various components of forecastings, some early forecasting, procedures based on weather and inoculum potential, modeling disease growth and disease prediction.

Practical

Measuring diseases, spore dispersal and trapping, weather recording, survey, multiplication of inoculum, computerized data analysis, function fitting, model preparation and validation.

PL PATH 520

PLANT QUARANTINE

2(2+0)

Objective

To acquaint the learners about the principles and the role of Plant Quarantine in containment of pests and diseases, plant quarantine regulations and set-up.

Theory

Definition of pest, pesticides and transgenics as per Govt. notification; relative importance; quarantine – domestic and international. Quarantine restrictions in the movement of agricultural produce, seeds and planting material; case histories of exotic pests/diseases and their status. Plant protection organization in India. Acts related to registration of pesticides and transgenics. History of quarantine legislations, PQ Order 2003. Environmental Acts, Industrial registration; APEDA, Import and Export of bio-control agents. Identification of pest/disease free areas; contamination of food with toxigens, microorganisms and their elimination; Symptomatic diagnosis 81 and other techniques to detect pest/pathogen infestations; VHT and other safer techniques of disinfestation/salvaging of infected material. WTO regulations; non-tariff barriers; Pest risk analysis, good laboratory practices for pesticide laboratories; pesticide industry; Sanitary and Phytosanitary measures.