



HOS 6932: ROOT AND RHIZOSPHERE ECOLOGY

3 CREDITS

Instructor: Dr. Lorenzo Rossi

Webpage: <https://ufl.instructure.com/courses/357898>

Contact Information:

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- Usually replies to voicemails and emails in 24 hours
- Office hours: online conferencing via Canvas/Zoom every Friday 11am-12pm (or by request)

Lectures: 100% Online course. Each week, there is a block of content available with specific due dates.

Course Description: The aim of this course is to provide a complete view of the rhizosphere and its unique functioning that implies numerous strong and complex interactions among plant roots, soil constituents, and microorganisms. Furthermore, the course not only aims to address current knowledge and achievements but also outlines the future challenges that confront rhizosphere studies. Topics incorporate how roots and the rhizosphere respond to different environments, including multiple interactions among soils, plant roots, microbes, mycorrhizae, and fauna, soil heterogeneity, biogeochemical cycles, abiotic stresses, and emerging contaminants.

Course prerequisites: BOT 2010 or BSC 2010

Knowledge prerequisites: This is an advanced course that examines the interactions between the plant root apparatus and the environment. To be successful in this course, students should have a general knowledge of biology, botany, microbiology, and soil chemistry.

Course objectives:

- To critically appraise the current literature on root and rhizosphere biology and ecology and to present and discuss recent plant root science articles in a form of a **journal club**.
- To develop an understanding of unique biochemical processes in roots and the rhizosphere.
- To discuss modern research techniques for field and lab studies on plant roots.
- To promote integration of different disciplines, such as plant physiology, biochemistry, natural product chemistry, molecular biology, genomics and, chemical ecology, to study root and rhizosphere processes.
- To raise awareness about environmental concerns which affect roots (*e.g.*, interaction between plant roots and heavy metals, engineered nanoparticles, emerging pathogens, etc.).

LEARNING OBJECTIVES

After successful completion of this course, students will be able to:

- Identify the role of plant roots in the global context of soil development and atmosphere composition.
- Classify and recognize root-derived products.
- Compare different root system architectures.
- Describe root responses to biotic and abiotic stresses.
- Explain key root-rhizosphere interactions, from beneficial microorganisms to detrimental nematodes.
- Recommend modern research techniques for field and lab studies on plant roots.
- Locate, appraise, and assimilate evidence from scientific studies related to plant root science

COURSE MATERIALS

Recommended textbooks

- Eshel A, and Beeckman T. (2013): **Plant Roots: The Hidden Half**, Fourth Edition. CRC Press. ISBN 978-14-398-4648-3.
- Dessaux Y, Hinsinger P, and Lemanceau P. (2010): **Rhizosphere: Achievements and Challenges**. Springer. ISBN 978-94-007-3092-2
- Cardon Z, and Whitbeck J. (2007): **The Rhizosphere: An Ecological Perspective**. Academic Press (Elsevier). eBook ISBN: 978-00-804-9304-6, Hardcover ISBN: 978-01-208-8775-0
- Pinton R, Varanini Z, and Nannipieri P. (2007): **The Rhizosphere: Biochemistry and Organic Substances at the Soil-Plant Interface**, Second Edition. CRC Press. ISBN 978-08-493-3855-7

Required readings

- Jacob P. Rutten; Kirsten ten Tusscher. 2019. **In Silico Roots: Room for Growth**. *Trends in Plant Science*. Volume 24, issue 3, p250-262.
- Sheikh M. F. Rabbi; Matthew K. Tighe; Richard J. Flavel; Brent N. Kaiser; Chris N. Guppy; Xiaoxian Zhang; Iain M. Young. 2018. **Plant roots redesign the rhizosphere to alter the three-dimensional physical architecture and water dynamics**. *New Phytologist*. Volume 219, Issue 2, p542-550.
- Xiangpei Kong; Guangchao Liu; Jiajia Liu; Zhaojun Ding. 2018. **The Root Transition Zone: A Hot Spot for Signal Crosstalk**. *Trends in Plant Science*. Volume 23, Issue 5, p403-409.
- Rahul Bhosale, Jitender Giri, Bipin K. Pandey, Ricardo F. H. Giehl, Anja Hartmann, Richard Traini, Jekaterina Truskina, Nicola Leftley, Meredith Hanlon, Kamal Swarup, Afaf Rashed, Ute Voß, Jose Alonso, Anna Stepanova, Jeonga Yun, Karin Ljung, Kathleen M. Brown, Jonathan P. Lynch, Liam Dolan, Teva Vernoux, Anthony Bishopp, Darren Wells, Nicolaus von Wirén, Malcolm J. Bennett & Ranjan Swarup. 2018. **A mechanistic framework for auxin dependent Arabidopsis root hair elongation to low external phosphate**. *Nature communications*. Volume 9, Article number: 1409

EVALUATION OF LEARNING

Assignment		% of grade	Points
1)	15 Weekly Quizzes/Discussions	70	1500
2)	First Exam	10	250
3)	Mid-Term Exam	10	250
4)	Final Exam	10	250
	Total	100	2250

Quizzes

At the end of each module, a specific quiz will assess the student's learning. Ten questions related to the module will be available. Students will have 2 attempts to answer the questions properly. Up to 5 points will be rewarded for a correct response to each question, for a total of 50 points per quiz.

Discussions

At the end of each week, a discussion board with a specific prompt will be ready for the students. Students will not be able to read posts made by other students until after they have already completed and submitted their own post. Each submitted post should consist of 500 words or less and must address all parts of the prompt. Each student will also be expected to post a reply to at least two other students' posts to receive full credit. Please note that points will not be assigned separately for discussion comments and discussion posts. Students will either receive all potential points for making an original post and posting two comments, or they will receive nothing for skipping either part of the assignment. Poor quality submissions will receive partial credit.

The grading procedures of the discussion will follow this rubric.

Criteria	Ratings			Pts
Original Response to Prompt	25.0 to >10.0 pts Response addresses all parts of the prompt in a convincing and clear manner, and consists of 500 words or less	10.0 to >0.0 pts Response only addresses some parts of the prompt and/or is significantly more than 500 words	0.0 pts Response not submitted; or all expectations of discussion thread not met	25.0 pts
Reply to Peers	25.0 pts Student responds to at least 2 peers with substantive comments that further the conversation	0.0 pts Student does not respond to at least 2 peers with substantive comments that further the conversation; or all expectations of discussion thread not met		25.0 pts
Total Points: 50.0				

Exams

- 1) First Exam
- 2) Mid-Term Exam
- 3) Final Exam

Content covered

- Modules 1-5
 Modules 6-10
 Modules 11-15

All three exams will have 5 questions. Fifty points will be available for each question, for a total of 250 points. Students will have 7 days to start the exam and, once they started, they will have 24 hrs to complete it.

Assignment breakdown	Points x Number of assignments = Total Points
15 Quizzes	50 x 15 = 750
15 Discussions	50 x 15 = 750
3 Exams	250 x 3 = 750
Total	2250

Critical dates

First Exam	9/27/2019	(Modules 1-5)
Mid Term Exam	11/4/2019	(Modules 6-10)
Final Exam	12/11/2019	(Modules 11-15)

GRADING SCALE

A	=	94 - 100 %	C	=	< 77 - 74 %
A-	=	< 94 - 90 %	C-	=	< 74 - 70 %
B+	=	< 90 - 87 %	D+	=	< 70 - 67 %
B	=	< 87 - 84 %	D	=	< 67 - 64 %
B-	=	< 84 - 80 %	D-	=	< 64 - 61 %
C+	=	< 80 - 77 %	E	=	< 61 %

Passing Grade Points

A	4.0
A-	3.67
B+	3.33
B	3.0
B-	2.67
C+	2.33
C	2.0
C-	1.67
D+	1.33
D	1.0
D-	0.67
S	0

Additional information on current UF grading policies for assigning grade points can be found here:

- *Grading policy*, www.catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx

Course organization

The module material of a given week will be made available the Friday of the week before. Quizzes and discussion posts must be submitted by midnight of the Friday of a given module's week.

Module 0: Introduction to the course

Module 1: Definition of the rhizosphere and origin of roots

Module 2: Root structure, functions, and modifications

Module 3: Regulation of root growth

Module 4: Classification and function of root-derived products

Module 5: Root exudates and mineral nutrition

Module 6: Root system architecture and nutrient acquisition

Module 7: Legume-Rhizobia symbiosis

Module 8: Mycorrhizal fungi and nutrient acquisition

Module 9: Rhizobacteria that promote plant growth

Module 10: Drought and salt stress

Module 11: Heat and flooding stress

Module 12: Stress from trace metals and emerging contaminants

Module 13: Stresses caused by pathogens

Module 14: Modern research techniques for field experiments

Module 15: Modern research techniques for laboratory experiments

Course schedule

8/20/2019	Week 1 – Module 1– Definition of the rhizosphere/1
8/22/2019	Week 1 – Module 1 – Definition of the rhizosphere/2
8/23/2019	Week 1 – Module 1 – Quiz #1, Discussion #1
8/26/2019	Week 2 – Module 2 – Root structure and development/1
8/28/2019	Week 2 – Module 2 – Root structure and development/2
8/30/2019	Week 2 – Module 2 – Quiz #2, Discussion #2
9/2/2019	Labor Day
9/3/2019	Week 3 – Module 3 – Regulation of root growth/1
9/5/2019	Week 3 – Module 3 – Regulation of root growth/2
9/6/2019	Week 3 – Module 3 – Quiz #3, Discussion #3
9/9/2019	Week 4 – Module 4 – Classification and function of root-derived products/1
9/11/2019	Week 4 – Module 4 – Classification and function of root-derived products/2
9/13/2019	Week 4 – Module 4 – Quiz #4, Discussion #4
9/16/2019	Week 5 – Module 5 – Root exudates and mineral nutrition/1
9/18/2019	Week 5 – Module 5 – Root exudates and mineral nutrition/2
9/20/2019	Week 5 – Module 5 – Quiz #5, Discussion #5
9/23/2019	Week 6 – Module 6 – Root system architecture and nutrient acquisition/1
9/25/2019	Week 6 – Module 6 – Root system architecture and nutrient acquisition/2
9/27/2019	Week 6 – Module 6 – Quiz #6, Discussion #6
9/27/2019	First Exam (Modules 1-5)
9/30/2019	Week 7 – Module 7 – Legume-Rhizobia symbiosis/1
10/2/2019	Week 7 – Module 7 – Legume-Rhizobia symbiosis/2
10/3/2019	Week 7 – Module 7 – Quiz #7, Discussion #7
10/4/2019	Homecoming – 🐾 Go Gators! 🐾
10/7/2019	Week 8 – Module 8 – Mycorrhizal fungi and nutrient acquisition/1
10/9/2019	Week 8 – Module 8 – Mycorrhizal fungi and nutrient acquisition/2
10/11/2019	Week 8 – Module 8 – Quiz #8, Discussion #8
10/14/2019	Week 9 – Module 9 – Rhizobacteria that promote plant growth /1
10/16/2019	Week 9 – Module 9 – Rhizobacteria that promote plant growth /2

10/18/2019	Week 9 – Module 9 – Quiz #9, Discussion #9
10/21/2019	Week 10 – Module 10 – Drought and salt stress/1
10/23/2019	Week 10 – Module 10 – Drought and salt stress/2
10/25/2019	Week 10 – Module 10 – Quiz #10, Discussion #10
10/28/2019	Week 11 – Module 11 – Heat and flooding stress/1
10/30/2019	Week 11 – Module 11 – Heat and flooding stress/2
11/1/2019	Week 11 – Module 11 – Quiz #11, Discussion #11
11/4/2019	Mid-Term Exam (Modules 6-10)
11/4/2019	Week 12 – Module 12 – Stresses from metals and emerging contaminants/1
11/6/2019	Week 12 – Module 12 – Stresses from metals and emerging contaminants/2
11/8/2019	Week 12 – Module 12 – Quiz #12, Discussion #12
11/11/2019	Veterans Day
11/12/2019	Week 13 – Module 13 – Stresses caused by pathogens/1
11/14/2019	Week 13 – Module 13 – Stresses caused by pathogens/2
11/15/2019	Week 13 – Module 13 – Quiz #13, Online discussion #13
11/18/2019	Week 14 – Module 14 – Modern research techniques for field experiments/1
11/20/2019	Week 14 – Module 14 – Modern research techniques for field experiments/2
11/22/2019	Week 14 – Module 14 – Quiz #14, Discussion #14
11/25/2019	Week 15 – Module 15 – Modern research techniques for laboratory experiments/1
11/27/2019	Holiday break
11/29/2019	Happy Thanksgiving!
12/2/2019	Week 15 – Module 15 – Modern research techniques for laboratory experiments/2
12/4/2019	Week 15 – Module 15 – Quiz #15, Discussion #15
12/11/2019	Final Exam (Modules 11-15)

COURSE POLICIES

Attendance and Make-up Policy

Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies that can be found at:

- *UF Attendance policy*, <https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>

Academic Honesty

As a student at the University of Florida, you have committed yourself to uphold the Honor Code, which includes the following 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.” You are expected to exhibit behavior consistent with this commitment to the UF academic community, and on all work submitted for credit 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."

It is assumed that you will complete all work independently in each course unless the instructor provides explicit permission for you to collaborate on course tasks (e.g. assignments, papers, quizzes, exams). Furthermore, as part of your obligation to uphold the Honor Code, you should report any condition that facilitates academic misconduct to appropriate personnel. It is your individual responsibility to know and comply with all university policies and procedures regarding academic integrity and the Student Honor Code. Violations of the Honor Code at the University of Florida will not be tolerated. Violations will be reported to the Dean of Students Office for consideration of disciplinary action.

- For more information regarding the Student Honor Code, please see:
<http://www.dso.ufl.edu/scct/process/student-conduct-honor-code>

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 when appropriate.

Services for Students with Disabilities

Students with disabilities requesting accommodations should first register with the Disability Resource Center by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

- *Disability Resource Center*, 0001 Reid Hall, (352) 392-8565, www.dso.ufl.edu/drc/

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.

- *Counseling and Wellness Center*, 3190 Radio Road, 392-1575, www.counseling.ufl.edu
 - Counseling Services
 - Groups and Workshops
 - Outreach and Consultation
 - Self-Help Library
 - Wellness Coaching
- *U Matter We Care*, www.umatter.ufl.edu
- *Sexual Assault Recovery Services (SARS)*, Student Health Care Center, 392-1161.
- *University Police Department*, 392-1111 (or 9-1-1 for emergencies), www.police.ufl.edu

Additionally, if you would like orientation on choosing a major, finding an internship, or planning your career, I encourage you to use the university's on-campus resources.

- *Career Connections Center*, CR-100 Reitz Union, 392-1601, <https://career.ufl.edu/>

Course Evaluation Process

Student assessment of instruction is an important part of the effort to improve teaching and learning. At the end of the semester, you are expected to provide feedback on the quality of instruction in this course using a standard set of university and college criteria. Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Evaluations are typically open during the last two or three weeks of the semester. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>.

Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>

Student Complaints

You can file and resolve any complaints about your experience in this course in the following site:

- *Student complaints in residential courses*, <https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>
- *Student complaints in online courses*, <http://distance.ufl.edu/student-complaint-process/>