

Instructor: Dr. Jeffrey Rollins

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Lab Coordinator: Dr. Rosanne Healy

Teaching Assistant: Pei-Ling Yu

Class Location: 2306 Fifield Hall

Class Times: 7 week module : March 12 to April 25, 2018 (Final Exam: May 3)

Lectures: MF period 5 (11:45-12:35 pm); W period 5-6 (11:45- 1:40 pm)

Labs: TR period 5-6 (11:45- 1:40 pm)

Class Website: <http://elearning.ufl.edu/> (e-Learning in Canvas)

Office Hours: M & F 1:00-2:00 PM or by appointment, 1419 Fifield Hall

Course Description: This course is an introduction to the biology and diversity of fungal plant pathogens. Fungi and their allies are a diverse group of organisms that comprise the majority of plant pathogens. Their members are found in every fungal order, as well as among numerous orders outside the Kingdom Fungi but traditionally studied as fungi, e.g., the Stramenopiles. This course will include a survey of taxonomic groups of fungal and fungal-like plant pathogens, an overview of common fungal pathogens in various types of plant culture systems, and discussion of general plant pathology principles as they relate to fungal pathogens. Lectures and labs are co-taught with PLP4260C: Introduction to Plant Pathogenic Fungi. Students enrolled in the graduate course will have a course project and more rigorous Exams and Quizzes relative to their undergraduate classmates.

Course Objectives: Students will learn to

- distinguish among taxonomic orders that contain fungal pathogens, and identify fungal pathogens to order and genus level;
- recognize several of the most common fungal plant pathogens and understand key aspects of their biology and lifecycles that distinguish them;
- differentiate patterns in disease development and control strategies as they pertain to specific growing systems;
- use knowledge of pathogen biology and epidemiology to develop reasonable hypotheses about effective long and short term control strategies for fungal pathogens.

Course Texts:

Recommended: **Plant Pathology 5th Edition** (2005) by G. N. Agrios, Elsevier Academic Press, Inc.; **Mycology Guide: Key Terms and Concepts, 2nd Edition**, by N. Vargas et al., APS Press

Required: Journal articles will be assigned throughout the course. These will be made available through the class website. **A Reading List is attached.**

Exams and Grading: There will be three, non-cumulative lecture exams. There will also be regular lab assignments, five short quizzes throughout the term, and a Pathogen Profile project (PLP6262 only).

Quizzes: Quizzes will be unannounced, and will be given at the beginning of class or lab periods. They will be **open-book**, but students will have a limited time to complete the questions. If you arrive late, you will not be given additional time to complete the quiz, nor will make-up quizzes be given for unexcused absences. Quiz questions will come from recent lectures or assigned readings, and will be designed to reinforce key concepts and help prepare you for questions that will appear on the exams.

Pathogen Profile Project: Each graduate student will develop **two (2)** pathogen or disease profiles.

Approved profiles will be posted on the "BugWood" website <https://bugwood.org/> with you, the student, as the author. Information found on this site will find utility in diagnostic clinics which may link articles to their

web sites and also by the public as introductory fact sheets. Additional information concerning project requirements and due dates can be found on page 5.

Course Grade

Your course grade will be based on the following assessments:

| Assessment | Points |
|------------------------------|------------|
| Exam I | 100 |
| Exam II | 100 |
| Exam III | 100 |
| Quizzes | 50 |
| Lab Assignments | 100 |
| Pathogen Profile Project* | 100 |
| Total Possible Points | 550 |

*PLP6262 only

Your course grade will be assigned as follows.

| <u>Letter Grade</u> | <u>Grade Points</u> | <u>Percentage</u> | <u>Assignment Points</u> |
|---------------------|---------------------|-------------------|--------------------------|
| A | 4.0 | 90 or above | ≥495 |
| A- | 3.67 | 87-89.9 | 478-494 |
| B+ | 3.33 | 84-86.9 | 462-477 |
| B | 3.0 | 80-83.9 | 440-461 |
| B- | 2.67 | 77-79.9 | 423-439 |
| C+ | 2.33 | 74-76.9 | 407-422 |
| C | 2.0 | 70-73.9 | 385-406 |
| C- | 1.67 | 67-69.9 | 368-384 |
| D+ | 1.33 | 64-66.9 | 352-367 |
| D | 1.0 | 60-63.9 | 330-351 |
| D- | 0.67 | 57-59.9 | 313-329 |
| E | 0.0 | 56.9 or below | ≤312 |

Class Attendance & Participation: Participation is a vital part of both the course experience and the course grade. Students will be expected to arrive at each class on time and prepared to fully participate in the lecture, lab, or other class activities. If you must miss a class due to illness or other extenuating circumstances, notify the instructor as soon as possible. Student athletes will be excused for official events through the University Athletic Association. Absences due to personal planning (leaving town, attending club functions, picking someone up at the airport, etc.) will not be excused, and missed points may not be made up.

Make-up Work: If you are ill on an exam day, notify the instructor as soon as you are able, and a make-up exam will be scheduled for you. If you must miss an exam for any other reason, please make arrangements ahead of time to reschedule. In most cases, **laboratory exercises may not be made up.** Laboratory cultures, demonstrations, and other materials are typically prepared in advance, often ephemeral or expendable by nature, and cannot be easily recreated. If you absolutely must miss a lab, it is particularly important to notify the instructor before the end of the missed lab period, so that at least some of the demonstration materials may be set aside for you to view and work on later.

UNIVERSITY POLICIES AND SERVICES

Grades and Grade Points

For information on current UF policies for assigning grade points, see <https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

Academic Honesty, Software Use, Campus Helping Resources, Services for Students with Disabilities

Academic Honesty

In 1995 the UF student body enacted an [honor code](#) and voluntarily committed itself to the highest standards of honesty and integrity. When students enroll at the university, they commit themselves to the standard drafted and enacted by students.

The Honor Pledge: We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity.

On all work submitted for credit by students at the university, the following pledge is either required or implied: **"On my honor, I have neither given nor received unauthorized aid in doing this assignment."**

Students should report any condition that facilitates dishonesty to the instructor, department chair, college dean, Student Honor Council, or Student Conduct and Conflict Resolution in the Dean of Students Office.

(Source: 2011-2012 Undergraduate Catalog)

It is assumed all work will be completed independently unless the assignment is defined as a group project, in writing by the instructor.

This policy will be vigorously upheld at all times in this course.

Software Use:

All faculty, staff and students of the university are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against university policies and rules, disciplinary action will be taken as appropriate.

Campus Helping Resources

Students experiencing crises or personal problems that interfere with their general well-being are encouraged to utilize the university's counseling resources. The Counseling & Wellness Center provides confidential counseling services at no cost for currently enrolled students. Resources are available on campus for students having personal problems or lacking clear career or academic goals, which interfere with their academic performance.

- *University Counseling & Wellness Center, 3190 Radio Road, 352-392-1575, www.counseling.ufl.edu/cwc/*
 - Counseling Services
 - Groups and Workshops
 - Outreach and Consultation
 - Self-Help Library
 - Training Programs
 - Community Provider Database
- *Career Resource Center, First Floor JWRU, 392-1601, www.crc.ufl.edu/*

Services for Students with Disabilities

The Disability Resource Center coordinates the needed accommodations of students with disabilities. This includes registering disabilities, recommending academic accommodations within the classroom, accessing special adaptive computer equipment, providing interpretation services and mediating faculty-student disability related issues.

0001 Reid Hall, 352-392-8565, www.dso.ufl.edu/drc/

THE INSTRUCTOR RESERVES THE RIGHT TO CHANGE OR MODIFY INFORMATION PROVIDED IN THE SYLLABUS. CLASS ANNOUNCEMENTS SUPERSEDE SYLLABUS STATEMENTS.

Disease/Pathogen Profile Project Information

Topic Selection

Each student will work on two different fungal pathogens chosen from a spreadsheet list found on the class website. You may **not** choose two species from the same Genus. I will maintain and update this sheet and topics will be claimed on a first-requested first-assigned basis. You will sign up by e-mailing me directly with the name of the fungi that you have chosen. I will update and post the spreadsheet in the order that I receive the e-mail requests. I will send an e-mail confirmation when I have approved your choice. Once someone has signed up for a particular pathogen, no one else will be permitted to profile that pathogen, either now or in future semesters. So, if you have a favorite pathogen, sign up early! This will allow us, over time, to build a diverse and useful resource of fungal disease information.

Profile Requirements

Profiles **must follow a provided template** from the Bugwood Wiki site http://wiki.bugwood.org/Diagnostic_resources and should include the following basic sections.

Taxonomy: accepted name, synonyms, common names, and classification from the Index Fungorum

<http://www.indexfungorum.org/names/Names.asp> or MycoBank

<http://www.mycobank.org/Biolomics.aspx?Table=Mycobank&Page=200&ViewMode=Basic> Databases

Pathogen: Repeat the scientific and common name information here and include information on the biology, host range, life cycle, etc.

Symptoms and Signs: general, and possibly host-specific if symptoms vary by host; if you are profiling a pathogen, this may include symptoms for more than one disease. Images (see below) are also included in this section.

Ecology and Spread: Environmental conditions conducive to disease development, how the pathogen spreads including any known vectors. Include information on the *Pathogen life cycle*: as much as is known, descriptive or diagrammatic (but see note on images below). If you create an original life cycle diagram, you will receive up to **five bonus points (+5)** per profile.

Geographic Distribution: If the organism is cosmopolitan and ubiquitous, indicate that; otherwise, indicate general geographic regions. An exhaustive country-by-country list is not necessary

Management: emphasis on cultural methods, no chemical brand names.

Diagnostic Procedures: methods typically used (possible advantages/disadvantages of each), culture media (provide recipes and source or link to the "Bugwood Diagnosticians Cookbook"), and appearance in culture, etc.

Resources and References: every source that you used in making your profile page, plus (optional) any other interesting/informative web links that you would like to include

Images

Profiles should include images of the pathogen and disease. The Bugwood site has a large database of images that should be included. You must list every image ID number available on your fungus/disease within the database but you may choose only the most relevant to show in your document. If images are not available from the Bugwood database you may include images from other websites but they must be clearly and completely cited within your document. If you include original pictures of the disease or fungus that you have created yourself, you will receive up to **five bonus points (+5)** per profile.

Style and Length

These profiles are intended for a general audience, including both home and professional growers, students, master gardeners, diagnosticians, extension agents, and anyone else who may have interest in your fungus or disease. The information should be presented in a clear and concise manner, minimizing technical jargon. The entire profile should be no more than five pages, and may be less. Sample profiles are available on the Bugwood site.

Due Dates

A first draft of **both** profiles will be due on **April 16**. A submission portal will be created on the class website for you to upload your draft as a **MS Word document (include the file extension and upload only one file containing both disease/pathogen profiles)**. Your draft profiles will be checked for originality using Turnitin[®] and by comparison with reference materials, edited for content and grammar using "Track Changes", and returned to you. Your final document will be due on **April 27**.

PLP6262 Fungal Plant Pathogens
Spring 2018

Course Schedule (Tentative)

| Date | Day | # | Topic |
|---------|-----|--------------|---|
| Mar 12 | M | Lecture 1 | Ways of Being: Plant-Fungal Interactions <ul style="list-style-type: none"> • Mutualism-parasitism continuum • Mycorrhizae • Epiphytes & Endophytes • Biotrophs, hemibiotrophs, and necrotrophs |
| Mar 13 | T | Lab 01 | Plant-Fungal Interactions <ul style="list-style-type: none"> • Endo- and Ecto-Mycorrhizae • Epiphytes and Endophytes • Pathogens: Spots, blights, wilts, root rots, damping-off |
| Mar 14 | W | Lecture 2 | Adaptations for Pathogenicity <ul style="list-style-type: none"> • Obligate vs. opportunistic pathogens • Pathogenicity factors |
| Mar 15 | R | Lab 02 | Isolating fungi from plant material <ul style="list-style-type: none"> • Techniques • Selective media |
| Mar 16 | F | Lecture 3 | Groups of Fungal Pathogens <ul style="list-style-type: none"> • Review of fungal orders & Stramenopiles • Taxonomic vs. functional groups |
| Mar 19 | M | Lecture 4 | Stramenopiles: Taxonomy, Biology, and Ecology |
| Mar 20 | T | Lab 03 | Isolation and maintenance of fungal cultures <ul style="list-style-type: none"> • Types and purposes of various fungal storage methods |
| Mar 21 | W | Lecture 5 | Chytrids: Taxonomy, Biology, and Ecology <ul style="list-style-type: none"> • Chytrid pathogens & pathogen vectors • Chytrid mycoparasites |
| Mar 21 | W | Discussion 1 | <ul style="list-style-type: none"> • Readings and Lecture Discussion |
| Mar 22 | R | Lab 04 | Stramenopile pathogens: the Oomycetes <ul style="list-style-type: none"> • <i>Pythium</i> vs. <i>Phytophthora</i> • Downy mildews |
| Mar 23 | F | Exam | Exam I |
| Mar 26 | M | Lecture 6 | Mucoromycota: Taxonomy, Biology, and Ecology |
| Mar 27 | T | Lab 05 | Chytrid & Mucoromycota pathogens <ul style="list-style-type: none"> • Chytrids in natural, agricultural, and landscape settings • Zygomycetes: field and postharvest rotters |
| Mar 28 | W | Lecture 7 | Ascomycota: Taxonomy, Biology, and Ecology |
| Mar 28 | W | Discussion 2 | <ul style="list-style-type: none"> • Readings and Lecture Discussion |
| Mar 29 | R | Lab 06 | Ascomycota pathogens <ul style="list-style-type: none"> • Structures & Functions • Recognizing an Ascomycete |
| Mar 30 | F | Lecture 8 | Basidiomycota: Taxonomy, Biology, and Ecology |
| April 2 | M | Lecture 9 | Fungal Disease Cycles and Epidemiology <ul style="list-style-type: none"> • Disease progress curves |

| | | | |
|----------|---|--------------|---|
| | | | <ul style="list-style-type: none"> • Polycyclic vs. Monocyclic diseases • Inoculum density and inoculum potential |
| April 3 | T | Lab 07 | Ascomycete pathogens, ct. <ul style="list-style-type: none"> • Sexual and asexual ascomycetes Conidial structures and identification |
| April 4 | W | Lecture 10 | <ul style="list-style-type: none"> • Lecture Review |
| April 4 | W | Discussion 3 | <ul style="list-style-type: none"> • Paper Discussion |
| April 5 | R | Lab 08 | Basidiomycete pathogens <ul style="list-style-type: none"> • Structures & functions • Recognizing a Basidiomycete |
| April 6 | F | Lecture 11 | Fungi in the Air: Airborne pathogens and Foliar diseases |
| April 9 | M | Lecture 12 | Soilborne Fungal Pathogens |
| April 10 | T | Lab 09 | Isolating fungi from soil <ul style="list-style-type: none"> • Dilution plating • Sclerotia |
| April 11 | W | Exam | <ul style="list-style-type: none"> • Exam II |
| April 12 | R | Lab 10 | Common pathogens of row crops |
| April 13 | F | Lecture 13 | Fungal Pathogens in Row Crops vs. Perennial Crops |
| April 16 | M | Lecture 14 | Diseases in Perennial Crops |
| April 17 | T | Lab 11 | Perennial crop diseases |
| April 18 | W | Lecture 15 | Forest Pathology & Pathogen Ecology |
| April 18 | W | Discussion 5 | Readings and Lecture Discussion |
| April 19 | R | Lab 12 | Infectious Development |
| April 20 | F | Lecture 16 | Diseases in Ornamental Plants |
| April 23 | M | Lecture 17 | Control of Fungal Diseases <ul style="list-style-type: none"> • Whetzel's principles of plant disease control • Cultural controls |
| April 24 | T | Lab 13 | Rust Diseases and Demo Materials |
| April 25 | W | Lecture 18 | Chemical Control of Fungal Diseases <ul style="list-style-type: none"> • Classes of chemicals and their modes of action • Chemical Resistance |
| May 3 | R | Exam | Exam III |

Reading List for PLP6905 (6262) (tentative, subject to change)

| Lab # | Reading |
|--------------|---|
| 01 | Bidartondo, Dawn of symbiosis between plants and fungi.pdf |
| 01 | Johnson, Functioning of mycorrhizal associations along the mutualism-parasitism continuum.pdf |
| 01* | Redman, Fungal Symbiosis from mutualism to parasitism.pdf |
| 01* | Kuo, Secret lifestyles of <i>Neurospora crassa</i> . |
| 02 | DeZwaan, <i>Magnaporthe grisea</i> pth11p.pdf |
| 02 | Jaroszuk-Scisel, Activities of CWDE.pdf |
| 02 | Thomma, <i>Alternaria</i> saprophyte to parasite.pdf |
| 02 | Schafer, One enzyme makes a fungal pathogen.pdf |
| 03 | Rossmann, Systematics of Plant Pathogenic Fungi.pdf |
| 03 | Taylor, One Fungus = One Name |
| 03 | Hawksworth, The Amsterdam Declaration on Fungal Nomenclature |
| 03 | Crous, Identifying and Naming Plant-Pathogenic Fungi_Past, Present, and Future |
| 04 | Beakes, Evolutionary phylogeny of oomycetes.pdf |
| 04 | Ivors, Microsatellite markers identify lineages of <i>P. ramorum</i> .pdf |
| 04 | Kroon, Genus <i>Phytophthora</i> Anno 2012.pdf |
| 04* | Nelson, Rhizosphere regulation of oomycete pathogens.pdf |
| 04* | vanWest, Oomycete Plant Pathogens use Electric Fields.pdf |
| 05 | Hwang, <i>Plasmodiophora brassicae</i> review.pdf |
| 05 | Kanyuka, <i>Polymyxa graminis</i> .pdf |
| 05* | Fry, Transmission of TNV by <i>Olpidium</i> .pdf |
| 06 | Hanson, Interaction of <i>Rhizoctonia</i> & <i>Rhizopus</i> .pdf |
| 06 | Holmes, Influence of wound type on <i>Rhizopus</i> soft rot.pdf |
| 06 | Partida-Martinez, Pathogenic fungus harbours endosymbiotic bacteria.pdf |
| 06 | Spatafora, Phylogenetic classification of zygomycete.pdf |
| 07 | Schoch, Ascomycota tree of life.pdf |
| 08 | Binder and Hibbett, Boletales.pdf |
| 08 | Lutz&Baur, Double Life of a Fungus.pdf |
| 09 | Scott, Spatiotemporal analysis of epiphytotics of downy mildew.pdf |
| 09* | Beltran, Epidemiology of <i>Monosporascus</i> root rot.pdf |
| 09* | Montes-Borrego, Role of oospores as primary inoculum.pdf |
| 10 | Noblin, Surface tension propulsion of fungal spores.pdf |
| 10 | Paul, Rain splash dispersal of <i>Gibberella</i> .pdf |
| 10 | Stolze-Rybczynski, Adaptation of spore discharge in basidiomycota.pdf |
| 10 | Trail, Fungal cannons- explosive spore discharge in ascomycota.pdf |
| 11 | Allen&Newhook, Chemotaxis of zoospores to ethanol in capillaries.pdf |
| 11 | Dobbs&Gash, Microbial and Residual Mycostasis.pdf |
| 11 | Duniway, Movement of Zoospores of <i>Phytophthora</i> in soils.pdf |
| 11 | Garcia-Garza, Fusox spore movement through soil.pdf |
| 11 | MacDonald&Duniway, Influence of soil texture and temp on motility of <i>Phytophthora</i> .pdf |
| 11* | Subbarao, Effects of Deep Plowing on <i>Scleronia minor</i> .pdf |
| 14 | Newhouse et al. - 2014 - Transgenic American chestnuts show enhanced blight.pdf |
| 14 | Multigene phylogeny of filamentous ambrosia fungi associated with ambrosia and bark beetles.pdf |

Full bibliography of Reading List articles

Massoumi Alamouti, S., Tsui, C. K. M., and Breuil, C. 2009. Multigene phylogeny of filamentous ambrosia fungi associated with ambrosia and bark beetles. *Mycol. Res.* 113:822–835.

Allen, R.N., and F.J. Newhook. 1973. Chemotaxis of zoospores of *Phytophthora cinnamomi* to ethanol in capillaries of soil pore dimensions. *Transactions of the British Mycological Society.* 61:287–IN12.

- Beakes, G.W., and S. Sekimoto. 2008. The Evolutionary Phylogeny of Oomycetes—Insights Gained from Studies of Holocarpic Parasites of Algae and Invertebrates. *In* Oomycete Genetics and Genomics: Diversity, Interactions, and Research Tools. K. Lamour and S. Kamoun, editors. John Wiley & Sons, Inc. 1–24.
- Beltrán, R., A. Vicent, J. García-Jiménez, and J. Armengol. 2008. Comparative Epidemiology of *Monosporascus* Root Rot and Vine Decline in Muskmelon, Watermelon, and Grafted Watermelon Crops. *Plant Disease*. 92:158–163.
- Bidartondo, M.I., D.J. Read, J.M. Trappe, V. Merckx, R. Ligrone, and J.G. Duckett. 2011. The Dawn of Symbiosis Between Plants and Fungi. *Biol. Lett.* 7:574–577.
- Crous, P.W., D.L. Hawksworth, and M.J. Wingfield. 2015. Identifying and Naming Plant-Pathogenic Fungi: Past, Present, and Future. *Annual Review of Phytopathology*. 53:247–267.
- DeZwaan, T.M., A.M. Carroll, B. Valent, and J.A. Sweigard. 1999. *Magnaporthe grisea* pth11p is a novel plasma membrane protein that mediates appressorium differentiation in response to inductive substrate cues. *Plant Cell*. 11:2013–2030.
- Dobbs, C.G., and M.J. Gash. 1965. Microbial and Residual Mycostasis in Soils. , *Published online: 25 September 1965*; | doi:10.1038/2071354a0. 207:1354–1356.
- Duniway, J.M. 1976. Movement of Zoospores of *Phytophthora cryptogea* in Soils of Various Textures and Matric Potentials. *Phytopathology*. 66:877.
- Fry, P.R., and R.N. Campbell. 1966. Transmission of a tobacco necrosis virus by *Olpidium brassicae*. *Virology*. 30:517–527.
- Gracia-Garza, J.A., and D.R. Fravel. 1998. Effect of Relative Humidity on Sporulation of *Fusarium oxysporum* in Various Formulations and Effect of Water on Spore Movement Through Soil. *Phytopathology*. 88:544–549.
- Hanson, L.E. 2010. Interaction of *Rhizoctonia solani* and *Rhizopus stolonifer* Causing Root Rot of Sugar Beet. *Plant Disease*. 94:504–509.
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- Holmes, G.J., and R.R. Stange. 2002. Influence of Wound Type and Storage Duration on Susceptibility of Sweetpotatoes to *Rhizopus* Soft Rot. *Plant Disease*. 86:345–348.
- Hwang, S.-F., S.E. Strelkov, J. Feng, B.D. Gossen, and R.J. Howard. 2011. *Plasmodiophora brassicae*: a review of an emerging pathogen of the Canadian canola (*Brassica napus*) crop. *Molecular Plant Pathology*. 13:105–113.
- Ivors, K., M. Garbelotto, I.D.E. Vries, C. Ruyter-Spira, B. Te Hekkert, N. Rosenzweig, and P. Bonants. 2006. Microsatellite markers identify three lineages of *Phytophthora ramorum* in US nurseries, yet single lineages in US forest and European nursery populations. *Mol. Ecol.* 15:1493–1505.
- Jaroszuk-Scisel, J., E. Kurek, A. Slomka, M. Janczarek, and B. Rodzik. 2011. Activities of cell wall degrading enzymes in autolyzing cultures of three *Fusarium culmorum* isolates: growth-promoting, deleterious and pathogenic to rye (*Secale cereale*). *Mycologia*. 103:929–945.
- Johnson, N.C., J.-H. Graham, and F.A. Smith. 2008. Functioning of mycorrhizal associations along the mutualism–parasitism continuum. *New Phytologist*. 135:575–585.
- Kanyuka, K., E. Ward, and M.J. Adams. 2003. *Polymyxa graminis* and the cereal viruses it transmits: a research challenge. *Molecular Plant Pathology*. 4:393–406.

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