ENVS 163 Plant disease ecology – Spring 2015

Environmental Studies, UC Santa Cruz

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Class meetings: Lecture MWF 9:30-10:40 in 221 ISB

Class website: The course website will be hosted on eCommons. Course syllabus, quizzes, assignments, and important links will all be available there.

Required text (available at Bay Tree Bookstore):
Schumann, G.L. & C.J. D'Arcy. 2010. *Essential Plant Pathology,* 2nd ed. APS Press, 369 pp.

Course goals and philosophy
This course is not an overview of important plant diseases and how to control them. You can look up that information on the web. I want you to be able to handle the next emergent pathogen that disrupts agricultural or wildland systems. I want you to think about pathogens as parts of complex dynamic systems. By the end of the course, you should be comfortable thinking about (1) life histories of the various taxa of plant pathogens, (2) how pathogen life history shapes the impact of disease on plants, plant populations, and plant communities, (3) how thinking about plants and their pathogens in an evolutionary ecology framework provides a basis for creating more effective means of managing diseases, (4) how mathematical models can help us understand spatial and temporal dynamics of plant diseases, and (5) how scientists learn about disease systems through the combined use natural history/observational studies, experiments, and models/theory. I also want you to have the analytical tools you need to continue learning about and acting on plant diseases and other environmental issues of importance to you.

Specifically:
1. You should be able to place plant diseases into the context of modern ecological and evolutionary theory, and connect that theory to disease management. For example, when would we expect natural selection to lead to an increase in virulence and when to a decrease? How can we manage agroecosystems to minimize the probability of disease outbreaks? How do physiological and behavioral adaptations in plants and pathogens shape interactions between them? How might climate change affect impacts of plant disease?
2. You should be able to critically evaluate scientific literature and put it to use in making arguments. This means being comfortable reading primary scientific literature that provides empirical tests of specific systems, and connecting them to larger theory and practices. Students often find this very challenging, but this is an important skill for you to be able to keep up to date about plant diseases (or just about any other aspect of environmental studies you could name) throughout your careers.

General expectations

1. Come to class prepared, on time, and ready to participate actively.
2. Do the readings and watch available lectures before class. Be able to answer the "Questions" and have a clear idea of the meaning of "Words to Know" at the end of each chapter of *Essential Plant Pathology*. Please use the CD than accompanies the book.
3. Ask questions. It is the best way to get me to slow down in lecture.
4. Go to office hours – get clarification, explore ideas, offer suggestions,
5. Follow up on what interests you, and use all available resources.
6. No cell phone use or internet-connected computers allowed during class. We will ask you to leave class if you violate this request. It is disrespectful to other students as well as to the instructors.
7. I have a zero tolerance policy for plagiarism and cheating. See the Academic Integrity section below, and the handout available on the eCommons site and at http://people.ucsc.edu/~ggilbert/Documents/Avoiding Plagiarism.pdf
8. Work together (except on quizzes and exams). This is not a competition. I don't curve grades (unless poor performance is clearly linked to my own incompetence). I strongly encourage you to form peer-review groups to help each other improve your written work.
9. Late assignments will be docked 5% of the value of the assignment (to max 25% off) per calendar day late, unless arrangements to turn it in late were made in advance. The first day late is recorded 5 min after the due date and time. Assignments will not be accepted more than one week after they are due. There are no make-ups on quizzes, which must be completed by the start of class on the day due. Make-ups on midterm exams are by oral exam only. Assignments must be posted to eCommons before class begins on the date due; those posted after the start of class will be marked 1 day late.

Course evaluation

10%	Lecture attendance and participation
13%	Online quizzes on readings
20%	Assignments: Life history poster, critical reviews/arguments, epidemiology homework
12%	Midterm exam 1
12%	Midterm exam 2
15%	Final Exam
3%	Final Paper outline
15%	Final paper

Lecture attendance and participation (10%). I expect you to attend and participate in lectures. Class begins promptly at 9:30. The lectures are designed to expand on the readings, so it is up to you to do the readings before class. Bring specific questions about the readings to the lectures, and ask them. Later in the course, some lectures will be available on line to be viewed before class; class time will focus on discussion and activities.

On-line quizzes on assigned readings and online materials (13%) I expect you to have read and thought about the assigned readings and other on-line materials before coming to class. To help you along, there are timed on-line quizzes about major points from the on-line materials that must be completed before the class for which the readings are assigned. Quizzes also cover handouts on statistics, writing, academic integrity, and posted on-line lectures. There are no make-ups on missed quizzes, but you can get full points for this dimension of the class by

correctly answering 90% of the questions throughout the quarter (that means if you miss a quiz, you can still get full points for the class). You cannot get more than full credit, however, even if you correctly answer more than 90% of the quiz questions.

Assignments (20%) Five assignments: One Life history poster & narration, four critical reviews / arguments, and an epidemiology homework. The epidemiology homework will have twice the weight of each of the other components.

Exams (39%). There will be two midterm exams (12% each) and a cumulative final exam (15%; Tues 9 June 4-7 pm). All materials in lectures, handouts, assignments, the textbook, and required readings are all fair game for the exams. Exams will be blends of multiple choice, short answer, illustrative graph-type questions, and more creative opportunities to put what you learn to use.

Final paper (3% for outline and 15% for final paper). The brevity of the final written product (5 pages) is not a reflection of how much work this assignment takes. The Secretaries of Agriculture and Interior have decided to fund five research institutes to address critical areas in plant disease ecology. The institutes can focus on a particular disease or on a particular topic that crosses many diseases. The institutes can focus on either applied problem solving or basic understanding that may later contribute to problem solving. You are asked to identify one topic that you are passionate about, and write a 5-page (single-spaced, 12-point font, 1-inch margins, including references) brief that synthesizes relevant published scientific literature to help the Secretaries understand the current state of research in the area and to make an evidence-based case that this is a topic of critical need. In addition, the Secretaries have requested that one of these 5 pages should be dedicated to proposing one specific example experiment that would be conducted at this institute. This description should include a clear description of the rationale, a graphical hypothesis, an outline of the experimental approach, and a self-evaluation of potential pitfalls or limitations of the experiment. You need to use a minimum of five articles from the primary peer-reviewed literature in a significant and appropriate way, and go beyond just reporting the results of those studies to present a clear, coherent, synthetic statement based on your analysis of the research. The challenge here is to take a body of work, understand it well, and tell a coherent story about the topic informed by and supported by the best available scientific literature. The complete citation for each article (in the format used in the journal *Ecology*) MUST be included for all citations in a Literature Cited section. Similarly, the in-text citations of the references must follow the style used in *Ecology*. See below for more details on assignment and grading.

Late policy and makeups. Quizzes and assignments are due before class begins (9:30 a.m.) on the day they are due. There are no make-ups for online quizzes. All other late assignments will be docked 5% of the assignment value per calendar day late (to max 25%), unless arrangements to turn it in late were made in advance. Assignments will not be accepted more than one week after they are due. Makeups on the midterm exams are by oral exam only.

Regrading of papers or exams. We strongly encourage you to come to office hours at any point to talk about things you don't understand, including about graded papers, quizzes, and exams. Requests for regrading, however, (of papers or particular questions on exams) will ONLY be considered when accompanied by a written request that explains clearly why you think the grade was incorrect. Written requests will be accepted no sooner than 6 hours after receiving the

graded work, and no later than 1 week after receiving it. Only Greg will handle regrades. If there are simple problems with the tally of the scores, you can check with Greg or your TA.

Academic integrity. I expect you to adhere to the highest standards of academic integrity in this class. When a student enrolls at UCSC he or she automatically agrees to abide by University policies. The student policy, principles, and processes related to academic integrity are available at www.ue.ucsc.edu/academic_integrity. Academic integrity and scholarship are core values of the UCSC community; plagiarism and cheating contradict these values, and so are very serious academic offenses. I have a zero tolerance policy for plagiarism and cheating. No credit will be given for an assignment where a breach of academic integrity is established, and we will follow the established UCSC process for Academic Dishonesty Cases. In addition, please review the handout prepared by Greg Gilbert and Ingrid Parker on Avoiding Plagiarism (also available on the course ecommons page) that summarizes what is considered violation of academic integrity – this handout will be included in your quizzes and exams. If you have any questions about UCSC policy please consult your professor or TA.

For additional clear descriptions and discussion of what constitutes plagiarism, please see the following web page from Plagiarism.org http://www.plagiarism.org/plagiarism-101/overview/. Note, however, that they focus on using MLA and APA standards, which are not commonly used in scientific writing nor in this class.

Peer-review of analytical brief for extra credit. You can receive up to 2 points extra credit toward your final course grade by participating in significant peer-review of the final paper. Full credit requires (1) providing substantive review comments to a peer in the class, (2) receiving and incorporating comments from a peer in the class, (3) turning in the original (hardcopy) reviewed drafts of both reviewers together as a bundle in class on the day the paper is due, along with a brief joint cover letter noting who the reviewers were, and an assessment of the value of doing the reviews.

Course evaluation extra credit. Course evaluations are now done through eCommons. They are extremely important to me as a professor that you complete them. I won't be able to see what you put on the evals until after the course grades are in, and I will never know what *you* wrote (they are anonymous), but I will know *if* you completed a course eval. Following departmental policy, you will get 0.25% added to your course grade for completing the course eval no later that 24h after the end of the final exam.

Syllabus for ENVS163 Plant Disease Ecology, Spring 2015

Date	Topics	Required readings	Due
M 30 Mar	Intro to course & diseases		
W 1 Apr	Plants	EPP Ch. 1	
F 3 Apr	Fungi	EPP Ch. 2; Syllabus; Avoid plagiarism	Quiz1
M 6 Apr	Fungi & Oomycetes	EPP Ch. 2; Kim et al. 2005	Quiz2
W 8 Apr	Bacteria	EPP Ch. 3	Quiz3
F 10 Apr	Nematodes	EPP Ch. 4;	Quiz4
M 13 Apr	Viruses	EPP Ch. 5; Tsugita et al. 1960	Quiz5
W 15 Apr	Parasitic plants	EPP Ch. 6	Quiz6; Life history posters
F 17 Apr	Abiotic diseases	EPP Ch. 7	Quiz7
M 20 Apr	Midterm 1: life histories		Midterm 1
W 22 Apr	Types of diseases	EPP Ch. 8	Quiz8
F 24 Apr	Types of diseases	EPP Ch. 8	
M 27 Apr	Other Symbioses	Kennedy '03; Rollinger '93; Clay '99	Quiz9
W 29 Apr	Ecological interactions	EPP Ch. 9A, Bradley et al. 2003	Quiz10; Critique 1
F 1 May	Physiological interactions	EPP Ch. 9B, Muthamilarasan 2013	Quiz11
M 4 May	Genetic Interactions	EPP Ch. 9C;	Quiz12
W 6 May	Genetic Interactions	EPP Ch. 9C; Narusaka et al. 2013	Critique 2: Genetics
F 8 May	Evolutionary ecology	Parker et al. 2015	Final Paper outlines
M 11 May	Epidemiology 1	EPP Ch. 10	Quiz13
W 13 May	Epidemiology 2	EPP Ch. 10	Quiz14
F 15 May	Epidemiology 3		Epidemiology HW; 9 pm
M 18 May	Midterm Exam 2		Midterm 2
W 20 May	Disease management	EPP Ch. 11; Zhan et al. 2014	Quiz15; Critique 3 Mgmt
F 22 May	Novel interactions	Parker & Gilbert 2004	Quiz16
M 25 May	Memorial Day Holiday		
W 27 May	Natural ecosystems	Grünwald et al. 2012	Quiz17
F 29 May	Akif Skalen: Extension	Eskalen et al. 2013	Quiz 18
M 1 Jun	Natural ecosystems	Gilbert 2002	Quiz 19
W 3 Jun	Biological control	Kuchment 2013; Arnold et al. 2003	Final Paper 9:30 a.m.
F 5 Jun	Disease into the future		Critique 4:Climate
Tu 9 Jun	Final exam: cumulative	4:00-7:00 pm	

ENVS163 Plant Disease Ecology
Virtual Reader

These readings are available in Resources in the ENVS 163 eCommons site.

Required readings

Arnold, A. E., L. C. Mejia, D. Kyllo, E. I. Rojas, Z. Maynard, N. Robbins, and E. A. Herre. 2003. Fungal endophytes limit pathogen damage in a tropical tree. Proceedings of the National Academy of Sciences of the United States of America 100:15649-15654.

Bradley, D. J., G. S. Gilbert, and I. M. Parker. 2003. Susceptibility of clover species to fungal infection: The interaction of leaf surface traits and environment. American Journal of Botany 90:857-864.

Clay, K. and J. Holah. 1999. Fungal endophyte symbiosis and plant diversity in successional fields. Science 285:1742-1744.

Eskalen, A., R. Stouthamer, S.C. Lynch, P.F. Rugman-Jones, M.Twizeyimana, A. Gonzalez, and T. Thibault. 2013. Host range of Fusarium Dieback and its ambrosia beetle (Coleoptera: Scolytinae) vector in southern California. Plant Disease 97: 938-951.

Gilbert, G. S. 2002. Evolutionary ecology of plant diseases in natural ecosystems. Annual Review of Phytopathology 40:13-43.

Grünwald, N.J., M. Garbelotto, E.M. Goss, K. Heungens, and S. Prospero. 2012. Emergence of the sudden oak death pathogen *Phytophthora ramorum*. Trends in Microbiology 20:131-138.

Kennedy, P. G., A. D. Izzo, and T. D. Bruns. 2003. There is high potential for the formation of common mycorrhizal networks between understory and canopy trees in a mixed evergreen forest. Journal of Ecology 91:1071-1080.

Kim, Y.K., C.L. Xiao, and J.D. Rogers. 2005. Influence of culture media and environmental factors on mycelial growth and pycnidial production of *Sphaeropsis pyriputrscens.* Mycologia 97:25-32

Kuchment, A. 2013. The end of orange juice. Scientific American March:51-59.

Muthamilarasan, M. and M. Prasad. 2013. Plant innate immunity: an updated insight into defense mechanism. J. Bioscience 38: 433-449

Narusaka, M., Y. Kubo, K. Hatakeyama, J. Imamura, H. Ezura, Y. Nanasato, Y. Tabei, Y. Takano, K. Shirasu, and Y. Narusaka. 2013. Interfamily transfer of dual NB-LRR genes confers resistance to multiple pathogns. PLoS ONE 8:e55954 doi:10.1371/journal.pone.0055954

Parker, I. M. and G. S. Gilbert. 2004. The evolutionary ecology of novel plant-pathogen interactions. Annual Review of Ecology Evolution and Systematics 35:675-700.

Parker et al. 2015. In Press (Not yet on eCommons) Coming soon!

Rollinger, J. L. and J. H. Langenheim. 1993. Geographic survey of fungal endophyte community composition in leaves of coastal redwood. Mycologia 85:149-156.

Tsugita, A., D. T. Gish, J. Young, H. Fraenkelconrat, C. A. Knight, and W. M. Stanley. 1960. The complete amino acid sequence of the protein of Tobacco Mosaic Virus. Proceedings of the National Academy of Sciences of the United States of America 46:1463-1469.

Zhan, J., P.H. Thrall, and J.J. Burdon. 2014. Achieving sustainable plant disease management through evolutionary principles. Trends in Plant Science 19:570-575.

Suggested readings – some additional papers drawn from in lectures

Alexander, H. M., P. H. Thrall, J. Antonovics, A. M. Jarosz, and P. V. Oudemans. 1996. Population dynamics and genetics of plant disease: A case study of anther-smut disease. Ecology 77:990-996.

Anagnostakis, S. L. 1987. Chestnut blight - the classical problem of an introduced pathogen. Mycologia 79:23-37.

Arny, D., S. Lindow, and C. Upper. 1976. Frost sensitivity of *Zea mays* increased by application of *Pseudomonas syringae*. Nature 262:282-284.

Augspurger, C. 1983. Seed dispersal of the tropical tree, *Platypodium elegans*, and the escape of its seedlings from fungal pathogens. Journal of Ecology 71:759-771.

Beare, J. A., S. A. Archer, and J. N. B. Bell. 1999. Effects of *Melampsora* leaf rust disease and chronic ozone exposure on poplar. Environmental Pollution 105:419-426.

Beckstead, J. and I. M. Parker. 2003. Invasiveness of *Ammophila arenaria*: Release from soil-borne pathogens? Ecology 84:2824-2831.

Bever, J. D., K. M. Westover, and J. Antonovics. 1997. Incorporating the soil community into plant population dynamics: the utility of the feedback approach. Journal of Ecology 85:561-573.

Bradley, D. J., G. S. Gilbert, and J. B. H. Martiny. 2008. Pathogens promote plant diversity through a compensatory response. Ecology Letters 11:461-469.

Brockwell, J., P. J. Bottomley, and J. E. Thies. 1995. Manipulation of Rhizobia microflora for improving legume productivity and soil fertility - A critical assessment. Plant and Soil 174:143-180.

Bruns, E., M. Carson, and G. May. 2012. Pathogen and host genotype differently affect pathogen fitness through their effects on different life-history stages. BMC Evolutionary Biology 12:135 DOI: 10.1186/1471-2148-12-135

Burdon, J. J., P. H. Thrall, and L. Ericson. 2006. The current and future dynamics of disease in plant communities. Annual Review of Phytopathology 44:19-39.

Dangl, J. L. and J. D. G. Jones. 2001. Plant pathogens and integrated defence responses to infection. Nature 411:826-833.

Fraedrich, S. W. 2008. California laurel is susceptible to laurel wilt caused by *Raffaelea lauricola*. Plant Disease 92:1469-1469.

Gardes, M. and T. D. Bruns. 1996. Community structure of ectomycorrhizal fungi in a *Pinus muricata* forest: Above- and below-ground views. Canadian Journal of Botany 74:1572-1583.

Gilbert, G. S. and C. O. Webb. 2007. Phylogenetic signal in plant pathogen-host range. Proceedings of the National Academy of Sciences of the United States of America 104:4979-4983.

Gosling, P., A. Hodge, G. Goodlass, and G. D. Bending. 2006. Arbuscular mycorrhizal fungi and organic farming. Agriculture Ecosystems & Environment 113:17-35.

Jaffee, B. A., H. Ferris, and K. M. Scow. 1998. Nematode-trapping fungi in organic and conventional cropping systems. Phytopathology 88:344-350.

Jatala, P. 1986. Biological control of plant-parasitic nematodes. Annual Review of Phytopathology 24: 453-489.

Kolmer, J. A. 1991. Evolution of distinct populations of *Puccinia recondita* f. sp. *tritici* in Canada. Phytopathology 81:316-322.

Power, A. G. and C. E. Mitchell. 2004. Pathogen spillover in disease epidemics. American Naturalist 164:S79-S89.

Rizzo, D. M. and M. Garbelotto. 2003. Sudden oak death: endangering California and Oregon forest ecosystems. Frontiers in Ecology and the Environment 1:197-204.

Runyon, J. B., M. C. Mescher, and C. M. De Moraes. 2006. Volatile chemical cues guide host location and host selection by parasitic plants. Science 313:1964-1967.

Shea, S. R., B. L. Shearer, J. T. Tippett, and P. M. Deegan. 1983. Distribution, reproduction, and movement of *Phytophthora cinnamomi* on sites highly conductive to Jarrah Dieback in South Western Australia. Plant Disease 67:970-973.

Tsugita, A., D. T. Gish, J. Young, H. Fraenkelconrat, C. A. Knight, and W. M. Stanley. 1960. The complete amino acid sequence of the protein of Tobacco Mosaic Virus. Proceedings of the National Academy of Sciences of the United States of America 46:1463-1469.

Vanderputten, W. H., C. Vandijk, and B. A. M. Peters. 1993. Plant-specific soil-borne diseases contribute to succession in foredune vegetation. Nature 362:53-56.

Yamazaki, M., S. Iwamoto, and K. Seiwa. 2009. Distance- and density-dependent seedling mortality caused by several diseases in eight tree species co-occurring in a temperate forest. Plant Ecology 201:181-196.

Assignment Details

15 April. Life history poster and podcast. Prepare a one-page, original (that means your words and drawings, and not just simply re-drawing something you found on line) life history poster (8.5"x11" or larger) of the plant disease of your choosing. It should (1) clearly identify the pathogen and host(s) of interest, (2) depict the most important aspects of the plant / pathogen life cycles as they relate to disease development, (3) describe how the pathogen causes disease on the plant, (4) impacts on the host, and (5) specific approaches to management of this disease. See p 56 in the Kuchment 2013 *The end of orange juice* for an excellent example. Do your best work on the drawings - you won't be graded on how life-like the drawing is, but by how effectively it conveys the information. On a separate sheet, include the full citations of references you used to design the poster. Record a 60-sec blurb for a radio podcast that effectively calls attention to the public of the importance of this pathogen. Turn in a hard copy of the poster, the citations, and the podcast by start of class on 15 April. Post the podcast to Basecamp dropbox as an .mp3 file named YOURLASTNAME.mp3). We will show the posters and listen to the podcasts in class on 17 April.

29 April. Critical Review 1: Environment and plant disease. Bradley, D. J., G. S. Gilbert, and I. M. Parker. 2003. Susceptibility of clover species to fungal infection: The interaction of leaf surface traits and environment. American Journal of Botany 90:857-864.

Being able to read the primary scientific literature is a professional skill that will allow you to stay on top of the latest information throughout your career, without having to simply take the work of interpreters at face value. Reading scientific papers efficiently, effectively, and critically is a learned skill – there are tricks to help, but it really just requires practice. By far, however, the best way to read scientific literature is with friends. Scholarly nerds (like professors and grad students) form journal clubs and reading groups not just because it is part of the educational and research process, but because (1) it make understanding the literature much easier, and (2) it is fun. Really. Fun! Get with it – everyone is doing it!

You are encouraged to talk to other about the paper, but each student should write his/her own critical review.

Each student must turn in a hard copy of their review in class, where we will discuss the paper and your reviews.

6 May. Critical Review 2: **Genetic and physiological interactions**. Narusaka, M., Y. Kubo, K. Hatakeyama, J. Imamura, H. Ezura, Y. Nanasato, Y. Tabei, Y. Takano, K. Shirasu, and Y. Narusaka. 2013. Interfamily transfer of dual NB-LRR genes confers resistance to multiple pathogns. PLoS ONE 8:e55954 doi:10.1371/journal.pone.0055954

Same structure of assignment as for Critical Review 1.

15 May. (9:00 p.m. on eCommons). Epidemiology homework using Excel. We will work on aspects of this assignment in class, but you will also need to put in significant time outside of class. The assignment is due to be posted to eCommons by 9:00 p.m. on Friday, giving you time after the final epidemiology class to make final changes.

20 May. Critical Argument 3: **Cultural disease management**.
You may choose any peer-reviewed, empirical paper (not a review paper) related to crop rotation or intercropping and plant disease management.
Each student prepares a critical review that (1) summarized the article read and (2) uses the findings from that article to support or refute the statement "Crop diversification, through rotation or multicropping, is an effective means of controlling plant disease". Note that it is not at all important whether your article supports or refutes the statement, but rather that you clearly argue how the particular article you read supports or refutes the statement. Bring a hard copy of your review to class to turn in, where we will discuss them.

5 June. Critical Argument 4: climate change and plant disease Do a Web of Science (or Google Scholar) search with the following Topic boolean search terms: (plant AND (disease* OR pathogen*)) AND (climate AND change) . Pick an article of interest to you, and prepare a critical review that (1) briefly summarizes the article read, and then (2) makes an argument, based on that finding of that article, that either (a) argues for federal funding for a related research program (you need to define what that program should be) or (b) argues that climate change impacts on plant disease are unlikely to be of major concern. What is important is that you support your argument clearly, not what position you take. Bring a hard copy with you to class to turn in and discuss. Be prepared to make an oral argument in 1 minute.

Critical Review / Argument Requirements

Length: The reviews should be 300-500 words for the summary plus 300-500 words for the critique or argument.
Writing: Clear, concise, unambiguous writing with correct spelling and good grammar.
Structure: Header, Summary, Critique (see details below and example)

EVALUATION

**********First 50% are in common for all 4 Critical Assignments **********

10 points: Structure. Please follow the header format shown in the example (student name, class and assignment, date, full citation of article reviewed. Should meet the expected length, have a clear structure, and clear, grammatically correct, stylistically appropriate writing.

40 points: Summary of the article. The first section (300-500 words) should explicitly describe (a) what did they set out to test?, (b) why did they want to test it? (c) what did they expect to find and why?, (d) how did they test it?, and (e) what did they find? Only include enough of the methods to know what kind of study was done (e.g., "… used fungicide application experiments in the field to…", "… through isolations of fungi from 30 species of symptomatic plant species, they examined …", "… collected rust spore samples from wheat fields across North America and testing their race structure using …"). You should not include detailed methods like " in a completely randomized block design in southern Mississippi, they added zero or 15 larvae to each of 20 replicate plots, 2x2-m each, on 4 April 2001 to ….". Provide what is needed to get the picture of what was done, but the focus should be on the objectives and the results.

**********Remaining 50% depends on the assignment **********

50 points: Critique for Assignments 1 & 2. Critique is not criticizing. It is a thoughtful evaluation. Answer explicitly (a) How did their results compare to their expectations? (b) Why is the finding important? (c) If appropriate, why did results differ from expected? Which would be more interesting – finding expected results or unexpected in this case and why? (d) Either one important concern about the paper OR one specific suggestion for a follow-up study to build on these findings (repeat with more reps or in a different place does not count) OR one specific question about the paper.

50 points: Argument for Assignment 3. Support or refute the statement "Crop diversification, through rotation or multicropping, is an effective means of controlling plant disease". Note that it is not at all important whether your article supports or refutes the statement, but rather that you clearly argue how the particular article you read supports or refutes the statement.

50 points: Argument for Assignment 4. Make an argument, based on that finding of that article, that either (a) argues for federal funding for a related research program (you need to define what that program should be) or (b) argues that climate change impacts on plant disease are unlikely to be of major concern. What is important is that you support your argument clearly, not what position you take.

Final Paper Assignment, Structure, and Grading Rubric
ENVS 163 Plant Disease Ecology
Due 3 June 2015 at start of class

The Secretaries of Agriculture and Interior have decided to fund five research institutes to address critical areas in plant disease ecology. The institutes can focus on a particular disease or on a particular topic that crosses many diseases. The institutes can focus on either applied problem solving or basic understanding that may later contribute to problem solving. You are asked to identify one topic that you are passionate about, and write a 5-page (single-spaced, 12-point font, 1-inch margins, including references) brief that synthesizes relevant published scientific literature to help the Secretaries understand the current state of research in the area and to make an evidence-based case that this is a topic of critical need. In addition, the Secretaries have requested that one of these 5 pages should be dedicated to proposing one specific example experiment that would be conducted at this institute. This description should include a clear description of the rationale, a graphical hypothesis, an outline of the experimental approach, and a self-evaluation of potential pitfalls or limitations of the experiment. You need to use a minimum of five articles from the primary peer-reviewed literature in a significant and appropriate way, and go beyond just reporting the results of those studies to present a clear, coherent, synthetic statement based on your analysis of the research. The challenge here is to take a body of work, understand it well, and tell a coherent story about the topic informed by and supported by the best available scientific literature. The complete citation for each article (in the format used in the journal *Ecology*) MUST be included for all citations in a Literature Cited section. Similarly, the in-text citations of the references must follow the style used in *Ecology*.

1. The **final paper outline (due 8 May)** must include (1) a title, (2) a 1-paragraph overview of the argument to be made, (3) full citations for 5 relevant articles from the literature, (4) one or two sentences for each of the citations specifying what that article contributes to your argument. (Worth 3% of final grade)

2. **The final paper (due 3 June)** should be an *analytical review and synthesis of the literature on a critical plant disease or topic in plant disease ecology, and make a clear evidence-based argument about why this topic is critical for significant research attention.* Worth 15% of final grade. It should include:

- Your full name, course number and name, date.
- Informative descriptive title
- The goal is to pick a single important issue, topic, or plant disease, take a body of scientific work related to it, understand it well, and tell a coherent story about the topic informed by and supported by the best available scientific literature.
- Appropriate structure and clear writing. Be sure that you present the big picture and the specific questions or issues you will address, in the order you will address them, in introducing your paper. Use signposts (section headings, strong topic sentences, etc.) to make it easy to see at a glance how your paper is structured, and how you are making your arguments. Be sure to include a strong, clear conclusion that synthesizes your argument that your topic is one of the critical areas to merit research.

- Minimum (that means no fewer than, but likely to include more than) of five peer-reviewed scholarly articles that you engage in a substantive and appropriate way in your paper. You should be analyzing and summarizing the literature, not just reporting it.
- Appropriate citation of all sources from which you derive information and ideas in the text and in the literature cited section at the end of the paper. Citation style MUST follow the style used in the journal *Ecology*. Look at a recent issue of *Ecology*, or the Instructions to Authors page of the Ecological Society of America for appropriate citation style. You can also refer to the *Avoiding Plagiarism* handout provided at the beginning of the quarter.
- Five pages, STAPLED, single spaced, 12-point font, 1 inch margins, with page numbers. Citations are included in text length.

3. The **final paper** must be submitted as STAPLED hard copy at the beginning of class.

4. ***Peer-review of final paper for extra credit.*** You can receive up to 2 points extra credit toward your final course grade by participating in significant peer-review of the final paper. Full credit requires (1) providing substantive written review comments to a peer in the class, (2) receiving and incorporating written comments from a peer in the class, (3) turning in the original reviewed drafts of both reviewers together as a bundle at the same time as turning in the papers, along with a brief joint cover letter noting who the reviewers were, and an assessment of the value of doing the reviews. Credit will be given according to the depth and constructiveness of the feedback given, and how peer-review comments were addressed in the final version. Note: Minimal, non-specific feedback like "Hey, this looks great, maybe see if you can cut a bit from the intro" would not get any credit.

Grading rubric for ENVS163 Plant Disease Ecology Final Paper Proposal

Name: Final score: _____/100

___/10: Paper title and your name:

____/30: 1-paragraph overview of the argument to be made. Must clearly state and delimit a topic, and outline the argument that this is an important topic for research.

____/40: Full citations for 5 relevant articles form the literature, in the format used in the journal *Ecology*

____/20: one or two sentences for each of the citations specifying what that article contributes to your argument.

Grading rubric for ENVS163 Plant Disease Ecology Final Paper

Name:

Paper title:

Final score: _____/100 Extra Credit for Peer-review: _____/2

____/10: Structure and guidelines: Following requirements for format, name, title, date as given. Length 5 pages, single spaced, 12 pt font. Page numbers (Note: papers on topics clearly outside the theme of this assignment will not receive any credit)

____/10: Grammar and style: No spelling errors. Good grammar and word choice. Clarity of expression. Good, effective structure of paragraphs. Effective signposts. Paraphrasing, rather that using direct quotes.

____/10: Appropriate citation of the literature. Inclusion of at least four appropriate peer-reviewed publications from the scientific literature, with appropriate in-text citations and literature cited section. MUST USE THE FORMAT USED IN THE JOURNAL *Ecology* (see Avoiding Plagiarism handout).

____/20: Effective use of peer-reviewed primary scholarly literature. Cited literature is accurately and substantively used to support your arguments. Descriptions of work and findings of others are clearly explained to be understandable by others in this class without having to read the original work.

____/20: Clearly explained experiment that defines a clear hypothesis and sets out to test that hypothesis in a rigorous way.

____/30: Coherent, synthetic, analytical review of research to make a clear argument. Clearly establish the goals of the paper, including specific questions or controversies, or particular issues that will be addressed. Effectively integrate and synthesize ideas and findings from multiple sources to address those goals, including a clear synthetic conclusion. Should tell a story.

General comments:

Required format for final paper: *Please follow this overall structure including this format for citations. Please number all pages. 5 pages, single spaced, 12 pt font*

Title of paper

Your Name
ENVS163 Plant Disease Ecology
Date

Then follows the body of the text – use sections and subsections as appropriate to help with the flow of the paper.

In the text use citations as follows:
Single author (Janzen 1971)
Two authors (Burdon & Chilvers 1984)
Three or more authors (Bradley *et al.* 2002)
Multiple citations (Janzen 1971, Burdon & Chilvers 1984)

Literature Cited: (Use the format exactly as given below).
For journal articles:

Hansen, E. M., & E. M. Goheen. 2000. *Phellinus weirii* and other native root pathogens as determinants of forest structure and process in western North America. *Annual Review of Phytopathology* 38: 515–539.

Harms, K. E., S. J. Wright, O. Calderon, A. Hernandez, & E. A. Herre. 2000. Pervasive density-dependent recruitment enhances seedling diversity in a tropical forest. *Nature* 404:493–495.

Hawksworth, D. L. 2001. The magnitude of fungal diversity: the 1.5 million species estimate revisited. *Mycological Research* 105:1422–1432.

For a book:

Hubbell, S. P. 2001. *The Unified Neutral Theory of Biodiversity and Biogeography*. Princeton University Press, Princeton.

For a book chapter:

Connell, J. H. 1971. On the role of natural enemies in preventing competitive exclusion in some marine animals and in rain forest trees. In P. J. Boer & G. R. Graadwell, eds. *Dynamics of Numbers in Populations (Proceedings of the Advanced Study Institute, Osterbeek 1970)*. Wageningen: Centre for Agricultural Publication and Documentation, pp. 298–312.

For a website:

Center for Tropical Research in Ecology, Agriculture, and Development. http://centread.ucsc.edu. Accessed 5 May 2015.

Suggested exercise to help select a topic for the Final Paper
And maximize your effective use of Web of Science

Purposes:
(1) Develop skills for effectively using the Web of Science to find scientific literature,
(2) Finding and evaluating literature to be used for your final paper, and
(3) Proposing the topic for your final paper.

What to do:

1. Pick a particular pathogen, disease, or concept that you think might be a good topic for your final paper. For example:

A disease	**A pathogen**	**A concept**
Laurel wilt	*Phytophthora ramorum*	induced resistance

2. Go to the University Library web page at http://library.ucsc.edu. Click More databases in the FIND ARTICLES box at left, then choose Web of Science.

3. Click in the top search box (above "*Example:* oil spill* mediterranean") and type the name of your pathogen or disease or concept in the *Topic* box and click "Search". Record the number of "results found" you got for your search terms. Read through the titles and abstracts of the articles (click on the title to see the abstract), check and make a record of those that seem interesting and useful. If the UC library has an electronic subscription to the journal, clicking on "UC-eLinks" will take you to the online text. Others are available only in the library. Note which ones are readily available to you.

5. From the results page, use the "Sort by" tool at the top to sort by Times cited - highest to lowest. This will show which papers are the "classics" on the topic (although by default newer papers, even if exceptional, haven't had the same opportunity to be cited).

6. Click on the title of a paper you are interested in. Click on the number after "Cited Reference". This shows you all the articles that were cited in that paper, allowing you to follow back into history and find the papers that informed that work.

7. Now click on the number after "Times cited" for that citations. This shows you all the papers that have cited that publication – allowing you to follow the paper's impact forward in time. For instance, today a search on "laurel wilt" produced 91 results. The top-cited article in that collection cited 19 previous publications and was in turn cited 71 times. Often you'll find the most useful papers in following up who cited papers you are really interested in.

8. Peruse the references you find in while exploring the citations. Gather and examine at least five articles that you can access either electronically or in the Science & Engineering library.

9. Use this process to explore pathogens, diseases, or topics for your final paper. Be sure that there are adequate publications for you to be able to write a paper!