Jordan University of Science and Technology
Faculty of Agriculture
Dept. of Plant Production
Course name: Advanced Plant Pathology
Course number: **PP745**

Semester offered: Fall (every year)

Instructor: Dr. Firas Abu-El Samen (hiasat@just.edu.jo).

Office hours: Mon 9-12 am

Time and place: MW 12:45-2:15 pm, Dept. Seminar room

General description and objectives:

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 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.

Objectives:

1. Learn about the general principles of plant pathogenesis with emphasis on bacterial, fungal, nematode, and viral pathogenic strategies.
2. Learn the genetic, molecular and biochemical underpinnings of the emerging concepts and paradigms that lead to successful plant colonization.
3. Learn how plants defend themselves against invading pathogens including basic defenses and genetic resistance provided by major resistance genes.
4. Learn how knowledge gained from studies of plant pathogenesis can be translated
   into stable, sustainable and environmentally-sound approaches of crop protection.

Prerequisites:

An introductory course in plant pathology such as PP441 and an introductory course in Genetics or Biochemistry and molecular biology should provide sufficient background to the contents of this course.

Grading

Midterm Exam ----------30 pt
Term paper (equivalent to second exam)-------- -30 pt
Final Exam----------40 pt
Total ----------**100 pt**

*Important dates and deadlines***

Outline for your term paper	30/10/2006
Midterm Exam	4/12/2006
Term paper first draft due	11/12/2006
Term paper final draft (dead line)	3/1/2007
Final Exam	Finals week (15/1/2007)

** There are no make up exams regardless of the reasons for missing an exam, students who miss the exam for any reason will have to prepare a term paper or a project assigned by the instructor.

Term paper:

Each student will be required to submit one term paper, reviewing an important area in the host pathogen interactions. Some topics will be suggested by the instructor; however, students may also choose their own topic, with consent of the instructor. The length of the paper should be between10-12 pages (double space, 12pt Times New Roman or Arial) excluding references and figures. Appropriate references should be cited. Students need to use at least three kinds of references (Research articles, Review papers, books, conference proceedings, www resources, etc). Term paper should have at least 12 citations of different kinds including at least three original research papers. The American Phytopathological society citation method (found in Phytopathology and Plant Disease journals) should be used. After choosing a topics students are required to submit an outline for the term paper within ten days. After getting an approval for your outline you will have one month to submit a first draft that will be evaluated and corrected. Two weeks to one month later you need to submit your final paper upon which your grade will be assigned.

Text book: none is required, however many books and journal articles are going to be used. I have listed some useful references for students as reference materials (some are required readings). Class notes will be delivered as power point presentations and will be provided to students after each class as a PDF file attachment to an e-mail message from the instructor; please watch your e-mail for required and suggested readings.

Course Topics

No.	Topic	Contents and required readings	Lectures
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.**	2
2	**Determinants of plant-fungal specificity**	Fungal species-plant species specificity, fungal species-plant genotype specificity, fungal genotype-plant species specificity, fungal genotype-plant genotype, and fungal species-plant organ tissue specificity. Specificity below species level. **Readings: Michele C. Heath 1994.**	2
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. **Reading: Schafer 1994.**	2
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. **Readings: Walton JD 1994.**	2
5	**Infection process in plant pathogens III (Colonization)**	Mechanisms of colonization of plant tissues by plant pathogens. **Readings: Mendgen K., and Hahn M 2002.**	2
6	**Genetics and physiology of plant disease and disease resistance. (Host responses to infection- I)**	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.	2-3

7	**Plant Disease resistance genes (R-genes) structure and function.**	**Readings:** • **Greenberg JT., and Yao N. 2004.** • **Heath, MC. 2000** • **Baker, CJ and Orlandi EW.** 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. **Readings:** • **Jeffery L. Dangl & Jonathan D. G. Jones. 2001.** • **Scot H. Hulbert, Craig A.Webb, ShavannorM. Smith, and QingSun.2001.**	2
8	**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. **Readings:** • **Jan E. Leach and Frank F. White, 1996.** • **RIANNE LUDERER AND MATTHIEU H. A. J. JOOSTEN.2001.**	2
9	**Host responses to infection II**	Phenolic compounds, phenylpropanoid pathway, phenolics and host plant defenses, Lignification and papillae formation. **Readings:** • **Richard A. Dixon' and Nancy L. Paiva. 1995.** • **Ronald Hatfield and Wilfred Vermerris. 2001.** • **Nicholson, R.L., and Hammerschmidt, R.1992.**	2

10	**Host responses to infection III: (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. **Readings:** • **Hammerschmidt, 1999.**	2
11	**Host responses to infection IV: 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. **Readings:** **L.C.VANLOON and E.A.VANSTRIEN 1999.**	2
		Review lecture and discussion	1
		Total	24

Suggested references and readings

1. Agrios, G. N. Plant Pathology, 5th ed. Elsevier Academic Press. 922pp.

2. Aist, J. 1976. PAPILLAE AND RELATED WOUND PLUGS OF PLANT CELLS. Ann Rev. Phytopathology 14: 145-163.

3. Baker, C.J., and Orlandi, E. W. 1999. Active oxygen and pathogenesis in plants. In: Stacey, G., and Keen N. T. Plant Microbe interactions, Vol 4. Chapter 4. APS press, St. Paul, Minnesota.

4. Brian J. Staskawicz. 2001. Genetics of Plant-Pathogen Interactions Specifying Plant Disease Resistance. Plant Physiology, 2001,Vol.125, pp.73–76.

5. Dangl J.L., & Jones, J. D. G. 2001. Plant pathogens and integrated defense responses to infection, NATURE. Vol 411: 826-833.

6. Dixon, R.A., and Paiva, N.L. 1995. Stress-induced Phenylpropanoid Metabolism. The Plant Cell, 7, 1085-1097.

7. De Wit. P. J. G. M. 1992. MOLECULAR CHARACTERIZATIONOF GENE-FOR-GENE SYSTEMS IN PLANT-FUNGUS INTERACTIONS AND THE APPLICATION AVIRULENCE GENES IN OF PLANT PATHOGENS OF CONTROL. Annu. Rev. Phytopathol. 30: 391-418.

8. Ellis,J., Lawrence,G., Ayliffe,M., Anderson,P., Collins,N., Finnegan,J., Frost,D., Luck, J., and Pryor, T. 1997. ADVANCES IN THE MOLECULAR GENETIC ANALYSIS OF THE FLAX-FLAX RUST INTERACTION. Annu. Rev. Phytopathol.. 35:271–291.

9. Greenberg, J.T., and Yao, N. 2004. The role and regulation of programmed cell death in plant pathogen interactions. Cellular Microbiology 6:201-211.

10. Hammerschmidt, 1999. Phytoalexins: What have we learned after 60 years. Ann Rev Phytopathology 37: 285-306.

11. Hatfield, R. and Vermerris, W. 2001. Lignin Formation in Plants. The Dilemma of Linkage Specificity. *Plant Physiology*, 126, 1351–1357.

12. Heath, M.C. 1994. Current Concepts of the determinants of plant –fugal specificity.

13. Heath, M. C. Hypersensitive response-related death. 2000.Plant Molecular biology 44:321-334.

14. Hulbert, S.H.,.Webb, C. A., Smith, S.M., and Sun., Q. 2001. RESISTANCE GENE COMPLEXES: Evolution and Utilization. Annu. Rev. Phytopathol. 2001. 39:285–312.

15. Leach J.E., and White, F. F.1996. BACTERIAL AVIRULENCE GENES. Annu. Rev. of Phytopathol. 34:153–79.

16. LUDERER, R. AND. JOOSTEN, M.H. A. J 2001. Avirulence proteins of plant pathogens: determinants of victory and defeat. MOLECULAR PLANT PATHOLOGY
6 : 355–364.

17. Mendgen, K., and Hahn, M. 2002. Plant Infection and the establishment of fungal
biotrophy. Trends in Plant Science.

18. Nicholson, R.L., and Hammerschmidt, R.1992. Phenolic compounds and their role in disease resistance. Ann Rev. Phytopathology 30:369-389.

19. Schafer, W. 1994. Molecular Mechanisms of fungal Pathogenicity to plants. Annual review of Phytopathology 32: 461-477.

20. VANLOON, L.C., and VANSTRIEN, E.A.1999. The families of pathogenesis-related proteins, their activities, and comparative analysis of PR-1type proteins. Physiological and Molecular Plant Pathology 55: 85-97.

21. Walton, J. D. 1994. Deconstructing the cell wall. Plant Physiology 104: 1113-1118.