



Faculty of Agriculture
SKDU, Hanumangarh (Raj.)

M.Sc. (Ag.) Course Programs

PLANT PATHOLOGY

PLANT PATHOLOGY

Semester I			
SKDU Course code	Course No.	Course Title	Credit Hours
01MPAT101	PPATH-511	Mycology	3(2+1)
01MPAT102	PPATH-512	Detection and Diagnosis of Plant Diseases	3(0+3)
01MPAT103	PPATH-513	Principles of Plant Pathology	3(3+0)
01MPAT104	ENT-512	Insect Ecology	3(2+1)
Semester II			
02MPAT101	PPATH-511	Plant Bacteriology	3(2+1)
02MPAT102	PPATH-512	Diseases of Vegetables and Spices Crops	3(2+1)
02MPAT103	PPATH-513	Ecology of Soil-borne Plant Pathogens	3(2+1)
02MPAT104	ENT-512	Pests of Field Crops	2(2+0)
02MPAT105	STAT-521	Experimental Design	3(2+1)
Semester III			
03MPAT101	PPATH-531	Plant Virology	3(2+1)
03MPAT102	PPATH-532	Principles of Plant Disease Management	3(2+1)
03MPAT103	PPATH-533	Diseases of Field and Medicinal Plants	3(2+1)
03MPAT104	ENT-531	Pests of Horticultural & Plantation Crops	3(2+1)
Semester IV			
04MPAT101	PPATH-541	Seminar	1
04MPAT102	PPATH-542	Comprehensive	2
04MPAT103	PPATH-543	Research	15
Total			56

SEMESTER - I

PPATH 511

Mycology

3(2+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.

Lectures schedule: Theory

S. No.	Topic	No. of lectures
1.	General Introduction.	1
2.	Basic concept and definition of different terms.	3
3.	Importance of mycology in agriculture, relation of fungi to human affairs.	1
4.	History of mycology.	1
5.	Concepts of nomenclature and classification, fungal biodiversity.	3
6.	Reproduction in fungi.	2
7.	Comparative morphology, ultra structure, characters of different groups of fungi up to generic level: (a) Myxomycota and (b) Eumycota - i) Mastigomycotina ii) Zygomycotina iii) Ascomycotina iv) Basidomycotina v) Deuteromycotina	- 1 - 4 2 4 4 3
8.	Lichens types and importance.	1
9.	Fungal genetics and variability.	2

Lectures schedule: Practical

S. No.	Topic	No. of lectures
1.	Comparative study of genera of orders Plasmodiophorales and Chytridiales: <i>Plasmodiophora</i> and <i>Synchytrium</i> .	1
2.	Comparative study of fungi of order Peronosporales : <i>Pythium</i> , <i>Phytophthora</i> , <i>Sclerospora</i> , <i>Peronospora</i> , <i>Plasmopara</i> and <i>Albugo</i> .	2
3.	Comparative study of genera of order Mucorales : <i>Rhizopus</i> and <i>Mucor</i>	1
4.	Comparative study of genera of order Taphrinales : <i>Taphrina</i> .	1
5.	Comparative study of genera of order Erysiphales : <i>Erysiphe</i> , <i>Uncinula</i> , <i>Microsphaera</i> , <i>Sphaerotheca</i> , and <i>Podosphaera</i>	2

6.	Comparative study of fungi of order Sphaeriales : <i>Glomerella and Claviceps</i> .	1
7.	Comparative study of genera of order Uredinales: <i>Puccinia, Uromyces, Phragmidium and Melampsora</i> .	2
8.	Comparative study of genera of order Ustilaginales : <i>Ustilago ,Sphacelothica, Tolyposporium, Neovossia, and Urocystis</i> .	2
9.	Comparative study of genera <i>Colletotrichum , Phomopsis, Alternaria, Helminthosporium, Cercospora, Fusarium</i> etc.	2
10.	Collection, identification and preservation of specimens.	1
11.	Isolation and identification of plant pathogenic fungi.	1

Suggested Readings

1. Ainsworth GC, Sparrow FK & Susman HS. 1973. The Fungi – An Advanced Treatise. Vol. IV (A & B). Academic Press, New York.
2. Alexopoulos CJ, Mims CW & Blackwell M. 2000. Introductory Mycology. 5th Ed. John Wiley & Sons, New York. Mehrotra RS & Arneja KR. 1990. An Introductory Mycology. Wiley Eastern, New Delhi.
3. Sarbhoy AK. 2000. Text book of Mycology. ICAR, New Delhi.
4. Singh RS. 1982. Plant Pathogens – The Fungi. Oxford & IBH, New Delhi.
5. Webster J. 1980. Introduction to Fungi. 2nd Ed. Cambridge Univ. Press, Cambridge, New York.

PPATH 512

Detection and Diagnosis of Plant Diseases

3(0+3)

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 centrifuge, pH meter, micrometer, haemocytometer, 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 manuscripts.

Lectures schedule: Practical

S. No.	Topic	No. of lectures
1.	Methods to prove Koch's postulates with biotroph and necrotroph pathogens	4
2.	Pure culture techniques	4
3.	Use of selective media to isolate pathogens	2
4.	Preservation of plant pathogens and disease specimens	2
5.	Use of centrifuge & pH meter	2
6.	Use of micrometer haemocytometer & camera lucida	2
7.	Microscopic techniques & Staining methods	4
8.	Phase contrast system & Chromatography	6
9.	Use of Electron microscope	2
10.	Use of spectrophotometer & ultracentrifuge	2

11.	Use of electrophoretic apparatus	2
12.	Disease diagnostics	2
13.	Serological and molecular techniques for detection of plant pathogens	6
14.	Evaluation of fungicides, bactericides etc.	4
15.	Field experiments and data collection	2
16.	Preparation of manuscripts	2

Suggested Readings

1. Baudoin ABAM, Hooper G R, Mathre D E & Carroll R B. 1990. Laboratory Exercises in Plant Pathology: An Instructional Kit. Scientific Publ., Jodhpur.
2. Dhingra O D & Sinclair J B. 1986. Basic Plant Pathology Methods. CRC Press, London, Tokyo.
3. Fox R T V. 1993. Principles of Diagnostic Techniques in Plant Pathology. CABI Wallington. Mathews R E F. 1993. Diagnosis of Plant Virus Diseases. CRC Press, Boca Raton, Tokyo.
4. Pathak V N. 1984. Laboratory Manual of Plant Pathology. Oxford & IBH, New Delhi.
5. Forster D & Taylor SC. 1998. Plant Virology Protocols: From Virus Isolation to Transgenic Resistance. Methods in Molecular Biology. Humana Press, Totowa, New Jersey.
6. Matthews R E F. 1993. Diagnosis of Plant Virus Diseases. CRC Press, Florida.
7. Noordam D. 1973. Identification of Plant Viruses, Methods and Experiments. Cent. Agric. Pub. Doc. Wageningen. Trigiano R N, Windham M T & Windham A S. 2004. Plant Pathology- Concepts and Laboratory Exercises. CRC Press, Florida.
8. Chakravarti B P. 2005. Methods of Bacterial Plant Pathology. Agrotech, Udaipur.

PPATH 513

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.

Lectures schedule: Theory

S. No.	Topic	No. of lectures
1.	Introduction	1
2.	Importance, definitions and concepts of plant diseases.	3
3.	History and growth of Plant Pathology	3
4.	Biotic and abiotic causes of plant diseases	2
5.	Growth and reproduction of plant pathogens.	3
6.	Survival and dispersal of important plant pathogens.	1
7.	Role of environment and host nutrition on disease development.	2
8.	Host parasite interaction, recognition concept and infection.	3

9.	Symptomatology	2
10.	Disease development-role of enzymes, toxin and growth regulators	4
11.	Defense strategies-oxidative burst, phenolics, phytoalexins, PR proteins and elicitors.	4
12.	Altered plant metabolism as affected by plant pathogens.	2
13.	Genetics of resistance; R genes	2
14.	Mechanism of genetic variation in pathogens.	3
15.	Molecular basis for resistance; marker –assisted selection.	3
16.	Genetic engineering for disease resistance.	3
17.	Disease management strategies.	7

Suggested Readings

1. Agrios GN. 2005. Plant Pathology. 5th Ed. Academic Press, New York.
2. Heitefuss R & Williams PH. 1976. Physiological Plant Pathology. Springer Verlag, Berlin, New York.
3. Mehrotra RS & Aggarwal A. 2003. Plant Pathology. 2nd Ed. Oxford & IBH, New Delhi.
4. Singh RS. 2002. Introduction to Principles of Plant Pathology. Oxford & IBH, New Delhi.
5. Singh DP & Singh A. 2007. Disease and Insect Resistance in Plants Oxford & IBH, New Delhi.
6. Upadhyay RK & Mukherjee KG. 1997. Toxins in Plant Disease Development and Evolving Biotechnology. Oxford & IBH, New Delhi.

ENT 512

Insect Ecology

3(2+1)

Objective

To teach the students the concepts of ecology, basic principles of distribution and abundance of organisms and their causes. Study life tables, organization of communities, diversity indices. Train students in sampling methodology, calculation of diversity indices, constructing life tables, relating insect population fluctuations to biotic and/or abiotic causes.

Theory

History and Definition. Basic Concepts. Organisation of the Biological world. Plato's Natural Balance vs Ecological Dynamics as the modern view. Abundance and diversity of insects, Estimates and Causal factors. Study of abundance and distribution and relation between the two. Basic principles of abiotic factors and their generalised action on insects. Implications for abundance and distribution of organisms including insects- Law of the Minimum, Law of Tolerance, and biocoenosis, Systems approach to ecology, Basic concepts of abundance- Model vs Real world. Population growth- basic models – Exponential vs Logistic models. Discrete vs Continuous growth models. Concepts of Carrying capacity, Environmental Resistance and Optimal yield. Vital Statistics- Life Tables and their application to insect biology. Survivorship curves. Case studies of insect life tables. Population dynamics- Factors affecting abundance- Environmental factors, dispersal and migration, Seasonality in insects. Classification and mechanisms of achieving different seasonality- Diapause (Quiescence) - aestivation, hibernation, Biotic factors- Food as a limiting factor for distribution and abundance, Nutritional Ecology. Food chain-web and ecological succession. Interspecific interactions-Basic factors governing the interspecific interactions- Classification of interspecific interactions - The argument of cost-benefit ratios. Competition- Lotka- Volterra model, Concept of niche- ecological homologues, competitive exclusion. Prey-predator interactions- Basic model- Lotka-Volterra Model, Volterra's principle. Functional and numerical response. Defense mechanisms against predators/parasitoids- Evolution of mimicry, colouration, concept of predator satiation; evolution of life history strategies, Community ecology-Concept of guild, Organisation of communities- Hutchinson Ratio, May's d/w, Relation between the two and their association with Dyar's Law and Przibram's law.

Relative distribution of organisms, Concept of diversity- the Wallacian view. Assessment of diversity. Diversity- stability debate, relevance to pest management. Pest management as applied ecology.

Practical

Types of distributions of organisms. Methods of sampling insects, estimation of densities of insects and understanding the distribution parameters- Measures of central tendencies, Poisson Distribution, Negative Binomial Distribution. Determination of optimal sample size. Learning to fit basic population growth models and testing the goodness of fit. Fitting Holling's Disc equation, Assessment of prey-predator densities from natural systems and understanding the correlation between the two. Assessing and describing niche of some insects of a single guild. Calculation of nichebreadth, activity breadth and diagrammatic representation of niches of organisms. Calculation of some diversity indices- Shannon's, Simpson's and Avalanche Index and understanding their associations and parameters that affect their values. Problem solving in ecology. Field visits to understand different ecosystems and to study insect occurrence in these systems.

Lectures schedule: Theory

S. No.	Topic	No. of lectures
1.	History and definition , Basic Concept	1
2.	Organisation of the Biological world	1
3.	Plato's Natural balance vs Ecological Dynamics as the modern view	1
4.	Abundance and diversity of insects, Estimates and causal factors	1
5.	Study of abundance and distribution and relation between the two	1
6.	Basic principles of abiotic factors and their generalised action on insects	1
7.	Implications for abundance and distribution of organisms including insects- Law of the Minimum, Law of Tolerance and biocoenosis, System approach to ecology	2
8.	Basic concepts of abundance- Model vs Real world	1
9.	Population growth – basic models –Exponential vs Logistic models	1
10.	Discrete vs Continuous growth models	1
11.	Concepts of Carrying capacity, Environment Resistance and Optimal yield	1
12.	Vital Statistics – Life Tables and their application to insect biology	1
13.	Survivorship curves	1
14.	Case studies of insect life tables	1
15.	Population dynamics – Factors affecting abundance – Environmental factors, dispersal and migration, seasonality in insects	1
16.	Classification and mechanisms of achieving different seasonality – Diapause (Quiescence) – aestivation, hibernation	1
17.	Biotic factors – Food as a limiting factor for distribution and abundance, Nutritional Ecology	1
18.	Food chain – web and ecological succession	1
19.	Interspecific interactions – Basic factors governing the interspecific interactions – Classification of interspecific interactions – The argument of cost- benefit ratios	2
20.	Competition – Lotka – Volterra model, Concept of niche – ecological homologues, competitive exclusion	1
21.	Prey – predator interactions – Basic model – Lotka – Volterra Model, Volterra's principle	1
22.	Functional and numerical response	1
23.	Defense mechanisms against predators/parasitoids –Evolution of mimicry, colouration	1
24.	Concept of predator satiation ; evolution of life history strategies	1
25.	Community ecology – concept of guild	1
26.	Organisation of communities – Hutchinson Ratio, May's d/w , Relation between the two and their association with Dyar's Law and Przibram's law	1

27.	Relative distribution of organisms, Concept of diversity – the Wallacian view	1
28.	Assessment of diversity	1
29.	Diversity – stability debate, relevance to pest management	1
30.	Pest management as applied ecology	1

Lectures schedule: Practical

S. No.	Topic	No. of lectures
1.	Types of distributions of organisms	1
2.	Methods of sampling insects	1
3.	Estimation of densities of insects and understanding the distribution parameters – Measures of central tendencies	1
4.	Poisson Distribution, Negative Binomial Distribution	1
5.	Determination of optimal sample size	1
6.	Learning to fit basic population growth models and testing the goodness of fit	1
7.	Fitting hollings's Disc equation	1
8.	Assessment of prey – predator densities from natural systems and understanding the correlation between the two	2
9.	Assessing and describing niche of some insects of a single guild	1
10.	Calculation of niche breadth, activity breadth and diagrammatic representation of niches of organisms	2
11.	Calculation of some diversity indices – Shannon's and Avalanche Index and understanding their associations and parameters that affect their values	1
12.	Problem solving in ecology	2
13.	Field visits to understanding different ecosystem and to study insect occurrence in these systems	1

Suggested Readings

1. Chapman JL & Reiss MJ. 2006. *Ecology: Principles & Applications*. 2nd Ed. Cambridge Univ. Press, Cambridge
2. Gotelli NJ & Ellison AM. 2004. *A Primer of Ecological Statistics*. Sinauer Associates, Inc.
3. Sunderland, MA. Gotelli NJ. 2001. *A Primer of Ecology*. 3rd Ed. Sinauer Associates, Inc.
4. Sunderland, MA, Gupta RK. 2004. *Advances in Insect Biodiversity*. Agrobios, Jodhpur.
5. Krebs CJ. 1998. *Ecological Methodology*. 2 Ed. Benjamin-Cummings Publ. Co., New York.
6. Krebs CJ. 2001. *Ecology: The Experimental Analysis of Distribution and Abundance*. 5th Ed. Benjamin- Cummings Publ. Co., New York.
7. Magurran AE. 1988. *Ecological Diversity and its Measurement*. Princeton Univ. Press, Princeton. Price PW. 1997. *Insect Ecology*. 3rd Ed. John Wiley, New York.
8. Real LA & Brown JH. (Eds). 1991. *Foundations of Ecology: Classic Papers with Commentaries*. University of Chicago Press, Chicago.
9. Southwood TRE & Henderson PA. 2000. *Ecological Methods*. 3rd Ed. Methuen & Co. Ltd., London.
10. Speight MR, Hunta MD & Watt AD. 2006. *Ecology of Insects: Concepts and Application*. Elsevier Science Publ., The Netherlands.
11. Wilson EO & William H Bossert WH. 1971. *A Primer of Population Biology*. Harvard University, USA. Wratten SD & Fry GLA. 1980. *Field and Laboratory Exercises in Ecology*. Arnold, London.

SEMESTER - II

PPATH 522

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 list of 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.

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.

Lectures schedule: Theory

S. No.	Topic	No. of lectures
1.	Introduction to phytopathogenic procarya viz. MLO/phytoplasma, spiroplasma	2
2.	History of phytopathogenic procarya	1
3.	Introduction to other fastidious procarya	2
4.	Importance of phytopathogenic bacteria,	2
5.	Evaluation of bacteria	1
6.	Classification and nomenclature of phytopathogenic procarya	4
7.	List of important diseases caused by phytopathogenic procarya	2
8.	Growth and nutrition requirements of bacteria	3
9.	Reproduction in prokaryotes	2
10.	Preservation of bacterial cultures	1
11.	Variability among phytopathogenic procarya	2
12.	General biology of bacteriophage,	2
13.	L-form bacteria and <i>Bdellovibrio</i>	1
14.	Plasmids	2
15.	Procaryotic inhibitors and their mode of action against phytopathogenic bacteria	3
16.	Survival and dissemination of phytopathogenic bacteria	2

Lectures schedule: Practical

S. No.	Topic	No. of lectures
1.	Isolation of bacteria	2
2.	Purification and identification of bacteria	2
3.	Inoculation and Pathogenicity of bacteria	2

4.	Staining methods	2
5.	Biochemical and serological characterization of bacteria	4
6.	Isolation of plasmid	2
7.	Use of antibacterial chemicals/antibiotics	2

Suggested Readings

1. Goto M. 1990. Fundamentals of Plant Bacteriology. Academic Press, New York.
2. Jayaraman J & Verma JP. 2002. Fundamentals of Plant Bacteriology.
3. Kalyani Publ., Ludhiana. Mount MS & Lacy GH. 1982. Phytopathogenic Prokaryotes. Vols. I, II. Academic Press, New York.
4. Verma JP, Varma A & Kumar D. (Eds). 1995. Detection of Plant pathogens and their Management. Angkor Publ., New Delhi.
5. Verma JP. 1998. The Bacteria. Malhotra Publ. House, New Delhi.

PPATH -523

Diseases of Vegetables and Spices Crops

3(2+1)

Objective

To impart knowledge about symptoms, epidemiology of different diseases of vegetables and spices caused by fungal, bacterial and viral diseases and their management.

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.

Lectures schedule: Theory

S. No.	Topic	No. of lectures
1.	General introduction	1
2.	Diseases of potato	4
3.	Diseases of onion	1
4.	Diseases of tomato	3
5.	Diseases of garlic	1
6.	Diseases of crucifers	2
7.	Diseases of cucurbits	2
8.	Diseases of chilli	2
9.	Diseases of brinjal	2
10.	Diseases of leafy vegetables.	2
11.	Diseases of root crops	1
12.	Diseases of ginger	1
13.	Diseases of turmeric	1
14.	Diseases of saffron	2
15.	Diseases of black pepper	1
16.	Diseases of cumin	1

17.	Diseases of fenugreek	2
18.	Diseases of fennel	2
19.	Diseases of coriander	1

Lectures schedule: Practical

S. No.	Topic	No. of lectures
1.	Study of symptoms and host parasite relationship of diseases of potato	2
2.	Study of symptoms and host parasite relationship of diseases of tomato	1
3.	Study of symptoms and host parasite relationship of diseases of crucifers	1
4.	Study of symptoms and host parasite relationship of diseases of cucurbits	1
5.	Study of symptoms and host parasite relationship of diseases of chilli	1
6.	Study of symptoms and host parasite relationship of diseases of brinjal	1
7.	Study of symptoms and host parasite relationship of diseases of onion	1
8.	Study of symptoms and host parasite relationship of diseases of ginger & turmeric	1
9.	Study of symptoms and host parasite relationship of diseases of cumin	1
10.	Study of symptoms and host parasite relationship of diseases of coriander	1
11.	Study of symptoms and host parasite relationship of diseases of fenugreek	1
12.	Study of symptoms and host parasite relationship of diseases of fennel	2
13.	Collection and dry preservation of diseased specimens of important crops.	2

Suggested Readings

1. 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.
2. Godara, S, I, Kapoor, BBS and Rathore, B.S. 2010. Madhu Publications, Bikaner-3, India. Gupta VK & Paul YS. 2001. Diseases of Vegetable Crops. Kalyani Publ., New Delhi
3. Sherf AF & Mcnab AA. 1986. Vegetable Diseases and their Control. Wiley InterScience, Columbia. Singh RS. 1999. Diseases of Vegetable Crops. Oxford & IBH, New Delhi.
4. Gupta SK & Thind TS. 2006. Disease Problem in Vegetable Production. Scientific Publ., Jodhpur. 6 Walker JC. 1952. Diseases of Vegetable Crops. McGraw-Hill, New York.

PPATH 526

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. Suppressive 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.

Lectures schedule: Theory

S. No.	Topic	No. of lectures
1.	General Introduction.	1
2.	Soil as environment for plant pathogens	2
3.	Nature and importance of rhizosphere.	2
4.	Nature and importance of rhizosphere.	2
5.	Host exudates	2
6.	Soil and root inhibiting fungi	2
7.	Types of bio-control agents	2
8.	Inoculum potential	2
9.	Host and soil variables	2
10.	Concept of competition	2
11.	Predation	2
12.	Antibiosis and fungistasis.	8
13.	Biological control –Concepts and potentialities for managing soil-borne pathogens	2
14.	Suppressive and conducive soils	1

Lectures schedule: Practical

S. No.	Topic	No. of lectures
1.	Isolation and enumeration of organisms in soil	1
2.	Soil dilution plate method	2
3.	Isolation from rhizosphere	2
4.	Isolation of <i>Trichoderma</i>	1
5.	Isolation of bacteria from soil.	2
6.	Pathogenicity test by soil inoculation technique. Cont.	2
7.	Pathogenicity test by seed inoculation technique. Cont.	2
8.	Correlation between inoculum density of test pathogens and disease incidence. Cont.	2
9.	Demonstration of fungistasis natural soils; suppression of test soil-borne pathogens by antagonistic microorganisms, Cont.	2

Suggested Readings

1. Baker KF & Snyder WC. 1965. Ecology of Soil-borne Plant Pathogens. John Wiley, New York.
2. Cook RJ & Baker KF. 1983. The Nature and Practice of Biological Control of Plant Pathogens. APS, St Paul, Minnesota.
3. 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.
4. Parker CA, Rovira AD, Moore KJ & Wong PTN. (Eds). 1983. Ecology and Management of Soil-borne Plant Pathogens. APS, St. Paul, Minnesota.
5. borne Plant Pathogens. APS, St. Paul, Minnesota.

Objective

To familiarize the students about nature of damage and seasonal incidence of insect pests 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 pests of cereals and millets and their management. Polyphagous pests: grasshoppers, locusts, termites, white grubs, hairy caterpillars, and non-insect pests (mites, birds, rodents, snails, slugs etc.), Insect pests of pulses, tobacco, oilseeds and their management, Insect pests of fibre crops, forages, 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.

Lecture schedule-- Theory

S. No.	Topic	No. of lectures
1.	Systematic position, identification, distribution, host range, bionomics, nature and extent of damage, seasonal abundance and management of insect- pests of cereals and millets.	5
2.	Insect pests of pulses.	3
3.	Insect pests of tobacco.	1
4.	Insect pests of oilseeds.	4
5.	Insect pests of fibre crops.	4
6.	Insect pests of forage crops.	1
7.	Insect pests of sugarcane.	3
8.	Poly phagous pests- grasshopper, locust, termite, white grubs and red hairy caterpillar.	8
9.	Non- insect pests and their management- mites, birds, rodents, snails and slugs.	3

Lectures schedule: Practical

S. No.	Topic	No. of lectures
1.	Field visits, collection and identification of important pests and their natural enemies	6
2.	Detection and estimation of infestation and losses in different crops	4
3.	Study of life history of important pests	6

Suggested Readings

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

Objective

This course is meant for students of agricultural and animal sciences other than 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

Need for designing of experiments, characteristics of a good design. Basic principles of designs-randomization, replication and local control, Uniformity trials, size and shape of plots and blocks; Analysis of variance; Completely randomized design, randomized block design and Latin square design, Factorial experiments, (symmetrical as well as asymmetrical), orthogonality and partitioning of degrees of freedom, Confounding in symmetrical factorial experiments, Factorial experiments with control treatment, Split plot and strip plot designs; Analysis of covariance and missing plot techniques in randomized block and Latin square designs; Transformations, crossover designs, balanced incomplete block design, resolvable designs and their applications ~ concepts, randomisation procedure, analysis and interpretation of results. Response surfaces. Experiments with mixtures.

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 without and with confounding; Analysis with missing data; Split plot and strip plot designs; Transformation of data; Analysis of resolvable designs; Fitting of response surfaces.

Lectures schedule: Theory

S. No.	Topic	No. of lectures
1.	Basic concepts of design of experiment	2
2.	Basic principles of designs	3
3.	Uniformity trials	1
4.	Size and shape of plots and blocks	1
5.	Analysis of variance and transformations	2
6.	CRD, RBD and LSD	3
7.	Factorial experiments	4
8.	Confounding in symmetrical factorial experiments	2
9.	Factorial experiments with control treatment	2
10.	Split plot design	2
11.	Strip plot design	2
12.	Analysis of covariance and missing plot techniques	2
13.	Crossover designs	1
14.	Resolvable designs	1
15.	Response surfaces	2
16.	Experiments with mixtures	2

Lectures schedule: Practical

S. No.	Topic	No. of lectures
1.	Formation of plots	1
2.	Formation of blocks	1
3.	Analysis of CRD	1

4.	Analysis of RBD	1
5.	Analysis of LSD	1
6.	Analysis of factorial experiment	1
7.	Analysis of asymmetric factorial experiments	1
8.	Analysis of confounded factorial experiments	1
9.	Analysis with missing data in RBD	1
10.	Analysis with missing data in LSD	1
11.	Transformation of data	1
12.	Analysis of SPD	1
13.	Analysis of strip plot design	1
14.	Analysis of resolvable designs	1
15.	Fitting of response surfaces	2

References:

1. Cochran WG & Cox GM. 1957. Experimental Designs. 2nd Ed. John Wiley.
2. Dean AM & Voss D. 1999. Design and Analysis of Experiments. Springer.
3. Federer WT. 1985. Experimental Designs. MacMillan.
4. Fisher RA. 1953. Design and Analysis of Experiments. Oliver & Boyd.
5. Nigam AK & Gupta VK. 1979. Handbook on Analysis of Agricultural Experiments. IASRI Publ.
6. Pearce SC. 1983. The Agricultural Field Experiment: A Statistical Examination of Theory and Practice. John Wiley.
7. Design Resources Server: www.iasri.res.in/design.

SEMESTER - III

PPATH 531

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 listing of important diseases and their management.

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.

Lectures schedule: Theory

S. No.	Topic	No. of lectures
1.	History of plant viruses	1

2.	Composition and structure of viruses	2
3.	Symptomatology of important plant viral diseases	1
4.	Transmission of important plant viral diseases	2
5.	Chemical properties of viruses	1
6.	Physical properties of viruses	1
7.	Host virus interaction	1
8.	Virus vector relationship	1
9.	Virus nomenclature and classification	4
10.	Genome organization of viruses	1
11.	Replication and movement of viruses	2
12.	Isolation and purification of viruses	2
13.	Electron microscopy	1
14.	Protein and nucleic acid based diagnostics	2
15.	Mycoviruses, phytoplasma arbo- and baculoviruses	1
16.	Satellite viruses, satellite RNAs, phages,	1
17.	viroids, prions	1
18.	Principles of the working of electron microscope and ultra-microtome	1
19.	Origin and evaluation, mechanism of resistance, genetic engineering and ecology	4
20.	Listing of important diseases and their management	2

Lectures schedule: Practical

S. No.	Topic	No. of lectures
1.	Study of symptoms caused by viruses	1
2.	Transmission of viruses	2
3.	Assay of viruses	2
4.	Physical properties of viruses	2
5.	Purification of viruses	2
6.	Methods of raising anti-sera	1
7.	Serological tests	2
8.	Electron microscopy	1
9.	Ultratome	1
10.	PCR	2

Suggested Readings

1. Bos L. 1964. Symptoms of Virus Diseases in Plants. Oxford & IBH., New Delhi.
2. Brunt AA, Krabtree K, Dallwitz MJ, Gibbs AJ & Watson L. 1995. Virus of Plants: Descriptions and Lists from VIDE Database. CABI, Wallington.
3. 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.
4. Noordam D. 1973. Identification of Plant Viruses, Methods and Experiments. Oxford & IBH, New Delhi.

PPATH -532

Principles of Plant Disease Management

3(2+1)

Objectives

To acquaint with different strategies for management of plant diseases.

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 and bioagents against plant pathogens; ED and MIC values, study of structural and functional details of sprayers and dusters.

Lectures schedule: Theory

S. No.	Topic	No. of lectures
1.	Principles of plant disease management by cultural methods	2
2.	Principles of plant disease management by physical methods	2
3.	Principles of plant disease management by biological methods	3
4.	Principles of plant disease management by chemical methods	3
5.	Principles of plant disease management by organic amendments	2
6.	Principles of plant disease management by botanicals	2
7.	Integrated control measures of plant diseases	2
8.	Disease resistance and molecular approach for disease management	2
9.	Foliage, seed and soil application of chemicals	2
10.	Role of stickers, spreaders and other adjuvants	2
11.	Health vis-à-vis environmental hazards	1
12.	Residual effects and safety measures	1
13.	History of fungicides, bactericides, antibiotics	1
14.	Concepts of pathogen, immobilization	1
15.	Chemical protection and chemotherapy	1
16.	Nature, properties and mode of action of antifungal, antibacterial and antiviral chemicals	6

Lectures schedule: Practical

S. No.	Topic	No. of lectures
1.	<i>In vitro</i> evaluation of chemicals against plant pathogens	4
2.	<i>in vivo</i> evaluation of chemicals against plant pathogens	4
3.	ED values	2
4.	MIC values	2
5.	Study of structural details of sprayers	2
6.	Study of structural details of dusters	2

Suggested Readings

1. Fry WE. 1982. Principles of Plant Disease Management. Academic Press, New York. Hewitt HG. 1998. Fungicides in Crop Protection. CABI, Wallington.
2. Marsh RW. 1972. Systemic Fungicides. Longman, New York.
3. Nene YL & Thapliyal PN. 1993. Fungicides in Plant Disease Control. Oxford & IBH, N 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.

Objective

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

Theory

Diseases of Cereal crops- wheat, barley, rice, pearl millet, sorghum and maize. Diseases of Pulse crops- gram, urdbean, mothbean, 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.

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.

Lectures schedule: Theory

S. No.	Topic	No. of lectures
1.	General introduction	1
2.	Diseases of wheat.	4
3.	Diseases of barley. sugarcane	1
4.	Diseases of rice	3
5.	Diseases of pearl millet	1
6.	Diseases of sorghum and maize.	2
7.	Diseases of gram	2
8.	Diseases of urdbean, mothbean, mungbean, and lentil.	2
9.	Diseases of pigeonpea and soybean	2
10.	Diseases of rapeseed and mustard, linseed and sesame.	2
11.	Diseases of sunflower, and castor.	1
12.	Diseases of groundnut.	1
13.	Diseases of cotton	1
14.	Diseases of.	2
15.	Diseases of berseem, Lucerne and oats.	1
16.	Diseases of cowpea and guar	1
17.	Diseases of plantago, liquorice and mulathi	2
18.	Diseases of rosagrass, sacred basil and menthe.	2
19.	Diseases of ashwagandha and Aloe vera	1

Lectures schedule: Practical

S. No.	Topic	No. of lectures
1.	Study of symptoms and host parasite relationship of diseases of wheat.	2
2.	Study of symptoms and host parasite relationship of diseases of barley.	1
3.	Study of symptoms and host parasite relationship of diseases of pearl millet.	1
4.	Study of symptoms and host parasite relationship of diseases of sorghum & Maize.	1
5.	Study of symptoms and host parasite relationship of diseases of gram.	1
6.	Study of symptoms and host parasite relationship of diseases of mothbean & Mung.	1

7.	Study of symptoms and host parasite relationship of diseases of mustard.	1
8.	Study of symptoms and host parasite relationship of diseases of linseed.	1
9.	Study of symptoms and host parasite relationship of diseases of castor.	1
10.	Study of symptoms and host parasite relationship of diseases of groundnut.	1
11.	Study of symptoms and host parasite relationship of diseases of cotton.	1
12.	Study of symptoms and host parasite relationship of diseases of fodder legumes and medicinal plants.	2
13.	Collection and dry preservation of diseased specimens of important crops.	2

Suggested Readings

1. Joshi LM, Singh DV & Srivastava KD. 1984. Problems and Progress of Wheat Pathology in South Asia. Malhotra Publ. House, New Delhi.
2. Rangaswami G. 1999. Diseases of Crop Plants in India. 4th Ed. Prentice Hall of India, N Delhi.
3. Ricanel C, Egan BT, Gillaspie Jr AG & Hughes CG. 1989. Diseases of Sugarcane, Major Diseases. Academic Press, New York.
4. Singh RS. 2007. Plant Diseases. 8th Ed. Oxford & IBH, New Delhi.
5. 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.
6. Thind, T.S. 1998. Diseases of field Crops and their management. National Agril. Technology Information Centre, Ludhiana, India.

ENT 531

Pests of Horticultural and Plantation Crops

3(2+1)

Objective

To impart knowledge on major pests of horticultural and plantation crops regarding the extent and nature of loss, seasonal history, their integrated management.

Theory

Systematic position, identification, distribution, host range, bionomics and seasonal abundance, nature and extent of damage and management of insect pests of various crops, Fruit Crops- mango, guava, banana, jack, papaya, pomegranate, litchi, grapes, ber, fig, citrus, aonla, pineapple, apple, peach and other temperate fruits, Vegetable crops- tomato, potato, radish, carrot, beetroot, cole crops, french beans, chow-chow, brinjal, okra, all gourds, gherkin, drumstick, leafy vegetables etc., Plantation crop- coffee, tea, rubber, coconut, arecanut, cashew, cocoa etc.; Spices and Condiments- pepper, cardamom, clove, nutmeg, chillies, turmeric, ginger, beetlevine etc., Ornamental, medicinal and aromatic plants and pests in polyhouses/ protected cultivation.

Practical

Collection and identification of important pests and their natural enemies on different crops; study of life history of important insect pests and non- insect pests.

Lecture schedule-- Theory

S. No.	Topic	No. of lectures
1.	Pests of mango	2
2.	Pests of guava, banana	2
3.	Pests of jack fruit, papaya, pomegranate	2
4.	Pests of litchi, ber	1

5.	Pests of grapes	2
6.	Pests of fig, aonla	1
7.	Pests of citrus	3
8.	Pests of apple, peach and other temperate fruits	2
9.	Pests of tomato, potato	1
10.	Pests of radish, carrot, beetroot	1
11.	Pests of cole crops	2
12.	Pests of beans	1
13.	Pests of brinjal	1
14.	Pests of okra, drumstick, leafy vegetables	1
15.	Pests of gourds	2
16.	Pests of plantation crops	2
17.	Pests of spices and condiments	1
18.	Pests of beetlevine, ornamental plants, aromatic plants	2
19.	Pests of medicinal plants	1
20.	Pests in polyhouses and protected cultivation	2

Lectures schedule: Theory

S. No.	Topic	No. of lectures
1.	Identification of important pests and their natural enemies on different crops; study of life history of important insect pests and non- insect pests: Pests of mango, guava, banana, jack fruit, papaya, pomegranate.	1
2.	Pests of litchi, ber, grapes, fig, aonla	1
3.	Pests of citrus	1
4.	Pests of apple, peach and other temperate fruits	1
5.	Pests of tomato, potato, radish, carrot, beetroot	1
6.	Pests of cole crops, beans	1
7.	Pests of brinjal, okra, drumstick, leafy vegetables, gourds	1
8.	Pests of plantation crops, spices, condiments, ornamental plants, aromatic plants	1
9.	Pests of beetlevine, medicinal plants	1
10.	Pests in polyhouses and protected cultivation	1
11.	Collection and study of life history of important insect pests and non- insect pests.	6

Suggested Readings

1. Atwal AS & Dhaliwal GS. 2002. *Agricultural Pests of South Asia and their Management*. Kalyani Publ., New Delhi.
2. Butani DK & Jotwani MG. 1984. *Insects and Vegetables*. Periodical Expert Book Agency, New Delhi.
3. Dhaliwal GS, Singh R & Chhillar BS. 2006. *Essential of Agricultural Entomology*. Kalyani Publ., New Delhi. Srivastava RP.1997. *Mango Insect Pest Management*. International Book Distr., Dehra Dun.
4. Verma LR, Verma AK & Goutham DC. 2004. *Pest Management in Horticulture Crops : Principles and Practices*. Asiatech Publ., New Delhi.

