Rhizosphere Biochemistry (SOS 6325), Fall 2007

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Prerequisites: SOS5305C (Soil Microbial Ecology) or SOS6323 (Ecological Diversity of Soil Microorganisms) or permission of instructor.

Course Description: The signaling and regulatory mechanisms involved in the structuring of rhizosphere communities will be surveyed. Roles of plants and microbes in nutrient cycling, nutrient acquisition, plant disease, biocontrol and bioremediation will be reviewed. Special emphasis is on the biochemical and genetic techniques used for studying plant-plant, plant-microbe and microbe-microbe interactions.

Learning Objectives: At the end of this course, the student will be able to:

- evaluate the role of chemical signaling in the structuring of rhizosphere communities
- compare and contrast investigative methods and techniques for studying genetic and biochemical rhizosphere interactions
- develop a proposal targeted at exploring a specific aspect of the rhizosphere biology

Course Format: Three 1-hr meetings per week (typically, 9 lectures + 3 paper discussion per month).

Frequency Taught: Fall semester, odd years

Class attendance: Required

Evaluation and Grading:

45% Journal article discussion
15% Midterm exam
40% Final paper. The first draft and the final draft of the paper are graded separately (10% and 30%, respectively).

Journal Article Discussions. Every other week, students and the instructor will select a recent research article, relevant to the topics discussed in lectures. We will select from original research articles published in *Proceedings of the*

National Academy of Sciences (http://www.pnas.org/), *Molecular Plant-Microbe Interactions* (http://www.ismpminet.org/mpmi/current/top.asp) or Plant Physiology (http://www.plantphysiol.org/). Two students will volunteer to critically evaluate the paper, and prepare a written 1-page summary of the article. This summary will be distributed to all class participants at least 2 days prior to the class discussion. The two students would lead a 30-min class discussion of the paper, addressing the study's hypotheses, experimental approaches, results and conclusions. All class participants will read the article and prepare questions and comments. To receive full credit (45%), each student would present at least one paper (35%) + contribute at least one question to each discussion (10%). The contributing questions must be directly related to the study's hypothesis, experimental approaches or conclusions.

Midterm: The midterm will contain questions which require short essay answers.

Final Paper: The final paper (5-10 pages) follows the guidelines for USDA proposals. Briefly, each student will identify a problem, related to the issues discussed throughout the semester (e.g. "Soybean roots infected with nematodes, do not form effective symbioses with *Bradyrhizobium*"). A hypothesis addressing causes of the problem is then formulated (e.g. "Nematodes produce and secrete substances which block recognition steps in the soybean-*Bradyrhizobium* symbiosis"). Three experimental approaches to test the hypothesis will be suggested. Potential strengths and limitations of each experimental approach will be discussed in detail.
The evaluation will be based on the following criteria:
a) does the hypothesis address reasonable causes of the problem?
b) are proposed experiments appropriate to test the hypothesis?
c) does the proposal rely on a single experimental approach? Relying on a single approach is discouraged.
d) does the report carefully discuss advantages and limitations of each experimental approach/technique?

The first draft of the paper is submitted no later than a week before the midterm exam. The draft will be returned with the instructor's suggestions/comments. The students will be encouraged to review the suggestions/comments and incorporate them into the final draft of the paper.

Notes on grading: No makeup midterm or assignments will be allowed. No late assignments will be accepted for full credit (10% of the grade will be deducted per each late day).

The final grade is a reflection of the individual student's mastery and comprehension of the subject material presented during the semester. The grading will not be based on a bell curve.
Grading will be: 90 to 100 A, 86 to 89 B+, 80 to 85 B, 76 to 79 C+, 70 to 75 C, 66 to 69 D+, 60 to 65 D, <60 E.

Course Outline:

Weeks 1, 2. Macronutrients in the rhizosphere: their sources and roles in promoting rhizosphere communities (Ch1, Ch2 of the Textbook).

Weeks 3, 4. Communications in the rhizosphere (supplemental reading: Brencic and Winans. 2005. Detection and response… Microbiol Mol Biol Rev 69:155-194)

a. Major classes of the rhizosphere signals and their origin. Chemical techniques and bioassays to separate, purify and identify rhizosphere signals.

b. Signal perception and signal transduction pathways in prokaryotes and eukaryotes.

c. Plant defense compounds.

Week 5. Root-root interactions. Allelopathy. (Ch. 2, 3)

Weeks 6, 7. Root-fungal interactions (Ch. 4, Ch7, Ch. 9).

a. Plant signals and their recognition by pathogenic and beneficial fungi.

b. Establishment of mycorrhizae (supplemental reading: Harrison. 2005. Signaling in the arbuscular… Annu Rev Microbiol 59: 19-42)

Midterm Exam

Weeks 8, 9, 10, 11. Root-bacterial interactions (Ch7, Ch. 8 + Lugtenberg et al., 2001. Molecular determinants of rhizosphere colonization by *Pseudomonas.* Annu. Rev. Phytopathol. 39:461-490).

a. Genetic, genomic and proteomic techniques to study plant-bacterial interactions (Rolfe et al., 2003. Proteomic analysis of legume-*Rhizobium* interactions. Comp. Funct. Genom. 4:225-228)

b. Legume-*Rhizobium* symbiosis: recognition and establishment, nodule biochemistry (Ch.10 + Long. 2001. Genes and signals in the *Rhizobium*-legume symbiosis. Plant Phys. 125:69-72; Gage. 2004. Infection and invasion... Microbiol Mol Biol Rev 68:280-300).

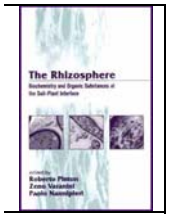
c. Plant-*Agrobacterium* interactions (recognition, infection, tumor biochemistry).

Week 12. Evolution of rhizosphere signaling. Convergence of signaling networks and pathways. (Hirsh et al., 2003. Molecular signals… Ecology 84:585-568; Mathesius. 2003. Conservation and divergence of signaling… Plant and Soil. 255:105-119)

Weeks 13, 14. Rhizosphere communities and their role in biocontrol, micronutrient acquisition, and bioremediation (Ch. 11 + Parke et al., 2001. Diversity of the *Burkholderia.*…Annual Rev. Phytopathol. 39:225-258)

Required Text:

1. The Rhizosphere: Biochemistry and Organic Substances at the Soil-Plant Interface. By R. Pinton et al., eds. Marcell Dekker. 2000. ISBN: 0824704274 (suggested)



Academic Honesty:

In Fall 1995, the University of Florida student body enacted a new 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 the students.

Preamble: In adopting this honor code, the students of the university of Florida recognize that academic honesty and integrity are fundamental values of the university community. Student who enroll at the university commit to holding themselves and their peers to the high standard of honor required by the honor code. Any individual who becomes aware of a violation of the honor code is bound by honor to take corrective action…

The Honor Code: *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 of Florida, the following pledge is either required or implied*: On my honor, I have neither given nor received unauthorized aid in doing this assignment.*

Accommodations for Students with Disabilities:
Students requiring classroom or laboratory accommodations must first register with the Dean of Students Office. They will provide documentation to the student who must then provide this documentation to the instructor when requesting accommodation.

UF Counseling Services:
Resources are available on-campus for students having personal problems or lacking clear career and academic goals. These resources include 1.) University Counseling Center, 301 Peabody Hall, 392-1575, personal and career counseling; 2.) SHCC Mental Health, Student Health Care Center, 392-1171, personal counseling; 3.) Center for Sexual Assault/Abuse Recovery and Education (CARE), Student Health Care Center, 392-1161, sexual assault counseling; and 4.) Career Resource Center, Reitz Union, 392-1601, career development assistance and counseling.

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.