Course Upgradation

MSc. (Ag.) Plant Pathology

(A Two-Year Course)

Under

School of Advanced Agriculture Sciences and Technology

Department of Plant Pathology

Proposed by

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Course effective from: 2026-27

M. Sc. (AG.) PLANT PATHOLOGY COURSES

MAJOR COURSES OF PLANT PATHOLOGY			
PPTH 501	Core	Mycology	3(2+1)
PPTH 502	Core	Plant Virology	3(2+1)
PPTH 503	Core	Plant Pathogenic Prokaryotes	3(2+1)
PPTH 504	Core	Plant Nematology	3(2+1)
PPTH 505	Core	Principles of Plant Pathology	3(2+1)
PPTH 506	Core	Techniques in Detection & Diagnosis of Plant Diseases	2(0+2)
PPTH 507	Core	Principles of Plant Disease Management	3(2+1)
PPTH 515	Core	Diseases of Field and Medicinal Crops	3(2+1)
		TOTAL	**23**
MINOR COURSES OF PLANT PATHOLOGY			
ENT 508	Minor	Concepts of Integrated Pest Management	2(2+0)
ENT 509	Minor	Pests of Field Crops	3(2+1)
ENT 520	Minor	Plant Quarantine, Biosafety and Biosecurity	2(2+0)
ENT 515	Minor	Techniques in Plant Protection	1(0+1)
		TOTAL	**08**
SUPPORTING COURSES OF PLANT PATHOLOGY			
STAT 511	Supporting	Experimental Designs	3(2+1)
GPB 516	Supporting	Breeding for Stress Resistance and Climate Change	3(2+1)
		TOTAL	**06**
COMMON COURSES FOR PG PROGRAMMES			
PGS 501	Compulsory Non-Credit	Library and Information Services	1(0+1)
PGS 502	Compulsory Non-Credit	Technical Writing and Communications Skills	1(0+1)
PGS 503	Compulsory Non-Credit	Intellectual Property and Its Management in Agriculture	1(1+0)
PGS 504	Compulsory Non-Credit	Basic Concepts in Laboratory Techniques	1(0+1)
PGS 505	Compulsory Non-Credit	Agricultural Research, Research Ethics and Rural Development Programmes	1(1+0)
		TOTAL	**05**
PPTH 591	Seminar	Master's Course Seminar	**01**
PPTH 521	Master's Research	Master's Research	**30**
TOTAL CREDITS			**73**

M. Sc. AG. PLANT PATHOLOGY COURSE STRUCTURE

Course code	Type	Course title	Min credits	CIA	ESE	Max. Marks
IST YEAR / IST SEM						
PPTH 501	Core	Mycology	3(2+1)	50	50	100
PPTH 505	Core	Principles of Plant Pathology	3(2+1)	50	50	100
PPTH 506	Core	Techniques in Detection & Diagnosis of Plant Diseases	2(0+2)	100	-	100
ENT 509	Minor	Pests of Field Crops	3(2+1)	50	50	100
GPB 512	Supporting	Breeding for Stress Resistance and Climate Change	3(2+1)	50	50	100
PGS 501	Compulsory Non-Credit	Library and Information Services	1(0+1)	100	-	100
PGS 502	Compulsory Non-Credit	Technical Writing and Communications Skills	1(0+1)	100	-	100
TOTAL			**16**			**700**
IST YEAR / IIND SEM						
PPTH 502	Core	Plant Virology	3(2+1)	50	50	100
PPTH 503	Core	Plant Pathogenic Prokaryotes	3(2+1)	50	50	100
PPTH 515	Core	Diseases of Field and Medicinal Crops	3(2+1)	50	50	100
ENT 508	Minor	Concepts of Integrated Pest Management	2(2+0)	50	50	100
STAT 511	Supporting	Experimental Designs	3(2+1)	50	50	100
PGS 503	Compulsory Non-Credit	Intellectual Property and Its Management in Agriculture	1(1+0)	50	50	100
PGS 504	Compulsory Non-Credit	Basic Concepts in Laboratory Techniques	1(0+1)	100	-	100
TOTAL			**16**			**700**
IIND YEAR / IIIRD SEM						
PPTH 504	Core	Plant Nematology	3(2+1)	50	50	100
PPTH 507	Core	Principles of Plant Disease Management	3(2+1)	50	50	100
ENT 520	Minor	Plant Quarantine, Biosafety and Biosecurity	2(2+0)	50	50	100
ENT 515	Minor	Techniques in Plant Protection	1(0+1)	100	-	100
PGS 505	Compulsory Non-Credit	Agricultural Research, Research Ethics and Rural Development Programmers'	1(1+0)	50	50	100
TOTAL			**10**			**500**
IIND YEAR / IVTH SEM						
PPTH 591	Seminar	Master's Course Seminar	1	100	-	100
PPTH 599	Research	Master's Research (Thesis/Dissertation) Thesis Report Viva-Voce Examination	30	100	-	100
TOTAL			**31**			**200**
GRAND TOTAL			**73**			**2100**

SYLLABUS OF MAJOR COURSES OF PLANT PATHOLOGY

PPTH 501 **MYCOLOGY** **3(2+1)**

Objective: To study the nomenclature, classification and characters of fungi.

Theory

UNIT I

Introduction, definition of different terms, basic concepts. Importance of mycology in agriculture, relation of fungi to human affairs. History of mycology. Importance of culture collection and herbarium of fungi. Somatic characters and reproduction in fungi. Modern concept of nomenclature and classification, Classification of kingdom fungi: Stramenopila and Protists.

UNIT II

The general characteristics of protists and life cycle in the Phyla Plasmodiophoromycota, Dictyosteliomycota, Acrasiomycota and Myxomycota. Kingdom Stramenopila: characters and life cycles of respective genera under Hypochytriomycota, Oomycota and Labyrinthulomycota.

UNIT III

Kingdom fungi: General characters, ultrastructure and life cycle patterns in representative genera under Chytridiomycota, Zygomycota, Ascomycota; Archiascomycetes, Ascomycetous yeasts, Pyrenomycetes, Plectomycetes, Discomycetes, Loculoascomycetes, Erysiphales and anamorphs of ascomycetous fungi.

UNIT IV

Basidiomycota; general characters, mode of reproduction, types of basidiocarps and economic importance of Hymenomycetes. Uridinales and Ustilaginales; variability, host specificity and life cycle pattern in rusts and smuts. Mitosporic fungi; status of asexual fungi, their teliomorphic relationships, Molecular characterization of plant pathogenic fungi.

Practical

Detailed comparative study of different groups of fungi; Collection of cultures and live specimens. Saccardoan classification and classification based on conidiogenesis. Vegetative structures and different types of fruiting bodies produced by slime molds, stramenopiles and true fungi. Myxomycotina: Fructification, plasmodiocarp, sporangia, plasmodium and aethalia. Oomycota; somatic and reproductory structures of Pythium, Phytophthora, downy mildews and Albugo, Zygomycetes: Sexual and asexual structures of Mucor, Rhizopus, General characters of VAM fungi. Ascomycetes; fruiting structures, Erysiphales, and Eurotiales; general identification characters of Pyrenomycetes, Discomycetes, Loculoascomycetes and Laboulbeniomycetes, Basidiomycetes; characters, ultrastructures and life cycle patterns in Ustilaginomycetes and Teliomycetes, Deuteromycetes; characters of Hyphomycetes and Coelomycetes and their teliomorphic and anamorphic states, Collection, preservation, culturing and identification of plant parasitic fungi. Application of molecular approaches and techniques for identification of fungal pathogens.

Suggested Readings:

- Ainsworth GC, Sparrow FK &Susman HS. 1973. The Fungi – An Advanced Treatise. Vol. IV (A & B). Academic Press, New York.
- Alexopoulos CJ, Mims CW & Blackwell M.2000. Introductory Mycology. 5th Ed. John Wiley & Sons, New York.
- Maheshwari R 2016. Fungi: Experimental Methods in Biology 2nd edn. CRC Press, US. Mehrotra RS & Arneja KR. 1990. An Introductory Mycology. Wiley Eastern, New Delhi. Sarbhoy AK. 2000. Text book of Mycology. ICAR, New Delhi.
- Singh RS. 1982. Plant Pathogens – The Fungi. Oxford & IBH, New Delhi.

Course Outcome

Students are expected to gain fundamental knowledge of the nomenclature, classification, morphology, reproduction and life cycles of fungi, protists and stramenopiles. It helps in understanding the economic and agricultural importance of fungi, especially plant pathogenic forms, and their role in human affairs. Students develop skills in identifying major fungal groups based on somatic, reproductive and cultural characters, and learn both classical and molecular approaches for fungal identification, collection, preservation and culturing.

PPTH 502 **PLANT VIROLOGY** **3(2+1)**

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

Theory

UNIT I

History and economic significances of plant viruses. General and morphological characters, composition and structure of viruses. Myco-viruses, arbo and baculo viruses, satellite viruses, satellite RNAs, phages, viroids and prions. Origin and evolution of viruses and their nomenclature and classification.

UNIT II

Genome organization, replication in selected groups of plant viruses and their movement in host. Response of the host to virus infection: biochemical, physiological, and symptomatical changes. Transmission of viruses and virus-vector relationship. Isolation and purification of viruses.

UNIT III

Detection and identification of plant viruses by using protein and nucleic acid based diagnostic techniques. Natural (R-genes) and engineering resistance to plant viruses.

UNIT IV

Virus epidemiology and ecology (spread of plant viruses in fields, host range and survival). Management of diseases caused by plant viruses.

Practical

Study of symptoms caused by plant viruses (followed by field visit). Isolation and biological purification of plant virus cultures. Bioassay of virus cultures on indicator plants and host differentials. Transmission of plant viruses (Mechanical, graft and vector and study of disease development). Plant virus purification (clarification, concentration, centrifugation, high resolution separation and analysis of virions), Electron microscopy for studying viral particle morphology. Antisera production, Detection and diagnosis of plant viruses with serological (ELISA), nucleic acid (Non-PCR–LAMP, Later flow micro array & PCR based techniques. Exposure to basic bio-informatic tools for viral genome analysis and their utilization in developing detection protocols and population studies (BLASTn tool, Primer designing software, Bioedit tool, Claustal X/W, MEGA Software).

Suggested Readings

- Bos L. 1964. Symptoms of Virus Diseases in Plants. Oxford & IBH., New Delhi.
- Brunt AA, Krabtree K, Dallwitz MJ, Gibbs AJ & Watson L. 1995. Virus of Plants: Descriptions and Lists from VIDE Database. CABI, Wallington.
- Gibbs A & Harrison B. 1976. Plant Virology - The Principles. Edward Arnold, London. Hull R. 2002.
- Mathew's Plant Virology. 4th Ed. Academic Press, New York.
- Noordam D. 1973. Identification of Plant Viruses, Methods and Experiments. Oxford & IBH, New Delhi.
- Wilson C, 2014. Applied Plant Virology. CABI Publishing England

Course Outcome

Students are expected to understand the structure, classification, biology and evolution of plant viruses and their interaction with host plants and vectors. It develops knowledge of virus transmission, epidemiology and management strategies for viral diseases in crops. Students gain practical skills in symptom recognition, isolation, purification, detection and diagnosis of plant viruses using serological, molecular and bioinformatic tools, and learn approaches for developing natural and engineered resistance in plants.

PPTH 503 **PLANT PATHOGENIC PROKARYOTES** **3(2+1)**

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

Theory

UNIT I

Prokaryotic cell: History and development of Plant bacteriology, history of plant bacteriology in India. Evolution of prokaryotic life, Prokaryotic cytoskeletal proteins. Structure of bacterial cell. Structure and composition of gram negative and gram positive cell wall; synthesis of peptidoglycan; Surface proteins; Lipopolysaccharide structure; Membrane transport; fimbriae and pili (Type IV pili); Mechanism of flagellar rotatory motor and locomotion, and bacterial movement; Glycocalyx (S-layer; capsule); the bacterial chromosomes and plasmids; Operon and other structures in cytoplasm; Morphological feature of fastidious bacteria, spiroplasma and Phytoplasma.

UNIT II

Growth and nutritional requirements. Infection mechanism, role of virulence factors in expression of symptoms. Survival and dispersal of phytopathogenic prokaryotes.

UNIT III

Taxonomy of phytopathogenic prokarya: Taxonomic ranks hierarchy; Identification, Classification and nomenclature of bacteria, phytoplasma and spiroplasma. The codes of Nomenclature and characteristics. Biochemical and molecular characterization of phytopathogenic prokaryotes.

UNIT IV

Variability among phytopathogenic prokarya: general mechanism of variability (mutation); specialized mechanisms of variability (sexual like process in bacteria-conjugation; transformation; transduction); and horizontal gene transfer.

UNIT V

Bacteriophages, L form of bacteria, plasmids and bdellovibrios: Structure; Infection of host cells; phage multiplication cycle; Classification of phage, Use of phage in plant pathology/bacteriology, Lysogenic conversion; H Plasmids and their types, plasmid borne phenotypes. Introduction to bacteriocins. Strategies for management of diseases caused by phytopathogenic prokaryotes.

Practical

Study of symptoms produced by phytopathogenic prokaryotes. Isolation, enumeration, purification, identification and host inoculation of phytopathogenic bacteria. Stains and staining methods. Biochemical and serological characterization. Isolation of genomic DNA plasmid. Use of antibacterial chemicals/antibiotics. Isolation of fluorescent Pseudomonas. Preservation of bacterial cultures. Identification of prokaryotic organisms by using 16S rDNA, and other gene sequences. Diagnosis and management of important diseases caused by bacteria and mollicutes.

Suggested Readings

- Goto M. 1990. Fundamentals of Plant Bacteriology. Academic Press, New York.
- Jayaraman J & Verma JP. 2002. Fundamentals of Plant Bacteriology. Kalyani Publ., Ludhiana. Mount MS & Lacy GH. 1982. Phytopathogenic Prokaryotes. Vols. I, II Academic Press, New York. Salle AJ 1979. Fundamental Principles of Bacteriology 7th edn.
- Verma JP, Varma A & Kumar D. (Eds). 1995. Detection of Plant Pathogens and their Management. Angkor Publ., New Delhi.

Course Outcome

Students will be able to understand the structure, classification, biology and variability of plant pathogenic prokaryotes, including bacteria, phytoplasmas and spiroplasmas. It develops knowledge of their nutritional requirements, infection mechanisms, survival, dissemination and disease management strategies. Students acquire practical skills in isolation, identification, biochemical and molecular characterization, and diagnosis of phytopathogenic prokaryotes using classical and modern techniques.

PPTH 504 PLANT NEMATOLOGY 3(2+1)

Objective : To project the importance of nematodes in agriculture and impart basic knowledge on all aspects of plant nematology.

Theory

UNIT I

Characteristics of Phylum Nematoda and its relationship with other related phyla, history and growth of Nematology; nematode habitats and diversity- plant, animal and human parasites; useful nematodes; economic importance of nematodes to agriculture, horticulture and forestry.

UNIT II

Gross morphology of plant parasitic nematodes; broad classification, nematode biology, physiology and ecology.

UNIT III

Types of parasitism; nature of damage and general symptomatology; interaction of plant parasitic nematodes with other organisms.

UNIT IV

Plant nematode relationships, cellular responses to infection by important phytonematodes; physiological specialization among phytonematodes.

UNIT V

Principles and practices of nematode management; integrated nematode management.

UNIT VI

Emerging nematode problems, Importance of nematodes in international trade and quarantine.

Practical

Studies on kinds of nematodes- free-living, animal, insect and plant parasites; nematode extraction from soil; extraction of migratory endoparasites, staining for sedentary endoparasites; examination of different life stages of important plant parasitic nematodes, their symptoms and histopathology.

Suggested Readings

- Dropkin VH. 1980. An Introduction to Plant Nematology. John Wiley & Sons, New York. Maggenti AR. 1981. General Nematology. Springer-Verlag, New York.
- Perry RN & Moens M. 2013. Plant Nematology. 2nd Ed. CABI Publishing: Wallingford, UK. Perry RN, Moens M, & Starr, JL. 2009. Root-knot nematodes, CABI Publishing: Wallingford, UK.
- Sikora RA, Coyne D, Hallman J and Timper P, 2018. Plant Parasitic Nematodes in Subtropical and Tropical Agriculture.3rd edn. CABI Publishing, England.
- Thorne G. 1961. Principles of Nematology. McGraw Hill, New Delhi.
- Walia RK & Bajaj HK. 2003. Text Book on Introductory Plant Nematology. ICAR, New Delhi. Walia RK. & Khan MR. 2018. A Compendium of Nematode Diseases of Crop Plants, ICAR-AICRP (Nematodes), IARI, New Delhi.

Course Outcome

Students will be able to understand the diversity, morphology, biology and economic importance of nematodes in agriculture. It provides knowledge of plant–nematode interactions, types of parasitism, symptomatology and cellular responses to nematode infection. Students develop practical skills in nematode extraction, identification, diagnosis of nematode diseases and application of integrated nematode management strategies, including awareness of emerging nematode problems and quarantine issues.

PPTH 505 **PRINCIPLES OF PLANT PATHOLOGY** **3(2+1)**

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

Theory

UNIT I

Importance, definitions and concepts of plant diseases, history and growth of plant pathology, biotic and abiotic causes of plant diseases.

UNIT II

Growth, reproduction, survival and dispersal of important plant pathogens, role of environment and host nutrition on disease development.

UNIT III

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.

UNIT IV (12)

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

Practical

Basic plant pathological techniques. Isolation, inoculation and purification of plant pathogens and proving Koch's postulates. Techniques to study variability in different plant pathogens. Purification of enzymes, toxins and their bioassay. Estimation of growth regulators, phenols, phytoalexins in resistant and susceptible plants.

Suggested Readings

- Agrios GN. 2005. Plant Pathology. 5th Ed. Academic Press, New York.
- Heitefuss R & Williams PH. 1976. Physiological Plant Pathology. Springer Verlag, Berlin, New York. Mehrotra RS & Aggarwal A. 2003. Plant Pathology. 2nd Ed. Oxford & IBH, New Delhi.
- Singh RS 2017. Introduction to Principles of Plant Pathology. 5th edn. MedTech, New Delhi. Singh RP 2012. Plant Pathology 2nd edn. Kalyani Publishers, New Delhi.
- Singh DP & Singh A. 2007. Disease and Insect Resistance in Plants. Oxford & IBH, New Delhi. Upadhyay RK & Mukherjee KG. 1997. Toxins in Plant Disease Development and Evolving Biotechnology. Oxford & IBH, New Delhi.

Course Outcome

Students will gain fundamental understanding of plant pathology, including concepts, causes and development of plant diseases. It enables students to comprehend host–pathogen interactions, disease symptomatology, defense mechanisms and the genetic and molecular basis of disease resistance. Students gain essential practical skills in isolation, identification and study of plant pathogens, disease development and resistance mechanisms using classical and modern techniques.

PPTH 506 TECHNIQUES FOR 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

Detection of plant pathogens 1. based on visual symptoms, 2. Biochemical test 3. Using microscopic techniques, 4. Cultural studies; (use of selective media to isolate pathogens). 5. Biological assays(indicator hosts, differential hosts) 6. Serological assays 7. Nucleic acid based techniques (Non-PCR– LAMP, Later flow microarray & PCR based- multiplex, nested, qPCR, immune capture PCR, etc.). Phenotypic and genotypic tests for identification of plant pathogens. Molecular identification (16S rDNA and 16s-23S rDNA intergenic spacer region sequences-prokaryotic organisms; and eukaryotic organism by ITS region) and whole genome sequencing. Volatile compounds profiling by using GC-MS and LC-MS. FAME analysis, Fluorescence in-situ Hybridization (FISH), Flow Cytometry, Phage display technique, biosensors for detection of plant pathogens. Genotypic tools such as genome/specific gene sequence homology comparison by

BLAST (NCBI and EMBL) and electron microscopy techniques of plant virus detection and diagnosis.

Suggested readings

- Baudoin ABAM, Hooper GR, Mathre DE & Carroll RB. 1990. Laboratory Exercises in Plant Pathology: An Instructional Kit. Scientific Publ., Jodhpur.
- Dhingra OD & Sinclair JB. 1986. Basic Plant Pathology Methods. CRC Press, London, Tokyo. Fox RTV. 1993. Principles of Diagnostic Techniques in Plant Pathology, CABI Wallington.
- Mathews REF. 1993. Diagnosis of Plant Virus Diseases. CRC Press, Boca Raton, Tokyo. Pathak VN. 1984. Laboratory Manual of Plant Pathology. Oxford & IBH, New Delhi.
- Forster D & Taylor SC. 1998. Plant Virology Protocols: From Virus Isolation to Transgenic Resistance. Methods in Molecular Biology. Humana Press, Totowa, New Jersey.
- Matthews REF. 1993. Diagnosis of Plant Virus Diseases. CRC Press, Florida.
- Noordam D. 1973. Identification of Plant Viruses, Methods and Experiments. Cent. Agic. Pub. Doc. Wageningen.
- Trigiano RN, Windham MT & Windham AS. 2004. Plant Pathology-Concepts and Laboratory Exercises. CRC Press, Florida. Chakravarti BP. 2005. Methods of Bacterial Plant Pathology. Agrotech, Udaipur.

Course Outcome

This course will equip students with practical knowledge and hands-on skills in modern techniques used for detection, identification and diagnosis of plant pathogens. It enables understanding and application of visual, biochemical, cultural, biological, serological, molecular and advanced instrumental methods, including genomic, proteomic and bioinformatic tools. Students develop competence in accurate pathogen diagnosis and the use of sophisticated instruments for plant disease research and management.

PPTH 507 PRINCIPLES OF PLANT DISEASE MANAGEMENT 3(2+1)

Objective : To acquaint with different strategies for management of plant diseases.

Theory

UNIT I

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.

UNIT II

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. Label claim of fungicides.

UNIT III (14)

Application of chemicals on foliage, seed and soil, role of stickers, spreaders and other adjuvants, health vis-a-vis environmental hazards, residual effects and safety measures.

Practical :

Phytopathometry. Methods of in vitroevaluation of chemicals, antibiotics, bio agents against plant pathogens. Field evaluation of chemicals, antibiotics, bio agents against plant pathogens. Soil solarisation, methods of soil fumigation under protected cultivation. Methods of application of chemicals and bio control agents. ED and MIC values, study of structural details of sprayers and dusters. Artificial epiphytotic and screening of resistance.

Suggested Readings

- Fry WE. 1982. Principles of Plant Disease Management. Academic Press, New York.
- Hewitt HG. 1998. Fungicides in Crop Protection. CABI, Wallington. Marsh RW. 1972. Systemic Fungicides. Longman, New York.
- Nene YL & Thapliyal PN. 1993. Fungicides in Plant Disease Control. Oxford & IBH, New Delhi. Palti J. 1981. Cultural Practices and Infectious Crop Diseases. Springer Verlag, New York.
- Vyas SC. 1993 Handbook of Systemic Fungicides. Vols. I-III. Tata McGraw Hill, New Delhi.

PPTH 515 **DISEASES OF FIELD AND MEDICINAL CROPS** **3(2+1)**

Theory

UNIT I

Diseases of Cereal crops- Rice, wheat, barley, pearl millet, sorghum and maize.

UNIT II

Diseases of Pulse crops- gram, urd bean, mungbean, lentil, pigeonpea, soybean and cowpea.

UNIT III

Diseases of Oilseed crops- rapeseed and mustard, sesame, linseed, sunflower, groundnut, castor.

UNIT IV

Diseases of Cash crops- cotton, sugarcane.

UNIT V

Diseases of Fodder legume crops- berseem, oats, guar, lucerne,

UNIT VI

Medicinal crops- plantago, liquorice, mulathi, rosagrass, sacred basil, mentha, ashwagandha, Aloe vera

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.

Suggested Readings

- Joshi L M, Singh D.V & Srivastava K. D. 1984. Problems and Progress of Wheat Pathology in South Asia. Malhotra Publ. House, New Delhi.
- Rangaswami G. 1999. Diseases of Crop Plants in India. 4th Ed.. Prentice Hall of India, New Delhi. Ricanel C, Egan BT, Gillaspie Jr AG & Hughes CG. 1989. Diseases of Sugarcane, Major Diseases. Academic Press, New York.
- Singh RS. 2017. Plant Diseases. 10th Ed. Medtech, New Delhi.
- Singh US, Mukhopadhyay AN, Kumar J & Chaube HS. 1992. Plant Diseases of Internatiobnal Importance. Vol. I. Diseases of Cereals and Pulses. Prentice Hall, Englewood Cliffs, New Jersey.

Course Outcome

The students will acquire comprehensive knowledge of important diseases affecting cereal, pulse, oilseed, cash, fodder and medicinal crops. It helps in understanding disease symptoms, host–pathogen relationships and their impact on crop productivity. Students develop practical skills in disease diagnosis through symptom recognition, field collection and preservation of diseased plant specimens.

SYLLABUS OF MINOR COURSES OF PLANT PATHOLOGY

ENT 508 CONCEPTS OF INTEGRATED PEST MANAGEMENT 2(2+0)

Objective : To familiarize the students with principles of insect pest management, including concept and philosophy of IPM. Train students in computation of ETL and implementing IPM programmes.

Theory

UNIT I

History, origin, definition and evolution of various terminologies. Importance of resistance, principles, classification, components, types and mechanisms of resistance. National and international level crop protection organizations; insecticide regulatory bodies; synthetic insecticide, bio-pesticide and pheromone registration procedures; label claim of pesticides – the pros and cons.

UNIT II

Concept and philosophy, ecological principles, economic threshold concept and economic consideration. Insect- host plant relationships; theories and basis of host plant selection in phytophagous insects.

UNIT III

Tools of pest management and their integration- legislative, quarantine regulations, cultural, physical and mechanical methods; semiochemicals, biotechnological and bio-rational approaches in IPM. Pest survey and surveillance, forecasting, types of surveys including remote sensing methods, factors affecting surveys; political, social and legal implications of IPM; pest risk analysis; pesticide risk analysis; cost-benefit ratios and partial budgeting; case studies of successful IPM programmes. ITK-s in IPM, area-wide IPM and IPM for organic farming; components of ecological engineering with successful examples.

UNIT IV

Characterization of agro-ecosystems; sampling methods and factors affecting sampling; population estimation methods; crop loss assessment direct losses, indirect losses, potential losses, avoidable losses, unavoidable losses; global and Indian scenario of crop losses. Computation of EIL and ETL; crop modeling; designing and implementing IPM system. Screening techniques; breeding for insect resistance in crop plants; exploitation of wild plant species; gene transfer, successful examples of resistant crop varieties in India and world. Learning outcomes Students are expected to have significant knowledge of IPM concepts, estimation of losses due to insect pests, computation of ETL, EIL and should be able take management decisions.

Suggested Readings

- Dhaliwal GS and Arora R. 2003. Integrated Pest Management – Concepts and Approaches. Kalyani Publ., New Delhi.
- Horowitz AR and Ishaaya I. 2004. Insect Pest Management: Field and Protected Crops. Springer, New Delhi. Ignacimuthu SS and Jayaraj S. 2007. Biotechnology and Insect Pest Management. Elite Publ., New Delhi.

- Pedigo RL. 2002. Entomology and Pest Management. 4th Ed. Prentice Hall, New Delhi.
- Norris RF, Caswell-Chen EP and Kogan M. 2002. Concepts in Integrated Pest Management. Prentice Hall, New Delhi.
- Subramanyam B and Hagstrum DW. 1995. Integrated Management of Insects in Stored Products. Marcel Dekker, New York.

Course outcome

Students are expected to have significant knowledge of IPM concepts, estimation of losses due to insect pests, computation of ETL, EIL and should be able take management decisions.

ENT 509 **PESTS OF FIELD CROPS** **3(2+1)**

Objective : To familiarize the students about nature of damage and seasonal incidence of pestiferous insects that cause loss to major field crops and their effective management by different methods.

Theory

Systematic position, identification, distribution, host-range, bionomics, nature and extent of damage, seasonal abundance and management of insect and mite pests and vectors. Insect pest scenario in relation to climate change.

UNIT I

Polyphagous pests: grasshoppers, locusts, termites, white grubs, hairy caterpillars, and non-insect pests (mites, birds, rodents, snails, slugs etc.). Insect pests of cereals and millets and their management.

UNIT II

Insect pests of pulses, tobacco, oilseeds and their management.

UNIT III

Insect pests of fibre crops, forage crops, sugarcane and their management.

Practical

Field visits, collection and identification of important pests and their natural enemies; detection and estimation of infestation and losses in different crops; study of life history of important insect pests. Learning outcomes Students are expected to acquire knowledge of insect pests of field crops, their nature of damage, life history traits and effective management.

Suggested Readings

- David, BV and Ramamurthy, VV. 2001. Elements of Economic Entomology. Popular Book Depot, Chennai.
- Dhaliwal GS, Singh R and Chhillar BS. 2006. Essentials of Agricultural Entomology. Kalyani Publ., New Delhi.
- Dunston AP. 2007. The Insects: Beneficial and Harmful Aspects. Kalyani Publ., New Delhi
- Evans JW. 2005. Insect Pests and their Control. Asiatic Publ., New Delhi.
- Nair MRGK. 1986. Insect and Mites of Crops in India. ICAR, New Delhi.
- Prakash I and Mathur RP. 1987. Management of Rodent Pests. ICAR, New Delhi.
- Saxena RC and Srivastava RC. 2007. Entomology at a Glance. Agrotech Publ. Academy, Udaipur.

Course outcome

Students are expected to acquire knowledge of insect pests of field crops, their nature of damage, life history traits and effective management.

ENT 515 TECHNIQUES IN PLANT PROTECTION 1(0+1)

Objective : To acquaint the students with appropriate use of plant protection equipments and techniques related to microscopy, computation, pest forecasting, etc.

Theory

UNIT I

Pest control equipments, principles, operation, maintenance, selection, and application of pesticides; release of bio-control agents; seed dressing, soaking, root-dip treatment, dusting, spraying, and pesticide application through irrigation water; application of drones in plant protection.

UNIT II

Soil sterilization, solarization, deep ploughing, flooding, techniques to check the spread of pests through seed, bulbs, corms, cuttings and cut flowers.

UNIT III

Uses of light, transmission and scanning electron microscopy.

UNIT IV

Protein isolation from the pest and host plant and its quantification using spectrophotometer and molecular weight determination using SDS/PAGE.

UNIT V

Use of tissue culture techniques in plant protection. Computer application for predicting/ forecasting pest attack and identification. Learning outcomes Students are expected to have a good knowledge of different plant protection equipments and techniques related to pest forecasting.

Suggested Readings

- Alford DV. 1999. A Textbook of Agricultural Entomology. Blackwell Science, London. Crampton JM and Eggleston P. 1992. Insect Molecular Science. Academic Press, London.

Course outcome

Students are expected to have a good knowledge of different plant protection equipments and techniques related to pest forecasting.

ENT 520 PLANT QUARANTINE, BIO-SAFETY AND BIO-SECURITY 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. Also, to facilitate students to have a good understanding of the aspects of biosafety and biosecurity.

Theory

UNIT I

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.

UNIT II

Plant protection organization in India. Acts related to registration of pesticides and transgenics. Insecticide regulatory bodies, synthetic insecticides, bio-pesticides and pheromone registration

procedures. History of quarantine legislations, PQ Order 2003. Environmental Acts, Industrial registration; APEDA, Import and Export of bio-control agents.

UNIT III

Identification of pest/disease free areas; contamination of food with toxigens, microorganisms and their elimination; Symptomatic diagnosis and other techniques to detect pest/pathogen infestations; VHT and other safer techniques of disinfestation/salvaging of infected material.

UNIT IV

WTO regulations; non-tariff barriers; pest risk analysis, good laboratory practices for pesticide laboratories; pesticide industry; sanitary and phytosanitary measures. Global Positioning System (GPS) and Geographic Information System (GIS) for plant biosecurity, pest/disease and epidemic management, strategies for combating risks and costs associated with agroterrorism event, mitigation planning, integrated approach for biosecurity. Biosafety, policies and regulatory mechanism, Cartagena Protocol on Biosafety and its implications, issues related to release of genetically modified crops.

Learning outcomes

Students offering this course are expected to have a good knowledge of the rules and regulations of Plant Quarantine, WTO regulations, GAP, Sanitary and Phytosanitary measures.

Suggested Readings

- Rajeev K and Mukherjee RC. 1996. Role of Plant Quarantine in IPM. Aditya Books.
- Rhower GG. 1991. Regulatory Plant Pest Management. In: Handbook of Pest Management in Agriculture. 2nd Ed. Vol. II. (Ed. David Pimental), CRC Press.
- Shukla, A. and Veda, O.P. 2007. Introduction to Plant Quarantine. Samay Prakashan, New Delhi.

SYLLABUS OF COMMON COURSES FOR PG PROGRAMMES

PGS 501 LIBRARY AND INFORMATION SERVICES (0+1)

Objective To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines etc.) of information search.

Practical

Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing information from reference sources; Literature survey; Citation techniques/Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services; Use of Internet including search engines and its resources; e-resources access methods.

PGS 502 TECHNICAL WRITING AND COMMUNICATIONS SKILLS

(0+1)

Objective : To equip the students/scholars with skills to write dissertations, research papers, etc. To equip the students/scholars with skills to communicate and articulate in English (verbal as well as writing).

Practical Technical Writing –

Various forms of scientific writings- theses, technical papers, reviews, manuals, etc; Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion); Writing of abstracts, summaries, précis, citations etc.; commonly used abbreviations in the theses and research communications; illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations; Writing of numbers and dates in scientific writeups; Editing and proof-reading; Writing of a review article. Communication Skills - Grammar (Tenses, parts of speech, clauses, punctuation marks); Error analysis (Common errors); Concord; Collocation; Phonetic symbols and transcription; Accentual pattern: Weak forms in connected speech: Participation in group discussion: Facing an interview; presentation of scientific papers.

Suggested Readings

- Chicago Manual of Style. 14th Ed. 1996. Prentice Hall of India.
- Collins' Cobuild English Dictionary. 1995.
- Harper Collins. Gordon HM & Walter JA. 1970. Technical Writing. 3rd Ed.
- Holt, Rinehart & Winston. Hornby AS. 2000. Comp. Oxford Advanced Learner's Dictionary of Current English. 6th Ed. Oxford University Press.
- James HS. 1994. Handbook for Technical Writing. NTC Business Books.
- Joseph G. 2000. MLA Handbook for Writers of Research Papers. 5th Ed. Affiliated East- West Press.

- Mohan K. 2005. Speaking English Effectively. MacMillan India.
- Richard WS. 1969. Technical Writing.
- Barnes & Noble. Robert C. (Ed.). 2005. Spoken English: Flourish Your Language. 10.
- Abhishek. Sethi J & Dhamija PV. 2004. Course in Phonetics and Spoken English. 2nd Ed. Prentice Hall of India. 11.
- Wren PC & Martin H. 2006. High School English Grammar and Composition. S. Chand & Co.

PGS 503 INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE (1+0)

Objective : The main objective of this course is to equip students and stakeholders with knowledge of intellectual property rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge-based economy.

Theory

Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement; Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of plant varieties and farmers' rights and biodiversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

Suggested Readings

- Erbisch FH & Maredia K.1998. Intellectual Property Rights in Agricultural Biotechnology. CABI.
- Ganguli P. 2001. Intellectual Property Rights: Unleashing Knowledge Economy. McGraw-Hill.
- Intellectual Property Rights: Key to New Wealth Generation. 2001. NRDC & Aesthetic Technologies.
- Ministry of Agriculture, Government of India. 2004. State of Indian Farmer. Vol. V. Technology Generation and IPR Issues. Academic Foundation.
- Rothschild M & Scott N. (Ed.). 2003. Intellectual Property Rights in Animal Breeding and Genetics. CABI.
- Saha R. (Ed.). 2006. Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies. Daya Publ. House.

The Indian Acts - Patents Act, 1970 and amendments; Design Act, 2000; Trademarks Act, 1999; The Copyright Act, 1957 and amendments; Layout Design Act, 2000; PPV and FR Act 2001, and Rules 2003; National Biological Diversity Act, 2003.

PGS 504 BASIC CONCEPTS IN LABORATORY TECHNIQUES (0+1)

Objective : To acquaint the students about the basics of commonly used techniques in laboratory.

Practical

Safety measures while in Lab; Handling of chemical substances; Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccupets; washing, drying and sterilization of glassware; Drying of solvents/chemicals. Weighing and preparation of solutions of different strengths and their dilution; Handling techniques of solutions; Preparation of different agro-chemical doses in field and pot applications; Preparation of solutions of acids; Neutralization of acid and bases; Preparation of buffers of different strengths and pH values. Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sandbath, waterbath, oilbath; Electric wiring and earthing. Preparation of media and methods of sterilization; Seed viability testing, testing of pollen viability; Tissue culture of crop plants; Description of flowering plants in botanical terms in relation to taxonomy.

Suggested Readings

- Furr AK. 2000. CRC Hand Book of Laboratory Safety. CRC Press.
- Gabb MH & Latchem WE. 1968. A Handbook of Laboratory Solutions. Chemical Publ. Co.

PGS 505 AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES (1+0)

Objective : To enlighten the students about the organization and functioning of agricultural research systems at national and international levels, research ethics, and rural development programmes and policies of Government.

Theory

UNIT I

History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions; Consultative Group on International Agricultural Research (CGIAR): International Agricultural Research Centres (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility.

UNIT II

Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.

UNIT III

Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme, Integrated Rural Development Programme (IRDP) Panchayati Raj Institutions, Co- operatives, Voluntary Agencies/NonGovernmental Organisations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.

Suggested Readings

- Bhalla GS & Singh G. 2001. Indian Agriculture - Four Decades of Development. Sage Publ.
- Punia MS. Manual on International Research and Research Ethics. CCS, Haryana Agricultural University, Hisar.
- Rao BSV. 2007. Rural Development Strategies and Role of Institutions - Issues, Innovations and Initiatives. Mittal Publ.
- Singh K.. 1998. Rural Development - Principles, Policies and Management. Sage Publ.

SYLLABUS OF SUPPLEMENTARY COURSES OF PLANT PATHOLOGY

STAT 511 **EXPERIMENTAL DESIGNS** **3(2+1)**

Objective : This course is meant for students of agricultural and animal sciences other than Agricultural Statistics. Designing an experiment is an integrated component of research in almost all sciences. The students would be exposed to concepts of Design of Experiments so as to enable them to understand the concepts involved in planning, designing their experiments and analysis of experimental data.

Theory

Unit I

Need for designing of experiments, characteristics of a good design. Basic principles of designs-randomization, replication and local control.

Unit II

Uniformity trials, size and shape of plots and blocks, Analysis of variance, Completely randomized design, randomized block design and Latin square design.

Unit III

Factorial experiments, (symmetrical as well as asymmetrical). orthogonality and partitioning of degrees of freedom. Concept of confounding.

Unit IV

Split plot and strip plot designs, analysis of covariance and missing plot techniques in randomized block and Latin square designs; Transformations, Balanced Incomplete Block Design, resolvable designs and their applications, Lattice design, alpha design - concepts, randomization procedure, analysis and interpretation of results. Response surfaces. Combined analysis.

Practical

Uniformity trial data analysis, formation of plots and blocks, Fairfield Smith Law, Analysis of data obtained from CRD, RBD, LSD, Analysis of factorial experiments; Analysis with missing data; Split plot and strip plot designs.

Suggested Reading

- Cochran WG and Cox GM. 1957. Experimental Designs. 2nd Ed. John Wiley.
- Dean AM and Voss D. 1999. Design and Analysis of Experiments. Springer.
- Montgomery DC. 2012. Design and Analysis of Experiments, 8th Ed. John Wiley. • Federer WT. 1985. Experimental Designs. MacMillan.
- Fisher RA. 1953. Design and Analysis of Experiments. Oliver & Boyd.
- Nigam AK and Gupta VK. 1979. Handbook on Analysis of Agricultural Experiments. IASRI Publ.
- Pearce SC. 1983. The Agricultural Field Experiment: A Statistical Examination of Theory and Practice. John Wiley.
- www.drs.icar.gov.in.

GPB 516 BREEDING FOR STRESS RESISTANCE AND CLIMATE CHANGE 3(2+1)

Objective: To apprise about various abiotic and biotic stresses influencing crop yield, mechanisms and genetics of resistance and methods to breed stress tolerant varieties.

Theory

Unit I

Concept and impact of climatic change; Importance of plant breeding with special reference to biotic and abiotic stress resistance; Classification of biotic stresses major pests and diseases of economically important crops.

Unit II

Concepts of resistance to insect and pathogen resistance; Analysis and inheritance of resistance variation; Host defence responses to pathogen invasions- Biochemical and molecular mechanisms; Acquired and induced immunity and systemic acquired resistance (SAR); Host-pathogen interaction, gene-for-gene hypothesis, molecular evidence for its operation and exceptions; Concept of signal transduction and other host-defence mechanisms against viruses and bacteria.

Unit III

Types and genetic mechanisms of resistance to biotic stresses –Horizontal and vertical resistance in crop plants; Quantitative resistance/ adult plant resistance and slow rusting resistance; Classical and molecular breeding methods - Measuring plant resistance using plant fitness; Behavioural, physiological and insect gain studies; Phenotypic screening methods for major pests and diseases; Recording of observations; Correlating the observations using marker data – Gene pyramiding methods and their implications. Classification of abiotic stresses - Stress inducing factors, moisture stress/ drought and water logging and submergence; Acidity, salinity/ alkalinity/ sodicity; High/ low temperature, wind, etc.; Stress due to soil factors and mineral toxicity; Physiological and Phenological responses; Emphasis of abiotic stresses in developing breeding methodologies.

Unit IV

Genetics of abiotic stress resistance; Genes and genomics in breeding cultivars suitable to low water regimes and water logging and submergence, high and low/ freezing temperatures; Utilizing MAS procedures for identifying resistant types in important crops like rice, sorghum, wheat, cotton, etc.; Breeding for resistance to stresses caused by toxicity, deficiency and pollutants/ contaminants in soil, water and environment.

Unit V

Use of crop wild relatives as a source of resistance to biotic and abiotic factors in major field crops; Transgenics in management of biotic and abiotic stresses, use of toxins, protease inhibitors, lectins, chitinases and Bt for diseases and insect pest management.

Practical

Understanding the climatological parameters and predisposal of biotic and abiotic stress factors-ways of combating them for diseases caused by fungi and bacteria; Symptoms and data recording, use of MAS procedures; Phenotypic screening techniques for sucking pests and chewing pests – Traits to be observed at plant and insect level; Phenotypic screening techniques for nematodes and borers; Ways of combating them; Evaluating the available populations like RIL, NIL, etc. for pest resistance; Use of standard MAS procedures. Breeding strategies - Weeds – ecological, environmental impacts on the crops; Breeding for herbicide resistance; Screening crops for drought and flood resistance; factors to be considered and breeding strategies; Screening varieties of major crops for acidity and alkalinity- their effects and breeding strategies; Screening forage crops for resistance to sewage water and tannery effluents; Quality parameters evaluation.

Suggested Reading

- Blum A. 1988. Plant Breeding for Stress Environments. CRC Press.
- Christiansen MN and Lewis CF. 1982. Breeding Plants for Less Favourable Environments. Wiley International.
- Fritz RS and Simms EL. (Eds.). 1992. Plant Resistance to Herbivores and Pathogens: Ecology, Evolution and Genetics. The University of Chicago Press.
- Li PH and Sakai A. 1987. Plant Cold Hardiness. Liss, New York Springer
- Luginpill P. 1969. Developing Resistant Plants - The Ideal Method of Controlling Insects. USDA, ARS, Washington DC.
- Maxwell FG and Jennings PR. (Eds.). 1980. Breeding Plants Resistant to Insects. John Wiley & Sons. Wiley-Blackwell.
- Roberto F. 2018. Plant Breeding for Biotic and Abiotic Stress Tolerance. Springer.
- Russel GE. 1978. Plant Breeding for Pest and Disease Resistance. Butterworths.
- Sakai A and Larcher W. 1987. Frost Survival in Plants. Springer-Verlag.
- Singh BD. 2006. Plant Breeding. Kalyani Publishers, New Delhi.
- Turener NC and Kramer PJ. 1980. Adaptation of Plants to Water and High Temperature Stress. John Wiley & Sons.
- Van der Plank JE. 1982. Host-Pathogen Interactions in Plant Disease. Academic Press.