

PI P 551 - Course Description Plant Epidemiology and Disease Management

Credits 3, Prereq PI P 429. Principles and practical implications of plant disease epidemics, disease control, and pathogen ecology. Examples of diseases caused by fungi, prokaryotes, viruses, and nematodes of crops grown in the Pacific Northwest and of international importance will be used to discuss the above topics.

Spring semester, 2018. Tuesday and Thursday, 10:35-11:50 am. Room 343, Johnson Hall. Instructor: Dennis A. Johnson, 317 Johnson Hall. Consultation with students by appointment, Phone: 509 335 3753, email: dajohn@wsu.edu

Course Objective

Aid students to gain a thorough understanding of important principles and concepts of plant epidemiology, plant pathogen ecology and disease management. Lectures, interactive discussions of current and historical literature, and case histories will be used to help meet stated objective.

Course Outline

INTRODUCTION - 2 lectures

- What is epidemiology, terminology, historical perspective
- The Land-Grant Mission: Agricultural research, Extension, and instruction
- Lessons from the past

ECOLOGICAL VIEW of PLANT PATHOGENS – 1 lecture

SAMPLING and STATISTICS IN EPIDEMIOLOGY – 1 lecture

THE GENETIC BASIS of EPIDEMICS – 1 lecture

DISEASE ASSESSMENT and MONITORING – 1.5 lectures

- Disease diagnosis, host growth stages, disease severity-incidence relationships, diagram and field keys, field sampling

ENVIRONMENTAL INFLUENCES on DISEASE – 1.5 lectures

- Influences on pathogen ecology vs. influences on host;
- Foliar diseases, soil borne diseases and post-harvest diseases

TEMPORAL ANALYSIS of EPIDEMICS - 2 lectures

- Description and comparison of disease progress curves
- Disease models, disease progress and rates
- Dispersal gradients of aerially dispersed pathogens and how they affect the spread of disease

EPIDEMIOLOGY and PLANT DISEASE MANAGEMENT – 2.5 lectures

THEORY and PRACTICAL IMPLICATIONS of DISEASE MANAGEMENT- 1 lecture
Economic and threshold considerations

MANAGING HOST GENES – 3.5 lectures
Epidemiologic and genetic concepts, partial resistance, stabilizing selection, aggressiveness, fitness, multilines, and varietal mixtures

FORECASTING and SIMULATION of EPIDEMICS – 1.5 lectures

CROP LOSS ASSESSMENT and MODELING – 0.5 lecture

INOCULUM POTENTIAL - 1 lecture

PATHOGEN DISPERSAL, TRANSPORT – 3 lectures
Microbiology of the atmosphere
Aerial and soil pathogens, disease gradients, dissemination, quantifying inoculum of airborne and soilborne pathogens

VECTORS of PLANT PATHOGENS – 0.5 lecture

SPATIAL ASPECTS of PLANT DISEASE EPIDEMICS - 1 lecture
Methods, experiments, analysis, and interpretation

MANAGEMENT WITH CHEMICALS
Pathogen insensitivity to chemical and coping with fungicide resistance
2.5 lectures

Students with Disabilities: Reasonable accommodations are available for students with a documented disability. If you have a disability and need accommodations to fully participate in this class, please visit the Access Center (Washington Building 217) to meet with an Access Advisor. All accommodations MUST be approved through the Access Center. Either drop by the Access Center or call 509-335-3417 to schedule an appointment.

Contact: Meredith Goodwin m.goodwin@wsu.edu

Grading System

<u>Activity</u>	<u>Percent of Grade</u>
Exams: 3 15% each	45%
Final	20%
Class Participation & Discussion	25%
Quizzes	10%
Total	100%

Exam Schedule

25 January, Thursday.

Exam I

1 March, Thursday.

Exam II

5 April, Thursday.

Exam III

April 30, Monday, 10:10 am – 12:10

Final Exam (Comprehensive)

Learning Outcomes and Assessment

Student Learning Outcomes	Course topics/ dates	Evaluation of Outcome. This utco will be evaluated primarily by:
Define, explain, discuss and give examples of terms, concepts and principles of plant disease epidemics, pathogen ecology and disease management.	All topics and class dates	Written and oral examinations and class discussions
Apply relevant information from previous plant disease epidemics to current threats from plant pathogens	All topics and class dates	Written and oral examinations and class discussions
Develop disease management strategies for potential and contemporary plant disease epidemics	Epidemiology and plant disease management	Written and oral examinations and class discussions
Quantitatively compare and characterize disease epidemics	Introduction, disease Assessment and monitoring, temporal analysis of epidemics	Written and oral examinations and class discussions
Discuss historical events that relate to plant epidemiology	Epidemics of the past and present	Written and oral examinations and class discussions

Classroom and campus safety are of paramount importance at Washington State University, and are the shared responsibility of the entire campus population. WSU urges students to follow the “**Alert, Assess, Act**” protocol for all types of emergencies and the “**Run, Hide, Fight**” response for an active shooter incident. Remain **ALERT** (through direct observation or emergency notification), **ASSESS** your specific situation, and **ACT** in the most appropriate way to assure your own safety (and the safety of others if you are able).

Please sign up for emergency alerts on your account at [MyWSU](#). For more information on this subject, campus safety, and related topics, please view the [FBI's Run, Hide, Fight video](#) and visit the [WSU safety portal](#).

Reasonable accommodations are available for students who have a documented disability. Please notify the instructor during the first week of class of any accommodations needed for the course. Late notification may cause the requested accommodations to be unavailable. All accommodations must be approved through the Disability Resource Center (DRC) in Administration Annex 206, 335-6155.

READING MATERIAL – PL P 551

Selected journal articles are also assigned as required reading

<u>Topic</u>	<u>Reference No. & Chapter</u>	
Introduction, Historical Perspective	-	Handout
Land-Grant Mission	#6	pgs iii-iv
Ecological perspective of plant pathogens	-	
Sampling and Statistics in Epidemiology	-	
Genetic Basis of Epidemics	#5	Chapter 13
Disease Assessment and Monitoring	#7	Chapter 2
Environmental Influences on Disease	#1	Chapter 4
Temporal Analysis of Epidemics	#10	Chapter 3
Epidemiology and Plant Disease Management	#10	Chapters 10, 11, 12
Theory and Practical Implication of Disease Management	#8	Chapter 14
Economic and Threshold Considerations	#6	Chapter 4
Managing Host Genes	#4	Chapter 11
Disease Forecasting	-	-
Crop Loss Assessment and Modeling (supplemental)	#2	Chapter 14
Inoculum Potential	#5	Chapter 7
Microbiology of the Atmosphere	#3	Chapters 3
Pathogen Dispersal (supplemental)	#9	Chapter 9
Soil Pathogens - Dispersal	#5	Chapter 9
Spatial Aspects of Plant Disease Epidemics	-	-

Management with Chemicals	#4	Chapters 12
Pathogen Insensitivity to Chemicals	#6	Chapters 14

References

1. Bruehl, G. W. 1987. Soilborne Plant Pathogens. Macmillan Pub. Co. N. Y.
2. Campbell, C. L. and Madden, L. V. 1990. Introduction to Plant Disease Epidemiology. John Wiley. N. Y.
3. Gregory, P. H. 1961. The Microbiology of the Atmosphere. Interscience Pub. N. Y.
4. Horsfall, J. G. and Cowling, E. B. 1977. Plant Disease, An Advanced Treatise. Vol. I. Academic Press. N. Y.
5. Horsfall, J. G. and Cowling, E. B. 1978. Plant Disease, An Advanced Treatise. Vol. II. Academic Press. N. Y.
6. Johnson, D.A. 2008. (Editor). Potato health Management. Second Edition. APS Press. St. Paul, MN.
7. Madden, L.V. et al. 2007. The Study of Plant Disease Epidemics. APS Press. St. Paul, MN.
8. Maloy, O. C. 1993. Plant Disease Control, Principles, and Practice. John Wiley & Sons. N. Y.
9. Stakman, E. C. and Harrar, J. G. 1957. Principles of Plant Pathology. Ronald Press Co. N. Y.
10. Van der Plank, J. E. 1963. Plant Disease: Epidemics and Control. Academic Press. N. Y.

Reading Assignments

Familiarity with the literature is of critical importance to graduate education and professional success. Consequently, reading assignments will be given and your understanding of the material will be evaluated in exams and class and lab discussions.

PI P 551 - READING MATERIAL –

Selected Journal Articles. Articles are required reading unless indicated as supplemental.

Historical perspective

Fry, W.E. et al. 2015. Five reasons to consider *Phytophthora infestans* a reemerging pathogen. *Phytopathology* 105:966-981.

McCook, S., and Vandermeer, J. 2015. The big rust and the red Queen: Long-term perspectives on coffee rust research. *Phytopathology* 105:1164-1173.

Fry, W.E. and Goodwin, S.B. 1997. Re-emergence of potato and tomato late blight in the United States. *Plant Dis.* 81:1349-1357. (supplemental)

Ecological view of plant pathogens

Browning, J.A. 1974. Relevance of knowledge about natural ecosystems to development of pest management programs for agro-ecosystems. *Proceedings Am. Phytopatho. Soc.* 1:191-199.

Thurston, H.D. 1990. Plant disease management practices of traditional farmers. *Plant Dis.* 74:96-101.

Genetic Basis of epidemics

Goodwin, S.B. 1997. The population genetics of *Phytophthora*. *Phytopathology* 87:462-473. (supplemental)

Leonard, K.J.. et al. 2004. Patterns of virulence in natural populations of *Puccinia coronata* on wild oat in Israel and in agricultural populations on cultivated oats in the United States. *Phytopathology* 94:505-514. (supplemental)

Disease assessment, monitoring and diagnosis

Bock, C.H., et al. 2015. Disease severity estimates-Effects of rater accuracy and assessment methods for comparing treatments. *Plant Dis.* 99:1104-1112.

Khot, L., Sankaran, S., Carter, A.H., Johnson, D.A., and Cummings, T.F. 2015. UAS imaging-based decision tools for arid winter wheat and irrigated potato production management. *International Journal of Remote Sensing.* 37:125-137. (supplemental)

Nameth, S.T. et al. 1999. Bacterial blight of geranium: a history of diagnostic challenges. *Plant Dis.* 83:204-212.

Turechek, W.W. et al. 2001. Sequential sampling for incidence of *Phomopsis* leaf blight of strawberry. *Phytopathology* 91:336-347. (supplemental)

Environmental influences on plant disease

Yarwood, C.E. 1956. Humidity requirements of foliage pathogens. *Plant Dis. Rep.* 40:318-321. (supplemental)

Rowlandson, T. et al. 2015. Reconsidering leaf wetness duration determination for plant disease management. *Plant Dis.* 99:310-319. (supplemental)

Rotem et al. 1971. Relativity of limiting and optimum inoculum loads, wetting durations, and temperatures for infection by *Phytophthora infestans*. *Phytopathology* 61:275-279.

Rowell, J.B. et al. 1958. Effect of certain environmental conditions on infection of wheat by *Puccinia graminis*. *Phytopathology* 48:371-377. (supplemental)

Porter, L.D. and Johnson, D.A. 2004. Survival of *Phytophthora infestans* in surface water. *Phytopathology* 94:380-387. (supplemental)

Temporal analysis of epidemics

Berger, R.D. et al. 1997. Lesion expansion as an epidemic component. *Phytopathology* 87:1005-1013.

Hu, X. et al. 2015. Combining models is more likely to give better predictions than single modes. *Phytopathology* 105:1174-1182. (supplemental)

Epidemiology and plant disease control

Berger, R.D. 1977. Application of epidemiological principles to achieve plant disease control. *Annu. Rev. Phytopathol.* 15:165-183. (supplemental)

Roelfs, A.P. 1982. Effects of barberry eradication on stem rust in the United States. *Plant Dis.* 66:177-181.

Maloy, O.C. 1997. White pine blister rust control in North America: A case history. *Annu. Rev. Phytopathol.* 35:87-109.

Hughes, G., and Burnett, F.J. 2015. Integrating experience, evidence and expertise in the crop protection decision process. *Plant Dis.* 99:1197-1203. (supplemental)

Managing host genes

Ahned, H.U. et al. 1997. Epidemiological effect of gene deployment strategies on bacterial blight of rice. *Phytopathology* 87:66-70.

Nowicki, M. et al. 2012. Potato and tomato late blight caused by *Phytophthora infestans*: An overview of pathology and resistance breeding. *Plant Dis* 96:4-17.

Mundt, C.C. 2002. Use of multiline cultivars and cultivar mixtures for disease management. *Annu. Rev. Phytopathol.* 40:381-410. (supplemental)

Pataky, J.K. and Campana, M.A. 2007. Reduction in common rust severity conferred by the Pr 1D gene in sweet corn hybrids infected by mixtures of Pr 1D-virulent and avirulent *Puccinia sorghi*. *Plant Dis.* 91:1484-1488 (supplemental)

Disease forecasting and simulation of epidemics

Gatch, E.W., and du Toit, L.J. 2015. A soil bioassay for predicting the risk of spinach Fusarium wilt risk. *Plant Dis* 99:512-512. (supplemental)

Mackenzie, D.R. 1981. Scheduling fungicide applications for potato late blight with Blightcast. *Plant Dis*. 65:394-399.

Shtienberg, D. and Elad, Y. 1997. Incorporation of weather forecasting in integrated, biological-chemical management of *Botrytis cinerea*. *Phytopathology* 87:332-340. (supplemental)

Andrade-Piedra, J.L. et al 2005. Qualification of a plant disease simulation model: Performance of the LATEBLGIHT model across a broad range of environments. *Phytopathology* 95:1412-1422. (supplemental)

Inoculum potential

Bruehl, G.W., and Lai, P. 1966. Prior-colonization as a factor in the saprophytic survival of several fungi in wheat straw. *Phytopathology* 56:766-768.

Pathogen dispersal, transport

Aylor, D.E. et al. 2001. Quantifying the rate of release and escape of *Phytophthora infestans* sporangia from a potato canopy. *Phytopathology* 91:1189-1196.

Aylor, D.E. 2003. Spread of plant disease on a continental scale: Role of aerial dispersal on pathogens. *Ecology* 84 (8): 1989-1997. (supplemental)

Aylor, D.E. 1998. The aerobiology of apple scab. *Plant Dis*. 82:838-849. (supplemental)

Isard, S.A. et al. 2005. Principles of the atmospheric pathway for invasive species applied to soybean rust. *BioScience* 55: 851-861. (supplemental)

Willoquet, L. et al 2008. Spore dispersal and disease gradients in strawberry powdery mildew. *Can. J. Plant Pathol.* 30:434-441. (supplemental)

Spatial aspects of plant disease epidemics

Johnson, D.A. et al. 2003. Aerial photography used for spatial pattern analysis of late blight infection in irrigated potato circles. *Phytopathology* 93:805-812. (supplemental)

Management with chemicals, and pathogen insensitivity to chemicals

Delp, C.J. 1980. Coping with resistance to plant disease. *Plant Dis*. 64:652-657.

Mallowa, S.O. et al. 2015. Effect of maize hybrid and foliar fungicides on yield under low foliar disease severity conditions. *Phytopathology* 105:1080-1089. (supplemental)