

**PLANT PATHOLOGY**  
**Course Structure – at a Glance**

<b>CODE</b>	<b>COURSE TITLE</b>	<b>CREDITS</b>
PPA 501*	INTRODUCTORY MYCOLOGY	2+1
PPA 502*	INTRODUCTORY VIROLOGY	2+1
PPA 503*	INTRODUCTORY BACTERIOLOGY	2+1
PPA 504*	PRINCIPLES OF PLANT PATHOLOGY	3+0
PPA 505*	DETECTION AND DIAGNOSIS OF PLANT DISEASES	0+2
PPA 506	PRINCIPLES OF PLANT DISEASE MANAGEMENT	2+1
PPA 507	DISEASES OF FIELD CROPS	2+1
PPA 508	DISEASES OF FRUITS, PLANTATION, ORNAMENTAL AND MEDICINAL CROPS	2+1
PPA 509	DISEASES OF VEGETABLE AND SPICES CROPS	2+1
PPA 510	SEED HEALTH TECHNOLOGY	2+1
PPA 511	CHEMICALS IN PLANT DISEASE MANAGEMENT	2+1
PPA 512	ECOLOGY OF SOIL-BORNE PLANT PATHOGENS	2+1
PPA 513	DISEASE RESISTANCE IN PLANTS	2+0
PPA 514/ ENT 514\$	INSECT VECTORS OF PLANT VIRUSES AND OTHER PATHOGENS	1+1
PPA 515	BIOLOGICAL CONTROL OF PLANT DISEASES	1+1
PPA 516	INTEGRATED DISEASE MANAGEMENT	2+1
PPA 517	EPIDEMIOLOGY AND FORECASTING OF PLANT DISEASES	2+1
PPA 518	POST HARVEST DISEASES	1+1
PPA 519/ ENT 520\$	PLANT QUARANTINE	2+0
PPA 591	MASTER'S SEMINAR	1+0
PPA 599	MASTER'S RESEARCH	20
PPA 601	ADVANCED MYCOLOGY	2+1
PPA 602	ADVANCED VIROLOGY	2+1
PPA 603	ADVANCED BACTERIOLOGY	2+1
PPA 604**	MOLECULAR BASIS OF HOST-PATHOGEN INTERACTION	2+1
PPA 691	DOCTORAL SEMINAR I	1+0
PPA 692	DOCTORAL SEMINAR II	1+0
PPA 699	DOCTORAL RESEARCH	45

\*Compulsory for Master's programme; \*\* Compulsory for Ph. D. programme; \$ Cross-listed with Entomology



#### UNIT IV

Isolation and purification, electron microscopy, protein and nucleic acid based diagnostics.

#### UNIT V

Mycoviruses, phytoplasma arbo and baculoviruses, satellite viruses, satellite RNAs, phages, viroids, prions.

#### UNIT VI

Mechanism of resistance, genetic engineering and management of plant viruses.

#### **Practical**

Study of symptoms caused by viruses, transmission, assay of viruses, physical properties, purification, serological tests

#### **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.

### **PPA 503**

### **INTRODUCTORY PLANT BACTERIOLOGY**

**2+1**

#### **Objective**

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

#### **Theory**

##### UNIT I

History and introduction to phytopathogenic prokaryotes, viz., bacteria, MLOs, spiroplasmas and other fastidious prokaryotes. Importance of phytopathogenic bacteria

##### UNIT II

Bacterial cell structure, shape, size, flagellation, etc

##### UNIT III

Classification and nomenclature of phytopathogenic prokaryotes

##### UNIT IV

Growth, nutrition requirements, reproduction, preservation of bacterial cultures and variability among phytopathogenic bacteria.

##### UNIT V

General biology of bacteriophages, L form bacteria, plasmids and bdellovibrios.

##### UNIT VI

Prokaryotic inhibitors and their mode of action against phytopathogenic bacteria.

##### UNIT VII

Survival and dissemination of phytopathogenic bacteria.

#### **Practical:**

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

#### **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.

Verma JP, Varma A & Kumar D. (Eds). 1995. *Detection of Plant Pathogens and their Management*. Angkor Publ., New Delhi.

Verma JP. 1998. *The Bacteria*. Malhotra Publ. House, New Delhi.

**PPA 504** **PRINCIPLES OF PLANT PATHOLOGY** **3+0**

**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

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

**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. 2002. *Introduction to Principles of Plant Pathology*. Oxford & IBH, 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.

**PPA 505** **DETECTION AND DIAGNOSIS OF PLANT DISEASES** **0+2**

**Objective**

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

**Practical:**

UNIT I

Methods to prove Koch's postulates with biotroph and necrotroph pathogens, pure culture techniques, use of selective media to isolate pathogens.

UNIT II

Preservation of disease specimens, use of haemocytometer, micrometer, centrifuge, pH meter, camera lucida.

UNIT III



**Objective**

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

**Theory**

## UNIT I

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

## UNIT II

Diseases of Pulse crops- gram, urdbean, mungbean, lentil, pigeonpea, soybean.

## UNIT III

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

## UNIT IV

Diseases of Cash crops- cotton, sugarcane, jute.

## UNIT V

Diseases of Fodder legume crops- berseem, lucerne, cowpea.

**Practical**

Detailed study of symptoms of important diseases of above mentioned crops. Collection and dry preservation of diseased specimens of important crops. Microscopic study of important pathogens.

**Suggested Readings**

Joshi LM, Singh DV & Srivastava KD. 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. 1998. *Plant Diseases*. 7th Ed. Oxford & IBH, New Delhi.

Singh US, Mukhopadhyay AN, Kumar J & Chaube HS. 1992. *Plant Diseases of International Importance*. Vol. I. *Diseases of Cereals and Pulses*. Prentice Hall, Englewood Cliffs, New Jersey.

**PPA 508 DISEASES OF FRUITS, PLANTATION AND ORNAMENTAL CROPS 2+1****Objective**

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

**Theory**

## UNIT I

Introduction, symptoms, etiology, perpetuation and management of different fruit diseases like apple, pear, strawberry, citrus, mango, grapes, guava, banana, pineapple, papaya.

## UNIT II

Introduction, symptoms, etiology, perpetuation and management of diseases of plantation crops such as tea, coffee, rubber and coconut.

## UNIT III

Introduction, symptoms, etiology, perpetuation and management of ornamental plants such as roses, gladiolus, carnation, marigold, chrysanthemum.

**Practical**

Detailed study of symptoms of representative diseases of plantation crops. Collection and dry preservation of diseased specimens of important crops. Microscopic study of important pathogens.

### **Suggested Readings**

- Gupta VK & Sharma SK. 2000. *Diseases of Fruit Crops*. Kalyani Publ., New Delhi.
- Pathak VN. 1980. *Diseases of Fruit Crops*. Oxford & IBH, New Delhi.
- Singh RS. 2000. *Diseases of Fruit Crops*. Oxford & IBH, New Delhi.
- Walker JC. 2004. *Diseases of Vegetable Crops*. TTPP, India.

## **PPA 509 DISEASES OF VEGETABLE, SPICES AND MEDICINAL CROPS 2+1**

### **Objective**

To impart knowledge about symptoms, etiology and management of different diseases of vegetables, spices and medicinal plants.

### **Theory**

#### **UNIT I**

Symptoms, etiology and management of diseases of different root, bulb, leafy vegetables, crucifers, cucurbits and solanaceous vegetable crops.

#### **UNIT II**

Symptoms, etiology and management of diseases of different spice crops such as black pepper, cumin, coriander, turmeric, fennel, fenugreek and ginger.

#### **UNIT III**

Symptoms, etiology and management of diseases of Belladonna, Cinchona, Plantago, Rauwolfia, Withania and Opium Poppy

### **Practical**

Detailed study of symptoms of important diseases of vegetable and spice crops. Microscopic study of important pathogens.

### **Suggested Readings**

- Chaube HS, Singh US, Mukhopadhyay AN & Kumar J. 1992. *Plant Diseases of International Importance*. Vol. II. *Diseases of Vegetable and Oilseed Crops*. Prentice Hall, Englewood Cliffs, New Jersey.
- Gupta VK & Paul YS. 2001. *Diseases of Vegetable Crops*. Kalyani Publ., New Delhi
- Sherf AF & Mcnab AA. 1986. *Vegetable Diseases and their Control*. Wiley Inter Science, Columbia.
- Singh RS. 1999. *Diseases of Vegetable Crops*. Oxford & IBH, New Delhi.
- Gupta SK & Thind TS. 2006. *Disease Problem in Vegetable Production*. Scientific Publ., Jodhpur.
- Walker JC. 1952. *Diseases of Vegetable Crops*. McGraw-Hill, New York.

## **PPA 510 SEED HEALTH TECHNOLOGY 2+1**

### **Objective**

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

### **Theory**

#### **UNIT I**

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.

## UNIT II

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.

## UNIT III

Seed certification and tolerance limits, types of losses caused by seed-borne diseases in true and vegetatively propagated seeds. Epidemiological factors influencing the transmission of seed-borne diseases, forecasting of epidemics through seed-borne infection.

## UNIT IV

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.

### **Suggested Readings**

Agarwal VK & JB Sinclair. 1993. *Principles of Seed Pathology*. Vols. I & II, CBS Publ., New Delhi.

Hutchins JD & Reeves JE. (Eds.). 1997. *Seed Health Testing: Progress Towards the 21st Century*. CABI, Wallington.

Paul Neergaard. 1988. *Seed Pathology*. MacMillan, London.

Suryanarayana D. 1978. *Seed Pathology*. Vikash Publ., New Delhi.

## **PPA 511      CHEMICALS IN PLANT DISEASE MANAGEMENT**

**2+1**

### **Objective**

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

### **Theory**

#### UNIT I

History and development of chemicals; definition of pesticides and related terms; advantages and disadvantages of chemicals.

#### UNIT II

Classification of chemicals based on chemical nature and mode of action used in plant disease control and their characteristics.

#### UNIT III

Chemicals in plant disease control, viz., fungicides, bactericides and botanicals.

#### UNIT IV

Formulations and application of different fungicides; chemotherapy and phytotoxicity of fungicides.

#### UNIT V

Handling, storage and precautions to be taken while using fungicides; compatibility with other agrochemicals, persistence, cost-benefit ratio, factor affecting fungicides.

#### UNIT VI

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, *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, methods of application of chemicals.

### **Suggested Readings**

Bindra OS & Singh H. 1977. *Pesticides - An Application Equipment*. Oxford & IBH, New Delhi.

Nene YL & Thapliyal PN. 1993. *Fungicides in Plant Disease Control*. 3<sup>rd</sup> Ed. Oxford & IBH, New Delhi.

Torgeson DC (Ed.). 1969. *Fungicides*. Vol. II. *An Advanced Treatise*. Academic Press, New York.

Vyas SC. 1993. *Handbook of Systemic Fungicides*. Vols. I-III. Tata McGraw Hill, New Delhi.

## **PPA 512            ECOLOGY OF SOIL-BORNE PLANT PATHOGENS            2+1**

### **Objective**

To provide knowledge on soil-plant disease relationship.

### **Theory**

#### **UNIT I**

Soil as an environment for plant pathogens, nature and importance of rhizosphere and rhizoplane, host exudates, soil and root inhabiting fungi, bacteria, actinomycetes, etc. **UNIT II**

Relationship among soil microbes.

#### **UNIT III**

Suppressive soils, biological control, types of bio control agents, 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. Identification of different biocontrol agents.

### **Suggested Readings**

Baker KF & Snyder WC. 1965. *Ecology of Soil-borne Plant Pathogens*. John Wiley, New York.

Cook RJ & Baker KF. 1983. *The Nature and Practice of Biological Control of Plant Pathogens*. APS, St Paul, Minnesota.

Garret SD. 1970. *Pathogenic Root-infecting Fungi*. Cambridge Univ. Press, Cambridge, New York.

Hillocks RJ & Waller JM. 1997. *Soil-borne Diseases of Tropical Crops*. CABI, Wallington.

Parker CA, Rovira AD, Moore KJ & Wong PTN. (Eds). 1983. *Ecology and Management of Soil-borne Plant Pathogens*. APS, St. Paul, Minnesota.

## **PPA 513            DISEASE RESISTANCE IN PLANTS            2+0**

### **Objective**

To acquaint with disease resistance mechanisms in plants.

### **Theory**

#### **UNIT I**

Introduction and historical development, dynamics of pathogenicity, process of infection, variability in plant pathogens, gene centres as sources of resistance, disease resistance terminology.

## UNIT II

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.

## UNIT III

Host defence system, morphological and anatomical resistance, preformed chemicals in host defence, post infectious chemicals in host defence, phytoalexins, hypersensitivity and its mechanisms.

## UNIT IV

Gene-for-gene concept, protein-for-protein and immunization basis, management of resistance genes. Strategies for gene deployment.

### **Suggested Readings**

Deverall BJ. 1977. *Defence Mechanisms in Plants*. Cambridge Univ. Press, Cambridge, New York.

Mills Dallice et al.1996. *Molecular Aspects of Pathogenicity and Resistance: Requirement for Signal Transduction*. APS, St Paul, Minnesota.

Parker J. 2008. *Molecular Aspects of Plant Diseases Resistance*. Blackwell Publ.

Robinson RA. 1976. *Plant Pathosystems*. Springer Verlag, New York.

Singh BD. 2005. *Plant Breeding – Principles and Methods*. 7th Ed. Kalyani Publ., Ludhiana

Van der Plank JE. 1975. *Principles of Plant Infection*. Academic Press, New York.

Van der Plank JE. 1978. *Genetic and Molecular Basis of Plant Pathogenesis*. Springer Verlag. New York.

Van der Plank JE. 1982. *Host Pathogen Interactions in Plant Disease*. Academic Press, New York.

Van der Plank JE. 1984. *Disease Resistance in Plants*. Academic Press, New York.

## **PPA 514/ ENT 514 INSECT VECTORS OF PLANT VIRUSES AND OTHER PATHOGENS**

**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**

#### UNIT I

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.

#### UNIT II

Transmission of plant viruses and fungal pathogens. Relation between viruses and their vectors.

#### UNIT III

Transmission of plant viruses by aphids, whiteflies, mealy bugs and thrips.

#### UNIT IV

Transmission of mycoplasma and bacteria by leaf hoppers and plant hoppers.

#### UNIT V

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.

**Suggested Readings**

Basu AN. 1995. *Bemisia tabaci* (Gennadius) - *Crop Pest and Principal Whitefly Vector of Plant Viruses*. Oxford & IBH, New Delhi.

Harris KF & Maramarosh K. (Eds.).1980. *Vectors of Plant Pathogens*. Academic Press, London.

Maramorosch K & Harris KF. (Eds.). 1979. *Leafhopper Vectors and Plant Disease Agents*. Academic Press, London.

Youdeovei A & Service MW. 1983. *Pest and Vector Management in the Tropics*. English Language Books Series, Longman, London.

**PPA 515                      BIOLOGICAL CONTROL OF PLANT DISEASES                      1+1****Objective**

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

**Theory**

## UNIT I

Concept of biological control, definitions, importance, principles of plant disease management with bioagents, history of biological control, merits and demerits of biological control.

## UNIT II

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.

## UNIT III

Factors governing biological control, role of physical environment, agroecosystem, operational mechanisms and cultural practices in biological control of pathogens, 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.

## UNIT IV

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 *in vivo* conditions. Study of cfu/g of formulated products.

**Suggested Readings**

Campbell R. 1989. *Biological Control of Microbial Plant Pathogens*. Cambridge Univ. Press, Cambridge.

Cook RJ & Baker KF. 1983. *Nature and Practice of Biological Control of Plant Pathogens*. APS, St. Paul, Mennisota.

Fokkemma MJ. 1986. *Microbiology of the Phyllosphere*. Cambridge Univ. Press, Cambridge.

Gnanamanickam SS (Eds). 2002. *Biological Control of Crop Diseases*. CRC Press, Florida.



**Practical:**

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

**Suggested Readings**

Campbell CL & Madden LV. 1990. *Introduction to Plant Disease Epidemiology*. John Wiley & Sons. New York

Cowling EB & Horsefall JG. 1978. *Plant Disease*. Vol. II. Academic Press, New York.

Laurence VM, Gareth H & Frame Van den Bosch (Eds.). *The Study of Plant Disease Epidemics*. APS, St. Paul, Minnesota.

Nagarajan S & Murlidharan K. 1995. *Dynamics of Plant Diseases*. Allied Publ., New Delhi.

Thresh JM. 2006. *Plant Virus Epidemiology*. Advances in Virus Research 67, Academic Press, New York.

Van der Plank JE. 1963. *Plant Diseases Epidemics and Control*. Academic Press, New York.

Zadoks JC & Schein RD. 1979. *Epidemiology and Plant Disease Management*. Oxford Univ. Press, London.

**PPA 518****POST HARVEST DISEASES****1+1****Objective**

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

**Theory**

## UNIT I

Concept of post harvest diseases, definitions, importance with reference to environment and health.

## UNIT II

Types of post harvest problems both by biotic and abiotic causes.

## UNIT III

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.

## UNIT IV

Integrated approach in controlling diseases and improving the shelf life of produce with special reference to mycotoxigenic fungi, knowledge of Codex Alimentarius.

**Practical:**

Isolation characterization and maintenance of pathogens, role of different storage conditions on disease development. Comparative efficacy of different chemicals, fungicides, phytoextracts and bioagents.

**Suggested Readings**

Pathak VN. 1970. *Diseases of Fruit Crops and their Control*. IBH Publ., New Delhi.

Chaddha KL & Pareek OP. 1992. *Advances in Horticulture* Vol. IV, Malhotra Publ. House, New Delhi.

**PPA 519/ ENT 520****PLANT QUARANTINE****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**

### **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. 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. Sanitary and Phytosanitary measures.

### **Suggested Readings**

Rajeev K & 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.

## **PPA 601**

## **ADVANCED MYCOLOGY**

**2+1**

### **Objective**

To acquaint with the latest advances in Mycology.

### **Theory**

#### **UNIT I**

General introduction, historical development and advances in mycology.

#### **UNIT II**

Recent taxonomic criteria, morphological criteria for classification. Serological, Chemical (chemotaxonomy), Molecular and Numerical (Computer based assessment) taxonomy.

#### **UNIT III**

Interaction between groups: Phylogeny. Micro conidiation, conidiogenesis and sporulating structures of fungi imperfecti. Morphology and reproduction of representative plant pathogenic genera from different groups of fungi. Sexual reproduction in different groups of fungi.

#### **UNIT IV**

Population biology, pathogenic variability/vegetative compatibility.

#### **UNIT V**

Heterokaryosis and parasexual cycle. Sex hormones in fungi. Mechanism of nuclear inheritance. Mechanism of extra-nuclear inheritance.

### **Practical**

Study of conidiogenesis- phialides, prospores, arthospores. Study of fruit bodies in Ascomycotina. Study of hyphal anastomosis. Morphology of representative plant pathogenic genera from different groups of fungi.

### **Suggested Readings**

Alexopoulos CJ, Mimms CW & Blackwell M. 1996. *Introductory Mycology*. John Wiley & Sons, New York.

Dube HC. 2005. *An Introduction to Fungi*. 3rd Ed. Vikas Publ. House, New Delhi.

Kirk PM, Cannon PF, David JC & Stalpers JA. (Eds.). 2001. *Ainsworth and Bisby's Dictionary of Fungi*. 9th Ed., CABI, Wallington.

Ulloa M & Hanlin RT. 2000. *Illustrated Dictionary of Mycology*. APS, St. Paul, Minnesota.

Webster J & Weber R. 2007. *Introduction to Fungi*. Cambridge Univ. Press, Cambridge.

## **PPA 602**

## **ADVANCED VIROLOGY**

**2+1**

### **Objective**

To educate about the advanced techniques and new developments in the field of Plant Virology.

### **Theory**

#### **UNIT I**

Mechanism of virus transmission by vectors, virus-vector relationship, bimodal transmission and taxonomy of viruses, vector specificity for classes of viruses, virus replication, assembly and architecture, ultrastructural changes due to virus infection, variation, mutation and virus strains.

#### **UNIT II**

Immunoglobulin structure and functions of various domains, methods of immunodiagnosis, hybridoma technology and use of monoclonal antibodies in identification of viruses and their strains, Polymerase Chain Reaction.

#### **UNIT III**

Genome organization, replication, transcription and translational strategies of pararetroviruses and gemini viruses, satellite viruses and satellite RNA genome organization in tobamo-, poty-, bromo, cucummo, ilar and tospoviruses.

#### **UNIT IV**

Gene expression and regulation, viral promoters, molecular mechanism of host virus interactions, virus induced gene, molecular mechanism of vector transmission, symptom expression, viroids and prions.

#### **UNIT V**

Viral suppressors, a RNAi dynamics, resistant genes. Viruses potential as vectors, genetically engineered resistance, transgenic plants.

#### **UNIT VI**

Techniques and application of tissue culture.

### **Practical**

Purification of virus(es), SDS-PAGE for molecular weight determination, production of polyclonal antiserum, purification of IgG and conjugate preparation, serological techniques (i) DAC-ELISA (ii) DAS -ELISA (iii) DIBA (iv) Western blots (v) (ab) 2-ELISA, vector transmission (one each with aphid, leaf hopper and whitefly), methods for collecting vectors and their maintenance, nucleic acid isolation, PCR application.

### **Suggested Readings**

Davies 1997. *Molecular Plant Virology: Replication and Gene Expression*. CRC Press, Florida.

Fauquet *et al.* 2005. *Virus Taxonomy*. VIII Report of ICTV. Academic Press, New York.

Gibbs A & Harrison B. 1976. *Plant Virology - The Principles*. Edward Arnold, London.

Jones P, Jones PG & Sutton JM. 1997. *Plant Molecular Biology: Essential Techniques*. John Wiley & Sons, New York.

Khan JA & Dijkstra. 2002. *Plant Viruses as Molecular Pathogens*. Howarth Press, New York.

Maramorosch K, Murphy FA & Shatkin AJ. 1996. *Advances in Virus Research*. Vol. 46. Academic Press, New York.

Pirone TP & Shaw JG. 1990. *Viral Genes and Plant Pathogenesis*. Springer Verlag, New York.

Roger Hull 2002. *Mathew's Plant Virology* (4th Ed.). Academic Press, New York.

Thresh JM. 2006. *Plant Virus Epidemiology*. Advances in Virus Research 67. Academic Press, New York.

**PPA 603** **ADVANCED BACTERIOLOGY** **2+1**

**Objective**

To provide knowledge about the latest advances in phytobacteriology.

**Theory**

UNIT I

Current approaches for the characterization and identification of phytopathogenic bacteria. Ultrastructures and biology of bacteria.

UNIT II

Current trends in taxonomy of phytopathogenic procarya.

UNIT III

Role of enzyme, toxin, exopolysaccharide, polypeptide signals in disease development. Mechanism of wilt (*Ralstonia solanacearum*) development, mechanism of soft rot (*Erwinia* spp.) development, mechanism of Crown gall formation (*Agrobacterium tumifaciens*).

UNIT IV

Host-bacterial pathogen interaction, quorum-sensing phenomenon, Type III secretion system, HR/SR reactions, R-genes, Avr-genes, hrp genes, Effector protein.

UNIT V

Molecular variability among phytopathogenic procarya and possible host defense mechanism(s). Genetic engineering for management of bacterial plant pathogens-gene silencing, RNAi technology.

UNIT VI

Beneficial prokaryotes- Endophytes, PGPR, phylloplane bacteria and their role in disease management. Endosymbionts for host defence.

**Practical**

Pathogenic studies and race identification; Gram, Capsule, Endospore and Flagellar staining; test for secondary metabolite production, cyanides, EPS, siderophore; molecular tools to identify bacteria.

**Suggested Readings**

Dale JW & Simon P. 2004. *Molecular Genetics of Bacteria*. John Wiley & Sons, New York.

Garrity GM, Krieg NR & Brenner DJ. 2006. *Bergey's Manual of Systematic Bacteriology: The Proteobacteria*. Vol. II. Springer Verlag, New York.

Gnanamanickam SS. 2006. *Plant-Associated Bacteria*. Springer Verlag, New York.

Mount MS & Lacy GH. 1982. *Plant Pathogenic Prokaryotes*. Vols. I, II. Academic Press, New York.

Sigee DC. 1993. *Bacterial Plant Pathology: Cell and Molecular Aspects*. Cambridge Univ. Press, Cambridge.

Starr MP. 1992. *The Prokaryotes*. Vols. I – IV. Springer Verlag, New York.

**PPA 604 MOLECULAR BASIS OF HOST-PATHOGEN INTERACTION** **2+1**

**Objective**

To understand the concepts of molecular biology and biotechnology in relation to host-pathogen interactions.



## **Theory**

### **UNIT I**

Importance and role of biotechnological tools in Plant Pathology- Basic concepts and principles to study host pathogen relationship.

### **UNIT II**

Molecular basis of host-pathogen interaction- fungi, bacteria and viruses; recognition system, signal transduction.

### **UNIT III**

Induction of defense responses- pathogenesis related proteins, HR, reactive oxygen species, phytoalexins and systemic acquired resistance, Programmed Cell Death, Viral induced gene silencing.

### **UNIT IV**

Molecular basis of gene-for-gene hypothesis; R-gene expression and transcription profiling, mapping and cloning of resistance genes and marker-aided selection, pyramiding of R genes.

### **UNIT V**

Biotechnology and disease management; development of disease resistance plants using genetic engineering approaches, different methods of gene transfer, biosafety issues related to GM crops.

## **Practical**

Protein, DNA and RNA isolation, Plasmids extraction, PCR analysis, DNA and Protein electrophoresis, bacterial transformation.

## **Suggested Readings**

- Chet I. 1993. *Biotechnology in Plant Disease Control*. John Wiley & Sons, New York.
- Gurr SJ, Mc Pohersen MJ & Bowlos DJ. (Eds.). 1992. *Molecular Plant Pathology - A Practical Approach*. Vols. I & II, Oxford Univ. Press, Oxford.
- Mathew JD. 2003. *Molecular Plant Pathology*. Bios Scientific Publ., UK.
- Ronald PC. 2007. *Plant-Pathogen Interactions: Methods in Molecular Biology*. Humana Press, New Jersey.
- Stacey G & Keen TN. (Eds.). 1996. *Plant Microbe Interactions*. Vols. I-III. Chapman & Hall, New York; Vol. IV. APS Press, St. Paul, Minnesota.

## **PLANT PATHOLOGY**

### **List of Journals**

- Annals of Applied Biology* – Cambridge University Press, London
- Annual Review of Phytopathology* – Annual Reviews, Palo Alto, California
- Annual Review of Plant Pathology* - Scientific Publishers, Jodhpur
- Canadian Journal of Plant Pathology* - Canadian Phytopathological Society, Ottawa
- Indian Journal of Biotechnology* - National Institute of Science Communication and Information Resources, CSIR, New Delhi
- Indian Journal of Mycopathological Research*- Indian Society of Mycology, Kolkata.
- Indian Journal of Virology* - Indian Virological Society, New Delhi
- Indian Phytopathology* - Indian Phytopathological Society, New Delhi
- Journal of Mycology and Plant Pathology* - Society of Mycology and Plant Pathology, Udaipur
- Journal of Phytopathology* - Blackwell Verlag, Berlin
- Mycologia* - New York Botanical Garden, Pennsylvania
- Mycological Research* - Cambridge University Press, London
- Physiological Molecular Plant Pathology* - Academic Press, London

- Phytopathology* - American Phytopathological Society, USA
- Plant Disease* - The American Phytopathological Society, USA
- Plant Disease Research* – Indian Society of Plant Pathologists, Ludhiana
- Plant Pathology* - British Society for Plant Pathology, Blackwell Publ.
- Review of Plant Pathology* - CAB International, Wallingford
- Virology*- New York Academic Press

#### **e-Resources**

- [www.shopapspress.org](http://www.shopapspress.org)
- [www.apsjournals.apsnet.org](http://www.apsjournals.apsnet.org)
- [www.apsnet.org/journals](http://www.apsnet.org/journals)
- [www.cabi\\_publishing.org](http://www.cabi_publishing.org)
- [www.springer.com/life+Sci/agriculture](http://www.springer.com/life+Sci/agriculture)
- [www.backwellpublishing.com](http://www.backwellpublishing.com)
- [www.csiro.au](http://www.csiro.au)
- [www.annual-reviews.org](http://www.annual-reviews.org)

#### **Suggested Broad Topics for Master's and Doctoral Research**

- Pathogenesis and characterization of plant pathogens
- Survey and surveillance
- Induction of resistance using biotic and abiotic elicitors
- Variability in plant pathogens
- Plant-Virus-Vector relationships
- Genome organization of plant pathogens
- Dynamics of plant pathogen propagules and their biology
- Molecular tools in disease diagnosis
- Molecular mechanisms of pathogenesis in crops and seeds
- Rhizosphere in pathogenesis of seed-borne plant pathogens
- Transgenic resistance
- Development of disease prediction models in disease forecasting
- Integrated Disease Management
- Molecular Taxonomy of different plant pathogens
- Development of Rapid Diagnostic methods
- Development and Formulation of Improved Biocontrol Agent