

Course Syllabus Fall 2012 University of Wisconsin - Madison
PLANT PATHOLOGY 517 – PLANT DISEASE RESISTANCE

Instructor: Andrew Bent

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Course Overview:

Plant diseases are a major limiting factor in crop productivity. Diseases can be controlled to some extent by cultural practices such as crop rotation, tillage methods, time of planting, and use of fungicides. But the most straightforward method for disease control is to use disease-resistant plants.

There is a constant demand for plant varieties that have better disease resistance traits. For many crop species, a substantial portion of the breeder's effort is devoted to maintaining or improving disease resistance. Why? Pathogen populations may shift so that formerly effective resistance is no longer satisfactory. Changing grower practices or weather conditions may cause certain pathogens to rise or fall in prominence. New plant varieties bred for other traits may not carry effective disease resistance against some pathogens. For these and many other reasons, resistance breeding is an ongoing process.

The molecular basis of plant disease resistance is a "hot topic" in plant molecular biology research, and significant progress has been made. This new information is changing some of the ways that we think about resistance, and how we approach classical and molecular resistance breeding.

There are three key questions that we will address: *How does plant disease resistance work? Why does it sometimes fail? How can it be manipulated most successfully?* Basic and applied scientific approaches will share equal billing, with an overall focus on effective production and use of disease resistant plants.

Class Format/Style:

Class will meet twice a week for roughly 75 minutes of lecture and discussion. There is no laboratory component. This is a graduate-level class, and substantial self-motivation and student contributions are expected. Class meetings will not be 75 minute lectures - they will be lecture/discussions! Accordingly, consistent attendance is expected and you need to show up having read all assigned materials before class, so that you are ready to participate. No term-paper is assigned and no lengthy student presentations are scheduled. The tradeoff is that reading assignments may be a bit more substantial than you are used to, and your very active participation is expected during every class. Students will be asked regularly in class to weigh in with questions, ideas and criticisms. Students will also evaluate journal articles, sometimes in teams, and lead discussions of those articles.

Written Commentaries:

Students will turn in three brief essays during the semester. These will 1-2 page commentaries on an assigned paper from the primary research literature. A few students will receive the same paper, and can work together to evaluate the paper, but each student will then write their own essay. These papers will also be discussed in class. Detailed instructions will be distributed.

Evaluation and Grading:

First Examination	33 points
Second Examination	33 points
Written Commentaries	24 points (total)
<u>Class Participaton</u>	<u>10 points</u>
Total	100 points

Office Hours:

Students are encouraged to drop in, call or send e-mail any time with questions. You should feel very low barriers to approaching me – I am very happy to chat and help out. No formal office hours are established. Tuesdays and Thursdays after class will often be an excellent time to meet, but many other times are available.

Course Schedule (Class Topics and Reading Assignments)

This is still being developed and will be distributed separately. The schedule for the first week is finalized, as is a prospective schedule for first half of semester.

See Next Page

Lecture Schedule and Partial Reading List - Subject to Revision!

Plant Pathology 517: Plant Disease Resistance - Fall 2012 v.3

Introductory Material

Tu Sept 4 Opening Case Study and Introduction to Core Background Material

Review/Overview Readings for Sept 4 and Sept 6:

Morris et al. 2010 - Abstract only.

Plant Breeding (read carefully or skim, based on prior knowledge):

Simmonds & Smartt p. 25: Summary of Ch. 1: Crop Evolution

pp. 27-38 (Ch. 2) Basic Features of Plant Breeding

pp. 59-60 Conclusions & Summary of Ch. 3 (Breeding Objectives)

Plant Pathology (read carefully or skim, based on prior knowledge):

Lucas Chapters 1,2 (pp. 1-29)

Diseased Plant; Microbial Pathogens, Pathogen Structure and Function

Th Sept 6 Introductory Plant Pathology and Introductory Plant Breeding (35 min. each)

Lucas Ch. 12 pp. 217-232 Disease Management by Host Resistance

Disease Resistance and Resistance Breeding: Theories and Realities

Tu Sept 11 *Major Gene resistance, Horizontal resistance*

Russell pp. 15-26 – General Principles/Methods of Resistance Breeding

Th Sept 13 *Horizontal Resistance; A few comments on Epidemiology*

Vanderplank Ch. 7: Horizontal and Vertical Resistance

Tu Sept 18 *The Disease Screen*

P. Williams: "Screening for resistance to diseases" (Ch. 20 of Brown et al., eds)

Russell Book pages 63-79 Fungal inoculum preparation/use/scoring

Th Sept 20 *Breeding Strategies*

Russell pp. 34-41 Selecting and producing resistant varieties

Tu Sept 25 *Breeding Strategies - Including Quantitative Resistance*

Parlevliet Ch. 8 Identification and Evaluation of Quantitative Resistance

Th Sept 27 *Germplasm Collections and their use*

Kaplan - Agricultural Research Sept.'98 pp. 4-13 - Conserving Germplasm

Gurung 2012 - Germplasm screen of wheat for resistance to four diseases.

Tu Oct 2 *Marker-Assisted Selection in Resistance Breeding*

Due: *Commentary on assigned primary literature paper*

Miedenaar 2012 - MAS for Disease Resistance in Wheat and Barley

Th Oct 4 *Discussing the primary literature – Breeding papers*
Lead in-class Discussion of your article.
Look at (fully read or at least read for 10 min. per article) the other three articles

Tu Oct 9 *Mixtures/Multilines: Can diversity in a single field improve resistance?*
Nature 401:681-682 Crop strength through diversity
Nature 401:718-722 Genetic diversity and disease control in rice
Garrett & Mundt - *Phytopathology* 89:984-990 Epidemiology in Mixed Host Populations

Th Oct 11 Exam I
In Class: Discussion and Review: *Resistance Theories and Realities*
Exam is take-home exam (available 11:00am, due by 6:00 pm)

Tu Oct. 16 Doug Rouse - *Epidemiology 101*
Agrios, *Plant Pathology* - Chapter 8 - Epidemiology

Th Oct 18 Doug Rouse - *Managing host resistance, pesticides and other inputs, for sustainable disease control.*

Tu Oct. 23 Writing: Aubertot *et al.* 2006. Improved resistance management for durable disease control: A case study of phoma stem canker of oilseed rape (*Brassica napus*). *European Journal of Plant Pathology* 114: 91–106.

Th Oct 25 *Resistance Durability: Can it be predicted or improved?*
McDonald and Linde - *Annu. Rev. Phytopathol.* 40:349-379

Tu Oct. 30 Andrew Bent - *What I learned at the international Plant Resistance Sustainability conference last week*
Lauer *et al.* 2012 Grand Challenges (extract - handout) *Crop Sci.* 52:1003-1006
Brun *et al.* 2010. Quantitative resistance increases the durability of qualitative resistance to *Leptosphaeria maculans* in *Brassica napus*. *New Phytologist* 185: 285–299.

Th Nov 1 Mike Havey, UW-Madison: Veg. Crops Resistance Breeding Examples
Robaglia and Carenta 2006. Translation initiation factors: a weak link in plant RNA virus infection. *Trends Plant Sci.* 11:40-45.

Tu Nov 6 *Economic Disease Thresholds and other means of Establishing Disease Resistance Priorities*
Freeman & Pataky *Plant Disease* 85:1278

Th Nov 8 Suzanne Mickelson, Pioneer Hi-Bred
Due: *Commentary on assigned primary literature paper*

Tu Nov 13 *Primary Literature: Defending plants against disease*

Th Nov 15 *Molecular Basis of Resistance Traits I*

Hammond-Kosack and Jones Ch. 21 pp. 1128-1142 (start with 21.4.3)

(Two Separate Files on Learn@UW)

Source: Hammond-Kosack, K. and Jones, J. 2000. "Responses to Plant Pathogens" Chapter 21 in: Buchanan, B. B., Gruissem, W. and Jones, R. L., eds. *Biochemistry & Molecular Biology of Plants*. American Society of Plant Physiologists, Rockville, MD.

Tu Nov 20 *Molecular Basis of Resistance Traits II*

Hammond-Kosack and Jones (see above)

Dodds and Rathjen 2010. Plant immunity: towards an integrated view of plant-pathogen interactions *Nature Reviews Genetics* 11:539-548.

Th Nov 22 **No Class** - Thanksgiving Day

Tu Nov. 27 - James Brown, John Innes Centre, Norwich, England

Association genetics of Septoria resistance in wheat and its relationship to other traits

Brown 2009. *Annu. Rev. Phytopathol.*

Th Nov 29 (James Brown/ A. Bent - TBA)

Tu Dec 4 *Biotechnology Methods for Disease Control*

Collinge *et al.* *Ann.Rev.Phytopathol.* 48:269-291

Th Dec 6 *Molecular Basis of Resistance and Biotechnology Methods for Disease Control*

Handouts

Due: *Commentary on assigned primary literature paper*

Tu Dec 11 *Primary Literature: Molecular Basis of Resistance*

Th Dec 13 (Last Class) *Discussion/Review: Case Studies; Molecular Aspects*

Second Exam:

Brief (available for 6 hours) Take-Home Exam during Finals period, due Tues. Dec. 18 by 2:30 pm.