

**Department of Plant Pathology**  
**Faculty of Agricultural Sciences**  
**University of the Punjab, Lahore**  
**Course Outline**



<b>Programme</b>	B.Sc. (Hons.) Agriculture (Plant Pathology) 4 Year program	<b>Course Code</b>	<b>PP-308</b>	<b>Credit Hours</b>	3(2-1)
<b>Course Title</b>	<b>Plant Resistance to Diseases</b>				
<b>Course Introduction</b>					
This course, "Plant Resistance to Diseases," explores resistance strategies employed by the plants to overcome or counteract the biotic or abiotic diseases. Emphasis will be on developing an understanding of genetic and biochemical basis of resistance mechanisms and their potential practical implications.					
<b>Learning Outcomes</b>					
On the completion of the course, the students will:					
<ol style="list-style-type: none"> <li>1. To be familiar with disease resistance mechanisms of plants.</li> <li>2. To comprehend the infection mechanisms and environmental factors influencing disease development.</li> <li>3. To understand integrated disease management strategies, including cultural, chemical, and biological control methods.</li> </ol>					
<b>Course Content</b>				<b>Assignments/Readings</b>	
<b>Week 1</b>	<u><b>THEORY</b></u> <b>Unit-I:</b> 1.1 Introduction of the course 1.2 Historical development and importance of plant resistance against various pathogens 1.3 Disease management strategies			<ol style="list-style-type: none"> <li>1. Agrios, G.N. 2005. Plant Pathology, 5 th edition, Academic Press, New York, USA.</li> <li>2. Tortora, G.J., Funke, B.R. and Case, C.L. 2009. Microbiology: an introduction. The Benjamine/Cummings Pub. Co, Redwood City, California, USA.</li> </ol>	
	<u><b>PRACTICAL</b></u> ○ Isolating fungal and bacterial pathogens from infected plant samples				
<b>Week 2</b>	<u><b>THEORY</b></u> <b>Unit-II:</b> 2.1. Types of resistance 2.2. Infection mechanisms employed by fungi, bacteria, nematodes and viruses;			<ol style="list-style-type: none"> <li>1. Slusarenko, A.J., Fraser, R.S. and van Loon, L.C. eds., 2014. Mechanisms of resistance to plant diseases. Springer. United states</li> </ol>	
	<u><b>PRACTICAL</b></u> Methods for isolation and purification of plant pathogens				

Week 3	<p><b><u>THEORY</u></b>  <b>General discussion</b>  <b>Unit-III:</b>  3.1. Mechanisms of resistance against fungi, bacteria, nematodes and viruses</p>	<p>1. Wang, N., Sundin, G. W., Fuente, L. D. L., Cubero, J., Tatineni, S., Brewer, M. T., ... &amp; Munkvold, G. (2024). Key challenges in plant pathology in the next decade. <i>Phytopathology</i>®, 114(5), 837-842.</p>
	<p><b><u>RACTICAL</u></b>  Identification techniques: morphological, biochemical, and molecular approaches</p>	
Week 4	<p><b>Unit-IV:</b>  4.1 Mechanism and genetic basis of resistance towards plant pathogens;</p>	<p>2. Slusarenko, A.J., R.S.S. Fraser and L.C. Van Loon. 2000. Mechanisms of Resistance to Plant Diseases. Kluwer Academic Publishers.</p>
	<p><b><u>PRACTICAL</u></b>  Preparation and multiplication of inoculum</p>	
Week 5	<p><b><u>THEORY</u></b>  <b>Unit-V:</b>  4.1. gene centers as a source of resistance;  4.2. Gene pyramiding and mapping of genes responsible for disease resistance</p> <ul style="list-style-type: none"> <li>○</li> </ul>	<p><b><u>Reading</u></b>  Internet  PowerPoint slides  And research articles</p>
	<p><b><u>PRACTICAL</u></b>  Inoculation techniques for various plant pathogens</p> <ul style="list-style-type: none"> <li>○ Fungi and bacteria</li> <li>○ Nematodes</li> <li>○ Viruses</li> </ul>	
Week 6	<p><b><u>THEORY</u></b>  <b>Quiz test</b>  <b>Unit-VI:</b>  5.1 Host defense system  5.2 Morphological weapons</p>	<p>1. Agrios, G.N. 2005. Plant Pathology, 5 th edition, Academic Press, New York, USA.</p>
	<p><b><u>PRACTICAL</u></b>  Field visit for demonstrating resistance, susceptible and hypersensitive response of plants against pathogens</p>	

Week 7	<p><b><u>THEORY</u></b>  <b>Unit-VII:</b>  7.1 Host defense system  7.2 Biochemical system  7.3 Molecular and signaling pathways</p>	<p><b><u>Assignment (Theory):</u></b>  Topics will be assigned to individual or group of students.</p> <p><b><u>Books for reading</u></b></p> <p>1. Punja, Z.K. and Z. Punja. 2004. Fungal Disease Resistance in Plants: Biochemistry, Molecular Biology, and Genetic Engineering. CRC Press.</p>
	<p><b><u>PRACTICAL</u></b></p> <ul style="list-style-type: none"> <li>○ Demonstration of hypersensitive reaction, resistance and susceptibility</li> </ul>	
Week 8	<p><b><u>THEORY</u></b>  <b>Unit-VIII:</b>  8.1. Strategies for gene deployment  8.2 Breeding strategies  8.3 Cloning strategies</p>	<p>1. Hammerschmidt, R. and Kuc, J. eds., 2013. <i>Induced resistance to disease in plants</i> (Vol. 4). Springer Science &amp; Business Media.</p>
	<p><b><u>PRACTICAL</u></b></p> <ul style="list-style-type: none"> <li>○ Planning and execution of field trials for germplasm screening</li> <li>○ Soil preparation</li> </ul>	
Week 9	<b>MID-TERM</b>	
Week 10	<p><b><u>THEORY</u></b>  <b>Unit-IX:</b>  9.1 Transgenic approaches for crop protection  9.2 Gene hunting</p>	<p><b><u>Assignment (Theory):</u></b>  The use of Modern genome editing strategies in plant protection.  <b>Task:</b> Investigate recent literature to assess the effectiveness of GMOs in suppressing pathogens.</p>
	<p><b><u>PRACTICAL</u></b>  Seed processing and designing research plots  Setting up experiment setup for screening of germplasm</p>	
Week 11	<p><b><u>THEORY</u></b>  <b>Unit-X:</b>  10.1 Cross protection  10.2 RNA interference Technology</p>	<p><b><u>Reading</u></b></p> <p>1. Wang, N., Sundin, G. W., Fuente, L. D. L.,</p>

	<p><b><u>PRACTICAL</u></b>  <b>Monitoring and Data Analysis from Field Trials</b></p> <ul style="list-style-type: none"> <li>○ Techniques for monitoring pathogen populations in soil post-treatment</li> <li>○ Data collection, analysis, and interpretation of field trial results</li> </ul>	<p>Cubero, J., Tatineni, S., Brewer, M. T., ... &amp; Munkvold, G. (2024). Key challenges in plant pathology in the next decade. <i>Phytopathology</i>®, 114(5), 837-842.</p>
<p><b>Week 12</b></p>	<p><b>Unit-XI:</b>  11.1 CRISPR-CAS  11.2 Tissue Culture  <b><u>PRACTICAL</u></b></p> <ul style="list-style-type: none"> <li>○ screening of germplasm in green house against major plant pathogens</li> </ul>	
<p><b>Week 13</b></p>	<p><b><u>THEORY</u></b>  <b>Group Discussion</b></p> <p><b>Unit XII:</b>  12.1 Screening of germplasm  12.2 Resistance mitigation by using different rating scales/parameters</p> <p><b><u>PRACTICAL</u></b></p> <ul style="list-style-type: none"> <li>○ pathogen inoculation on already set up filed and greenhouse trials</li> </ul>	<p>1. Vidhyasekaran, P. 2002. Bacterial Disease Resistance in Plants: Molecular Biology and Biotechnological Applications, Food Products Press, an imprint of the Haworth Press Inc. 455 PP.</p>
<p><b>Week 14</b></p>	<p style="text-align: center;"><b>REVISION/TEST</b></p> <p><b><u>THEORY</u></b>  <b>Group Discussion/ class presentations</b>  <b><u>PRACTICAL</u></b></p> <ul style="list-style-type: none"> <li>○ Demonstration of various disease rating scales</li> </ul>	
<p><b>Week 15</b></p>	<p><b><u>THEORY</u></b>  <b>Unit XIII:</b>  13.1 Disease modeling  13.2 mechanism and genetic basis of plant resistance towards plant pathogens.</p> <p><b><u>PRACTICAL</u></b></p> <ul style="list-style-type: none"> <li>○ disease modelling;</li> </ul>	<p>1. Punja, Z.K. and Z. Punja. 2004. Fungal Disease Resistance in Plants: Biochemistry, Molecular Biology, and Genetic Engineering. CRC Press.</p>
<p><b>Week 16</b></p>	<p><b><u>THEORY</u></b>  <b>Unit XIV:</b>  14.1 Molecular markers  14.2 Course review</p> <p><b><u>PRACTICAL</u></b></p> <ul style="list-style-type: none"> <li>○ Detection of resistance genes using molecular markers</li> </ul>	<p>1. Wang, N., Sundin, G. W., Fuente, L. D. L., Cubero, J., Tatineni, S., Brewer, M. T., ... &amp; Munkvold, G. (2024). Key challenges in plant pathology in the next decade. <i>Phytopathology</i>®, 114(5), 837-842.  <b>2. Research articles</b></p>

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**FINAL-TERM**

**Textbooks and Reading Material**

**Suggested Readings**

**BOOKS**

- Agrios, G.N. 2005. Plant Pathology, 5<sup>th</sup> edition, Academic Press, New York, USA.
- Boland, G.J., L. David and Kuykendall. 1998. Plant Microbe Interactions and Biological Control. Marcel Dekker, Inc, USA.
- Moore, D. and L.A.N. Frazer. 2002. Essential Fungal Genetics. Springer Verlag, New York, USA.
- Punja, Z.K. and Z. Punja. 2004. Fungal Disease Resistance in Plants: Biochemistry, Molecular Biology, and Genetic Engineering. CRC Press.
- Robert S.F. and E.L. Simms. 1992. Plant Resistance to Herbivores and Pathogens: Ecology, Evolution, and Genetics. The University of Chicago Press, Ltd. London.
- Russel, G.C. 1981. Plant Breeding for Pest and Disease Resistance. Butterworths and Company, Ltd., London, UK.
- Sadasivan, S. and B. Thayumanavan. 2003. Molecular Host Plant Resistance to Pest. Marcel Dekker, USA.
- Singh, D.P. 2002. Breeding for Resistance to Biotic Stress, International Books Distribution Co. India.
- Slusarenko, A.J., R.S.S. Fraser and L.C. Van Loon. 2000. Mechanisms of Resistance to Plant Diseases. Kluwer Academic Publishers.
- Staples, C.R. and G.H. Toenniessen. 1981. Plant Disease Control Resistance and Susceptibility. John Wiley & Sons, Inc. New York, USA.
- Stubbs, R.W., J.M. Prescott, E.E. Sarri and H.J. Dubin. 1986. Cereal Disease Methodology Manual. CIMMYT, Mexico.
- 12. Van der Plank, J.E. 1984. Disease Resistance in Plants 2<sup>nd</sup> Edition, Academic Press

Inc., London 194 PP.

- 13. Vidhyasekaran, P. 2002. Bacterial Disease Resistance in Plants: Molecular Biology and Biotechnological Applications, Food Products Press, an imprint of the Haworth Press Inc. 455 PP.
- 14. Slusarenko, A.J., Fraser, R.S. and van Loon, L.C. eds., 2014. *Mechanisms of resistance to plant diseases*. Springer. United states
- 15. Hammerschmidt, R. and Kuc, J. eds., 2013. *Induced resistance to disease in plants* (Vol. 4). Springer Science & Business Media.
- Wang, N., Sundin, G. W., Fuente, L. D. L., Cubero, J., Tatineni, S., Brewer, M. T., ... & Munkvold, G. (2024). Key challenges in plant pathology in the next decade. *Phytopathology*®, 114(5), 837-842.

**Journal Articles/ Reports**

Resources will be shared during class

**Teaching Learning Strategies**

1. Class lectures
2. Discussions
3. Practical demonstrations
4. Hands on training where applicable

**Assignments: Types and Number with Calendar**

**Assignments**

Types and Number with calendar

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.