



Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

Shri Vaishnav Institute of Agriculture

Ph.D. Plant Pathology, II semester

Course Title with Credit Load

Ph.D. in Plant Pathology

Course Code	Course Title	Credits Hours
PL PATH 603	Advances in Plant Pathogenic Prokaryotes	2+1
PL PATH 604	Molecular Basis of Host-Pathogen Interaction	2+1
PL PATH 606	Plant Biosecurity and Biosafety	2+0
ENT 605	Bio-inputs for Pest Management	2+1
ENT 606	Insect Toxicology and Residues	2+1
STAT 522	Data Analysis Using Statistical Packages	2+1
PL PATH 692	Seminar II	0 + 1
PL PATH 699	Dissertation (Doctoral Research)	4



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Course Code	Course Name	TEACHING & EVALUATION SCHEME								
		Theory			Practical		Credits			
		END SEM University Exam	Mid term exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	L	P	Total	
PL PATH 603	Advances in Plant Pathogenic Prokaryotes	60	00	20	15	05	2	1	3	

1. Legends: L - Lecture; P – Practical

2. *Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.

Aim of the course

To learn about the latest developments in all the plant pathogenic prokaryotes as a whole.

Theory

Unit I

Prokaryotic cell: Molecular basis for origin and evolution of prokaryotic life, RNA world, prokaryotic cytoskeletal proteins. Flagella structure, assembly and regulation. Structure and composition (bacteria) cell wall/ envelop, Types of secretion systems (TI to TIV) and their molecular interaction, fimbriae and pili (Type IV pili), Bacterial chromosomes and plasmids, other cell organelles. Growth, nutrition and metabolism in prokaryotes (Embden-Meyerhof-Parnas (EMP) pathway, Phosphoketolase Pathway and Entner Doudoroff Pathway).

Unit II

Current trends in taxonomy and identification of phytopathogenic prokarya: International code of nomenclature, Polyphasic approach, New/ special detection methods for identification of bacterial plant pathogens. Taxonomic ranks hierarchy; Identification, Advances in classification and nomenclature.

Unit III

Bacterial genetics: General mechanism of variability (mutation), specialized mechanisms of variability. Transposable genetic elements in bacteria-integron and prophages, Mechanism of gene transfer. Pathogenicity islands, horizontal gene transfer, Bacterial Pan-Genome.

Unit IV

Bacteriophages: Composition, structure and infection. Classification and use of phages in plant pathology/ bacteriology. Host pathogen interactions: Molecular mechanism of pathogenesis: Pathogenicity factors of soft rot, necrosis, wilt, canker, etc. Immunization, induced resistance/ Systemic Acquired Resistance, Quorum sensing. Bacterial pathogenicity and virulence: Molecular mechanism of virulence and pathogenesis, bacterial secretion systems, pathogenicity of bacterial enzymes that degrade the cell walls, Role of hrp/hrc genes and TALE effectors. Synthesis and regulation of EPSs.

Unit V

Beneficial Prokaryotes-Endophytes, PGPR, Phylloplane bacteria and their role in disease management. Endosymbionts for host defence. Advances in management of diseases caused by prokaryotes: genetic engineering, RNA silencing; CRISPR cas9.



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Practical

- Pathogenic studies and race identification, plasmid profiling of bacteria, fatty acid profiling of bacteria, RFLP profiling of bacteria and variability status, Endospore, Flagella staining, Test for secondary metabolite production, cyanides, EPS, siderophore, specific detection of phytopathogenic bacteria using species/ pathovar specific primers;
- Basic techniques in diagnostic kit development, Molecular tools to identify phytoendosymbionts;
- Important and emerging diseases and their management strategies.

Suggested Reading

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

Garrity GM, Krieg NR and 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 and 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.

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PL PATH 604	Molecular Basis of Host-Pathogen Interaction	60	00	20	15	05	2	1	3

1. **Legends:** L - Lecture; P – Practical

2. *Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.

Aim of the course:

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

Theory

Unit I

History of host plant resistance and importance to Agriculture. Importance and role of biotechnological tools in plant pathology. Basic concepts and principles to study host pathogen relationship. Molecular genetics, imaging and analytical chemistry tools for studying plants, microbes, and their interactions.

Unit II

Different forms of plant-microbe interactions and nature of signals/ effectors underpinning these interactions. Plant innate immunity: PAMP/ DAMP. Molecular basis of host-pathogen interaction-fungi, bacteria, viruses and nematodes; recognition system, signal transduction.

Unit III

Induction of defence responses- HR, Programmed cell death, reactive oxygen species, systemic acquired resistance, induced systemic resistance, pathogenesis related proteins, phytoalexins and virus induced gene silencing. 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 IV

Gene for gene systems: Background, genetics, phenotypes, molecular mechanisms, races, breakdown of resistance (boom-and-bust cycles), Coevolution-arms race and trench warfare models, Metapopulations, cost of resistance, cost of unnecessary virulence, GFG in agricultural crops vs. natural populations, Durability of resistance, erosion of quantitative resistance. Pathogen population genetics and durability, viruses vs cellular pathogens.



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Unit V

Gene deployment, cultivar mixtures. Disease emergence, host specialization. Circadian clock genes in relation to innate immunity. 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, plasmid extraction, PCR analysis, DNA and Protein electrophoresis, bacterial transformation;
- Gene mapping and marker assisted selection;
- Development and use of molecular markers in identification and characterization of resistance to plant pathogens and their management.

Suggesting Reading

Chet I. 1993. Biotechnology in Plant Disease Control. John Wiley & Sons, New York.

Gurr SJ, McPhershen MJ and 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 and Keen TN. (Eds.). 1996. Plant Microbe Interactions. Vols. I-III. Chapman & Hall, New York; Vol. IV. APS Press, St. Paul, Minnesota.

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PL PATH 606	Plant Biosecurity and Biosafety	60	00	40	00	00	2	0	2

1. Legends: L - Lecture; P – Practical

2. *Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.

Aim of the course

To facilitate deeper understanding on plant biosecurity and biosafety issues in agriculture.

Theory

Unit I: History of biosecurity, Concept of biosecurity, Components of biosecurity, Quarantine, Invasive Alien Species, Biowarfare, Emerging/ resurgence of pests and diseases. Introduction and History of biosecurity and its importance.

Unit II: National Regulatory Mechanism and International Agreements/ Conventions, viz., Agreement on Application of Sanitary and Phytosanitary (SPS) Measures. World Trade Organization (WTO), Convention on Biological Diversity (CBD), International Standards for Phytosanitary Measures.

Unit-III: Pest risk analysis, risk assessment models, pest information system, early warning and forecasting system, use of 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.

Unit IV: Biosafety, policies and regulatory mechanism, Cartagena Protocol on Biosafety and its implications, Issues related to release of genetically modified crops.

Unit V: Emerging/resurgence of pests and diseases in the changing scenario of climatic conditions.

Suggested Reading

Biosecurity: A Comprehensive Action Plan.

Biosecurity Australia.

Biosecurity for Agriculture and Food Production.

FAO Biosecurity Toolkit 2008.

Grotto Andrew J and Jonathan B Tucker. 2006. Biosecurity Guidance.

Khetarpal RK and Kavita Gupta 2006. Plant Biosecurity in India – Status and Strategy. Asian Biotechnology and Development Review 9(2): 3963.

Randhawa GJ, Khetarpal RK, Tyagi RK and Dhillon BS (Eds.). 2001. Transgenic Crops and Biosafety Concerns. NBPGR, New Delhi.

e-Resources

<http://www.inspection.gc.ca/english/anima/heasan/fad/biosecure.sht ml>

www.fao.org/docrep/010/a1140e/a1140e00.htm Laboratory



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http://www.who.int/csr/resources/publications/biosafety/WHO_CD_S_EPR_2006.pdf

http://www.americanprogress.org/kf/biosecurity_a_comprehensive_action_plan.pdf

[www.biosecurity.govt.nz DEFRA. www.defra.gov.uk/animalh/diseases/control/biosecurity/index.htm](http://www.defra.gov.uk/animalh/diseases/control/biosecurity/index.htm)

www.daff.gov.au/ba; www.affa.gov.au/biosecurityaustralia Biosecurity New Zealand.

<http://www.fao.org/biosecurity/> CFIA.

List of Journals

- Annals of Applied Biology – Cambridge University Press, London
- Annals of Plant Protection Sciences- Society of Plant Protection, IARI, New Delhi
- 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 Plant Protection – Plant Protection Association of India, NBPGR, Hyderabad.
- Indian Journal of Virology – Indian Virological Society, New Delhi
- Indian Phytopathology-Indian Phytopathological Society, IARI New Delhi.
- Journal of Mycology and Plant Pathology – Society of Mycology and Plant Pathology, Udaipur.
- Journal of Plant Disease Science- Association of Plant Pathologists (Central India) PDKV, Akola.
- Journal of Phytopathology – Blackwell Verlag, Berlin
- Mycologia – New York Botanical Garden, Pennsylvania
- 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
- www.apsjournals.apsnet.org
- www.apsnet.org/journals
- www.cabi_publishing.org
- www.springer.com/life+Sci/agriculture
- www.backwellpublishing.com
- www.csiro.au
- www.annual-reviews.org

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		Theory			Practical		Credits		
		END SEM University Exam	Mid term exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	L	P	Total
ENT 605	Bio-inputs for Pest Management	60	00	20	15	05	2	1	3

1. Legends: L - Lecture; P – Practical

2. *Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.

Aim of the course

To appraise the students with advanced techniques in handling of different bioagents, modern methods of biological control and scope in cropping system-based pest management in agro-ecosystems.

Theory

Unit I

Scope of classical biological control and augmentative bio-control; introduction and handling of natural enemies; nutrition of entomophagous insects and their hosts.

Unit II

dynamics of bio-agents vis-à-vis target pest populations. Bio-inputs: mass production of bio-pesticides, mass culturing techniques of bioagents, insectary facilities and equipments,

Unit III

Basic standards of insectary, viable mass-production unit, designs, precautions, good insectary practices. Colonization, techniques of release of natural enemies, recovery evaluation, conservation and augmentation of natural enemies.

Unit IV

Survivorship analysis and ecological manipulations, large-scale production of bio-control agents, bankable project preparation. Scope of genetically engineered microbes and parasitoids in biological control,

Unit V

Genetics of ideal traits in bio-control agents for introgressing and for progeny selections, breeding techniques of bio-control agents.

Practical

- Mass rearing and release of some commonly occurring indigenous natural enemies;
- Assessment of role of natural enemies in reducing pest populations; • Testing side effects of pesticides on natural enemies;
- Effect of semio-chemicals on natural enemies, breeding of various bio-control agents, performance of efficiency analyses on target pests;
- Project document preparation for establishing a viable mass-production unit/ insectary;
- Observation of feeding behavior acts of predatory bugs/ beetles

Suggested Readings

Burges HD and Hussey NW. (Eds.). 1971. Microbial Control of Insects and Mites. Academic Press, London.



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Coppel HC and James WM. 1977. Biological Insect Pest Suppression. Springer Verlag, Berlin.

De Bach P. 1964. Biological Control of Insect Pests and Weeds. Chapman and Hall, London.

Dhaliwal, GS and Koul O. 2007. Biopesticides and Pest Management. Kalyani Publishers, New Delhi.

Gerson H and Smiley RL. 1990. Acarine Biocontrol Agents – An Illustrated Key and Manual. Chapman and Hall, New York.

Huffakar CB and Messenger PS. 1976. Theory and Practices of Biological Control. Academic Press, London

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ENT 606	Insect Toxicology and Residues	60	00	20	15	05	2	1	3

1. Legends: L - Lecture; P – Practical

2. *Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.

Aim of the course:

To acquaint the students with the latest advancements in the field of insecticide toxicology, biochemical and physiological target sites of insecticides, and pesticide resistance mechanisms in insects.

Theory

Unit I

Penetration and distribution of insecticides in insect systems; insecticide selectivity; factors affecting toxicity of insecticides. Modes of action of newer insecticide molecules; developments in bio-rational approaches; SPLAT; RNAi technology for pest management.

Unit II

Biochemical and physiological target sites of insecticides in insects; developments in biorationals, biopesticides and newer molecules; their modes of action and structural – activity relationships; advances in metabolism of insecticides.

Unit III

Joint action of insecticides; activation, synergism and potentiation.

Unit IV

Problems associated with pesticide use in agriculture: pesticide resistance; resistance mechanisms and resistant management strategies; pest resurgence and outbreaks; persistence and pollution; health hazards and other side effects.

Unit V

Estimation of insecticidal residues- sampling, extraction, clean-up and estimation by various methods; maximum residue limits (MRLs) and their fixation; bound and conjugated residues, effect on soil fertility; insecticide laws and standards, and good agricultural practices.

Practical

- Residue sampling, extraction, clean-up and estimation of insecticide residues by various methods;
- Calculations and interpretation of data;
- Biochemical and biological techniques for detection of insecticide resistance in insects;
- Preparation of EC formulation using neem oil.

Suggested Reading

Busvine JR. 1971. A Critical Review on the Techniques for Testing Insecticides. CABI, London.



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- Dhaliwal GS and Koul O. 2007. Biopesticides and Pest Management. Kalyani Publishers, New Delhi.
- Hayes WJ and Laws ER. 1991. Handbook of Pesticide Toxicology. Academic Press, New York.
- Ishaaya I and Degheele (Eds.). 1998. Insecticides with Novel Modes of Action. Narosa Publ. House, New Delhi.
- Matsumura F. 1985. Toxicology of Insecticides. Plenum Press, New York.
- O' Brien RD. 1974. Insecticides Action and Metabolism. Academic Press, New York.
- Perry AS, Yamamoto I, Ishaaya I and Perry R. 1998. Insecticides in Agriculture and Environment. Narosa Publ. House, New Delhi.
- Prakash A and Rao J. 1997. Botanical Pesticides in Agriculture. Lewis Publ., New York

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		END SEM University Exam	Mid term exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	L	P	Total
STAT 522	Data Analysis Using Statistical Packages	60	00	20	15	05	2	1	3

1. Legends: L - Lecture; P – Practical

2. *Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.

Objective

This course is meant for exposing the students in the usage of various statistical packages for analysis of data. It would provide the students a hands on experience in the analysis of their research data. This course is useful to all disciplines.

Theory

Unit I

Introduction to various statistical packages: Excel, R, SAS, SPSS. Data Preparation; Descriptive statistics; Graphical representation of data, Exploratory data analysis.

Unit II

Test for normality; Testing of hypothesis using chi-square, t and F statistics and Z-test.

Unit III

Data preparation for ANOVA and ANCOVA, Factorial Experiments, contrast analysis, multiple comparisons, Analyzing crossed and nested classified designs.

Unit IV

Analysis of mixed models; Estimation of variance components; Correlation and regression analysis, Probit, Logit and Tobit Models.

Unit V

Discriminant function; Factor analysis; Principal component analysis; Analysis of time series data, Fitting of non-linear models; Neural networks.

Practical

- Use of software packages for summarization and tabulation of data, obtaining descriptive statistics, graphical representation of data;
- Testing the hypothesis for one sample t-test, two sample t-test, paired t-test, test for large samples - Chi-squares test, F test, one-way analysis of variance;
- Designs for Factorial Experiments, fixed effect models, random effect models, mixed effect models, estimation of variance components;
- Linear regression, Multiple regression, Regression plots;
- Discriminant analysis - fitting of discriminant functions, identification of important variables;
- Factor analysis. Principal component analysis - obtaining principal component.



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Suggested Readings

- Anderson C.W. and Loynes R.M. 1987. The Teaching of Practical Statistics. John Wiley.
- Atkinson A.C. 1985. Plots Transformations and Regression. Oxford University Press.
- Chambers J.M., Cleveland W.S., Kleiner B and Tukey P.A. 1983. Graphical Methods for Data Analysis. Wadsworth, Belmont, California.
- Chatfield C. 1983. Statistics for Technology. 3rd Ed. Chapman & Hall. Chatfield C. 1995. Problem Solving: A Statistician's Guide. Chapman & Hall.
- Cleveland W.S. 1985. The Elements of Graphing Data. Wadsworth, Belmont, California.
- Ehrenberg ASC. 1982. A Primer in Data Reduction. John Wiley.
- Erickson B.H. and Nosanchuk T.A. 1992. Understanding Data. 2nd Ed. Open University Press, Milton Keynes.
- Snell E.J. and Simpson HR. 1991. Applied Statistics: A Handbook of GENSTAT Analyses. Chapman and Hall.
- Sprent P. 1993. Applied Non-parametric Statistical Methods. 2nd Ed. Chapman & Hall.
- Tufte ER. 1983. The Visual Display of Quantitative Information. Graphics Press, Cheshire, Conn.
- Velleman PF and Hoaglin DC. 1981. Application, Basics and Computing of Exploratory Data Analysis. Duxbury Press.
- Weisberg S. 1985. Applied Linear Regression. John Wiley.
- Wetherill GB. 1982. Elementary Statistical Methods. Chapman & Hall.
- Wetherill GB. 1986. Regression Analysis with Applications. Chapman & Hall.
- Cleveland WS. 1994. The Elements of Graphing Data, 2nd Ed., Chapman & Hall
- <http://freestatistics.altervista.org/en/learning.php>. <http://freestatistics.altervista.org/en/stat.php>.
- http://www.cas.lancs.ac.uk/glossary_v1.1/main.html. <http://www.stat.sc.edu/~grego/courses/stat706/>.
- www.drs.icar.gov.in.

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