# Jordan University of Science and Technology

## Faculty of Agriculture

## Plant Production Department

PP745 Advanced Plant Pathology

First Semester 2019-2020

| Course Catalog |
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| 3 Credit Hours. The contents of this course will cover two major components of plant-pathogen interactions, the first part of the course will cover the mechanisms and strategies used by plant pathogens to colonize plant tissues (pathogenesis) and the second part will focus on host plant defenses and responses against the invading pathogen (s) (host defenses). General principles and specific interactions using selected pathosystems will be used to illustrate microbial pathogenesis strategies. Interactions with economic significance and level of available knowledge will be chosen for detailed analysis. We will also highlight non-pathogenic interactions. Emphasis on this course will be on basic understanding of the cellular and molecular mechanisms of host pathogen interactions and genetics of plant pathogenesis covering milestone and recent advances in the area of plant pathogenesis. |

| Text Book | |
|---|---|
| **Title** | Plant Pathology |
| **Author(s)** | Agrios, G. N. |
| **Edition** | 5th Edition |
| **Short Name** | Agrios plant pathology |
| **Other Information** | Chapter 4 |

**Course References**

| Short name | Book name | Author(s) | Edition | Other Information |
|---|---|---|---|---|
| Annu. Rev. Phytopathol. 1971.9:275-296. | CURRENT STATUS OF THE GENE-FOB-GENE CONCEPT | H. Flor | 1st Edition | Annu. Rev. Phytopathol. 1971.9:275-296. |
| Genes 2018, 9, 339- | Disease Resistance Mechanisms in Plants | Ethan J. Andersen , Shaukat Ali , Emmanuel Byamukama , Yang Yen and Madhav P. Nepal | 1st Edition | Genes 2018, 9, 339; doi:10.3390/genes9070339 |

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| Annu. Rev. Phytopathol. 2007.45:399-436. | Elicitors, Effectors, and R Genes: The New Paradigm and a Lifetime Supply of Questions | Andrew F. Bent and David Mackey | 1st Edition | Annu. Rev. Phytopathol. 2007.45:399-436. |
| Physiological Plant Pathologv (1982) 21, 1-11 | Evidence for the occurrence of race and cultivar-specific elicitors of necrosis in intercellular fluids of compatible interactions of Cladosporium fulvum and tomato | P. ,J. G. M. DE WIT and G. SPIKMAN | 1st Edition | Physiological Plant Pathologv (1982) 21, 1-11 |
| Annu. Rev. Phytopathol. 2001.39:385-417 | SURFACE ATTACHMENT AND PRE-PENETRATION STAGE DEVELOPMENT BY PLANT PATHOGENIC FUNGI | Sara L. Tucker and Nicholas J. Talbot | 1st Edition | Annu. Rev. Phytopathol. 2001.39:385-417 |
| SCIENCE, VOL. 239: 288-209 | A Mechanism for Surface Attachment in Spores of a Plant Pathogenic Fungus | JOHN E. HAMER,* RicHARD J. HowARD, FORREST G. CHUMLEY, BARBARA VALENT | 1st Edition | SCIENCE, VOL. 239: 288-209 |
| Microbes and Infection, 2, 2000, 1631?1641 | The role of fungal appressoria in plant infection | Holger B. Deising, Stefan Werner, Marcus Wernitz | 1st Edition | Microbes and Infection, 2, 2000, 1631?1641 |
| Current Opinion in Plant Biology 2015, 26:8?13 | Regulation of appressorium development in pathogenic fungi | Lauren S Ryder and Nicholas J Talbot | 1st Edition | Current Opinion in Plant Biology 2015, 26:8?13 |
| PNAS vol. 98 u no. 14 u 8133?8138 | The role of haustoria in sugar supply during infection of broad bean by the rust fungus | Ralf T. Voegele, Christine Struck, Matthias Hahn, and Kurt Mendgen | 1st Edition | PNAS vol. 98 u no. 14 u 8133?8138 |
| Current Opinion in Plant Biology 2003, 6:320?326 | Establishing compatibility between plants and obligate biotrophic pathogens | Ralph Panstruga | 1st Edition | Current Opinion in Plant Biology 2003, 6:320?326 |
| Journal of Cell Science (2018) 131, jcs207373. doi:10.1242/jcs.207373 | Building a plant cell wall at a glance | Edwin R. Lampugnani*, Ghazanfar Abbas Khan*, Marc Somssich* and Staffan Persson | 1st Edition | Journal of Cell Science (2018) 131, jcs207373. doi:10.1242/jcs.207373 |

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| Annu. Rev. Phytopathol. 2014.52:427-451 | Plant Cell Wall? Degrading Enzymes and Their Secretion in Plant-Pathogenic Fungi | Christian P. Kubicek, Trevor L. Starr, and N. Louise Glass | 1st Edition | Annu. Rev. Phytopathol. 2014.52:427-451 |
| The Plant Cell, Vol. 8, 1723-1733, October 1996 O 1996 American Society of Plant Physiologists | Host-Selective Toxins: Agents of Compatibility | Jonathan D. Walton | 1st Edition | The Plant Cell, Vol. 8, 1723-1733, |
| MOLECULAR PLANT PATHOLOGY (2001) 2(4), 229?239 | Host-selective toxins as agents of cell death in plant? fungus interactions | JONATHAN E. MARKHAM AND JACQUES HILLE | 1st Edition | MOLECULAR PLANT PATHOLOGY (2001) 2(4), 229?239 |
| The Plant Cell, Vol. 8, 1821-1831, | Preformed Antimicrobial Compounds and Plant Defense against Funga1 Attack | Anne E. Osbourn | 1st Edition | The Plant Cell, Vol. 8, 1821-1831, |
| Int. J. Mol. Sci. 2009, 10, 3400-3419; doi:10.3390/ijms10083400 | Plant Antimicrobial Agents and Their Effects on Plant and Human Pathogens | Roc?o Gonz?lez-Lamothe , Gabriel Mitchell , Mariza Gattuso , Moussa S. Diarra , Fran?ois Malouin , and Kamal Bouarab | 1st Edition | Int. J. Mol. Sci. 2009, 10, 3400-3419; doi:10.3390/ijms10083400 |
| Current Opinion in Plant Biology 2015, 26:8?13 | Abrogation of disease development in plants expressing animal antiapoptotic genes | Lauren S Ryder and Nicholas J Talbot | 1st Edition | Current Opinion in Plant Biology 2015, 26:8?13 |
| Molecular Plant Pathology (2019) 20(8), 1163?1178 | The plant hypersensitive response: concepts, control and consequences | PETER BALINT-KURTI | 1st Edition | Molecular Plant Pathology (2019) 20(8), 1163?1178 |
| Journal of Experimental Botany, Vol. 59, No. 3, pp. 501?520, 2008 doi:10.1093/jxb/erm239 | The hypersensitive response; the centenary is upon us but how much do we know? | Luis A. J. Mur1,, Paul Kenton, Amanda J. Lloyd, Helen Ougham and Elena Prats | 1st Edition | Journal of Experimental Botany, Vol. 59, No. 3, pp. 501?520, 2008 doi:10.1093/jxb/erm239 |
| Trends in Plant Science, February 2012, Vol. 17, No. 2 | Phytoalexins in defense against pathogens | Ishita Ahuja, Ralph Kissen and Atle M. Bones | 1st Edition | Trends in Plant Science, February 2012, Vol. 17, No. 2 |
| Annu. Rev. Phytopathol. 1999. 37:285?306 | PHYTOALEXINS: What Have We Learned After 60 Years? | HAMMERSCHMIDT, R | 1st Edition | Annu. Rev. Phytopathol. 1999. 37:285?306 |

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| Microbiological Research 212?213 (2018) 29?37 | Pathogenesis-related proteins and peptides as promising tools for engineering plants with multiple stress tolerance | Sajad Alia,b, Bashir Ahmad Ganaib, Azra N Kamilib, Ajaz Ali Bhatc, Zahoor Ahmad Mira, Javaid Akhter Bhatd, Anshika Tyagia, Sheikh Tajamul Islame, Muntazir Mushtaqd, Prashant Yadava, Sandhya Rawata, Anita Grovera | 1st Edition | Microbiological Research 212?213 (2018) 29?37 |
| Physiological and Molecular Plant Pathology (1999) 55, 85?97 | The families of pathogenesis-related proteins, their activities, and comparative analysis of PR-1 type proteins | L. C. VAN LOON* and E. A. VAN STRIEN | 1st Edition | Physiological and Molecular Plant Pathology (1999) 55, 85?97 |

| **Instructor** | |
|---|---|
| Name | **Dr. Firas Abu El Samen** |
| Office Location | C4L2 |
| Office Hours | Sun : 08:00 - 10:00<br>Mon : 10:30 - 13:30<br>Wed : 10:30 - 13:30<br>Thu : 08:00 - 10:00 |
| Email | hiasat@just.edu.jo |

| **Class Schedule & Room** |
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| Section 1:<br>Lecture Time: Mon, Wed : 08:30 - 10:00<br>Room: LAB |

| **Tentative List of Topics Covered** | | |
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| **Weeks** | **Topic** | **References** |
| Week 1 | Introduction to genetics of plant-pathogen interactions: Key definitions, types of resistance, R-genes, Avirulence and virulence, gene for gene concept, compatible and incompatible interactions, forma specialis and race concepts. Readings: Chapter 4. Agrios 2005. | **Chapter 4** From **Agrios plant pathology** |
| Week 2 | Disease resistance in plants (An introduction): Definitions and types of resistance | From **Annu. Rev. Phytopathol. 1971.9:275-296.**,<br>From **Genes 2018, 9, 339-**,<br>From **Annu. Rev. Phytopathol. 2007.45:399-436.**,<br>From **Physiological Plant Pathologv (1982) 21, 1-11** |

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| Week 3 | Infection process in plant pathogens I (adhesion): Fungal attachment to plant surface. Mechanisms of spore adhesion, mechanism of spore adhesion in Magnaporthe grisea, Nectria haematococca, Colletotrichium spp., bacterial attachment. Germination of spores on plant surface and formation of infection structures. | From **Annu. Rev. Phytopathol. 2001.39:385-417**, From **SCIENCE, VOL. 239: 288-209** |
| Week 4 | Infection process in plant pathogens II (Penetration): Penetration through stomates, direct penetration, Thigmotropic responses, penetration by biotrophic, hemi-biotrophic and necrotrophic pathogens, induction of appressorium, plant waxes, cutin, pectin, cellulose, cell wall degrading enzymes, cutinases, pectinases and cellulases | From **Microbes and Infection, 2, 2000, 1631?1641**, From **Current Opinion in Plant Biology 2015, 26:8?13** |
| Week 5 | Infection process in plant pathogens III (Colonization) in biotrophic plant pathogens:Mechanisms of colonization of plant tissues by plant pathogens. Haustoria and biotrophic interfacial complex (structure and functions). | From **PNAS vol. 98 u no. 14 u 8133?8138**, From **Current Opinion in Plant Biology 2003, 6:320?326** |
| Week 6 | Biochemistry of plant cell wall. | From **Journal of Cell Science (2018) 131, jcs207373. doi:10.1242/jcs.207373** |
| Week 7 | Enzymes and pathogenicity: Cell wall degrading enzymes (CWDEs) produced by plant pathogens: Cutinases, Pectinases; Xylanases; Cellulases; Glucanases; proteinases etc., | From **Annu. Rev. Phytopathol. 2014.52:427-451** |
| Week 8 | Toxins in plant pathogenesis: Non ?host specific (selective toxins) (non-HSTs) and Host specific toxins (HSTs). | From **The Plant Cell, Vol. 8, 1723-1733, October 1996 O 1996 American Society of Plant Physiologists**, From **MOLECULAR PLANT PATHOLOGY (2001) 2(4), 229?239** |
| Week 9 | Structural defenses in plants and preformed compounds: Preformed defense mechanisms | From **The Plant Cell, Vol. 8, 1821-1831,**, From **Int. J. Mol. Sci. 2009, 10, 3400-3419; doi:10.3390/ijms10083400** |
| Week 10 | Genetics and physiology of plant disease and disease resistance. (host defenses): Physiology of resistance in plants, Hypersensitive response (HR) and programmed cell death (PCD), history of HR, general sequence of events of HR, Reactive oxygen species (ROS) and role in plant defense, oxidative burst, execution of HR. | From **Current Opinion in Plant Biology 2015, 26:8?13**, From **Molecular Plant Pathology (2019) 20(8), 1163?1178**, From **Journal of Experimental Botany, Vol. 59, No. 3, pp. 501?520, 2008 doi:10.1093/jxb/erm239** |

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| Week 11 | Plant Disease resistance genes (R- genes) structure and function: Major classes of R-genes, proposed functions of different domains, Chromosomal arrangement of R-genes, Forces affecting R-gene evolution, Effects of mutation and selection on R-gene evolution, Utilization of resistance genes as transgenics. | |
| Week 12 | Avirulence genes and avr proteins of plant pathogens:Receptor-ligand model, Bacterial avr genes, Structural features of avirulence genes, organization of Avr genes, Bacterial Avr genes functions, models for Avr genes functions, Type III secretion system in phytopathogenic bacteria. | |
| Week 13 | Host responses to infection I: Phenolic compounds, phenylpropanoid pathway, phenolics and host plant defenses, Lignification and papillae formation. | |
| Week 14 | Host responses to infection II: (Phytoalexins): Phytoalexins: Structure and distribution, Biosynthesis and elicitation, defense or just a response to infection? evidence of role in host defenses, pathogens may detoxify phytoalexins, Detoxification can be a tolerance mechanism and can be required for pathogenicity. | From **Trends in Plant Science, February 2012, Vol. 17, No. 2**, From **Annu. Rev. Phytopathol. 1999. 37:285?306** |
| Week 15 | Host responses to infection III: Pathogenesis related proteins (PR-proteins): Pathogenesis related proteins and host defense, Characteristics of PR-proteins and their proposed functions, families of PR-proteins (PR-1, PR-2, PR-3, PR-4 and PR-5 proteins families), role in host plant defense against invading pathogens, evidence for and against their role in host defense. | From **Microbiological Research 212?213 (2018) 29?37**, From **Physiological and Molecular Plant Pathology (1999) 55, 85?97** |
| Week 16 | Systemic Acquired Resistance (SAR) and induced systemic resistance (ISR): Differences between SAR and ISR and mechanisms involved in each type of resistance. | |

| **Relationship to Program Student Outcomes (Out of 100%)** | | | | |
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| SLO1 | SLO2 | SLO3 | SLO4 | SLO5 |
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