HOS 6355

ROOT AND RHIZOSPHERE ECOLOGY

3 CREDITS

Contact Information

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Guest Lecturers: **Dr. Diane Rowland**

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UF/IFAS Agronomy Department

Mr. Clemen De Oliveira

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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.

Contacting the Instructor and the Teaching Assistant:

Questions about class materials or content: Please use the discussion boards in Canvas for all questions about class mechanics or content. If you have a question about the class or subject material, others probably share the same question, and posting it to the discussion boards allows everyone to see the question and answer, just as if you had raised your hand in class and asked the question. If you use email to ask a general class related question, you will be asked to post your question on the appropriate board, and it will be answered there. Please do not use the discussion boards for questions about specific quiz questions on a quiz that is still open, as others may not have taken the quiz yet and would have an unfair advantage by seeing the questions ahead of time.

Individual questions, problems, or appointments: Please use the email function in Canvas to communicate with the instructor and TAs during the semester, rather than regular university email, except in extreme emergencies. Email and phone messages delivered on weekdays (M-F) will generally receive a reply within one business day. Messages may not be checked between 5:00 pm Friday and 8:00 am Monday; messages received over the weekend will generally receive a response on Monday. If I and/or the TAs plan to be out of the office or otherwise unavailable, I will post an announcement on the class website.

Questions about Grading: This is a large class, and we work as a team to manage the various components. The course TAs do the grading on the discussion assignments. The TAs are graduate students and apprentice instructors. If you have a question or concern about your discussion post grades, please contact the TA first. If you have an issue that cannot be resolved with your TA, your course instructor will be happy to work with you both to reach a satisfactory understanding. For questions about exam grades, please contact your main instructor. For questions about course concepts, including quiz questions, both the instructors and the TAs are ready to help!

Technical support: If you experience difficulties with accessing components of the site, including lectures, quizzes or tests, contact the UF help desk immediately. If they are not able to resolve your problem, contact the instructor with your help desk ticket number and a description of the problem and steps taken to resolve it. Extensions for due dates will be granted for documented technical problems, as needed.

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 between plant roots, soil constituents and microorganisms. Furthermore, the course focuses on current discoveries and achievements in plant root science and presents and discusses the future challenges that root and rhizosphere research is facing. Topics cover root structure and architecture, function, regulation; and root and rhizosphere response to varying environmental conditions, including interactions among microbes, mycorrhizae, micro fauna, fungi, soil heterogeneity, biogeochemical cycles, biotic and abiotic stresses, and emerging contaminants.

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

LEARNING OBJECTIVES

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

- Recognize key anatomical and morphological features of plant roots.
- Describe main physiological and biochemical responses in the root system.

- 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 recent 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*. Volume219, Issue2, 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, et a. 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 Quizzes due every week	35	1050
2)	15 Discussions due every week	35	1050
3)	First Exam	10	300
4)	Mid-Term Exam	10	300
5)	Final Exam	10	300
	Total	100	3000

Quizzes

At the end of each module, a specific quiz will assess the student's learning. Ten questions related to each module will be available. Students will have 2 possible attempts. 7 points will be available for each question, for a total of 70 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 in order to receive credit. Poor quality submissions will receive partial credit. The grading procedures of the discussion will follow this rubric:

Criteria	Ratings			Points
Original Response to Prompt	35.0 to >10.0 points Responses addresses all parts of the prompt in a convincing and clear manner, and consist of 500 words or less	20.0 to >0.0 points Response only address some parts of the prompt and/or is significantly more than 500 words	0.0 points Response not submitted; or all expectations of discussion thread not met	**35.0 points**
Reply to Peers	35.0 points Student responds to at least 2 peers with substantive comments that further the conversation	0.0 points Student does not respond to at least 2 peers with substantive comments that further the conversation; or all expectations of discussion thread not met		**35.0 points**
				Total Points: 70.0

Exams

There will be 3 exams in this course. All three exams will have 5 questions. 60 points will be available for each question, for a total of 300 points. Students will have 7 days to start the exam, and once started, they will have 24 hours to complete it.

Exams	**Content covered**
1) First Exam	Modules 1-5
2) Mid-Term Exam	Modules 6-10
3) Final Exam	Modules 11-15

Assignment breakdown	**Points x Number of assignments = Total Points**
15 Quizzes	70 × 15 = 1050
15 Discussions	70 × 15 = 1050
3 Exams	300 × 3 = 900
Total	3000

Critical dates

First Exam	10/5/2020	(Modules 1-5)
Mid Term Exam	11/6/2020	(Modules 6-10)
Final Exam	12/12/2020	(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 Saturday of the week before. Assignments will be due on the Friday of a given module 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: Plant growth promoting rhizobacteria
Module 10: Drought and salt stress
Module 11: Heat and flooding stress
Module 12: Trace metals and emerging contaminants stress
Module 13: Stresses caused by pathogens
Module 14: Modern research techniques for field experiments
Module 15: Modern research techniques for laboratory experiments

Course schedule

8/31/2020	Module 1 – Definition of the Rhizosphere/1
9/2/2020	Module 1 – Quiz #1, Discussion #1
9/4/2020	Module 2 – Root structure and development
9/7/2020	**Labor Day**
9/9/2020	Module 2 – Quiz #2, Discussion #2
9/11/2020	Module 3 – Regulation of root growth/1
9/14/2020	Module 3 – Regulation of root growth/2
9/16/2020	Module 3 – Quiz #3, Discussion #3
9/18/2020	Module 4 – Classification and function of root derived products/1
9/21/2020	Module 4 – Classification and function of root derived products/2
9/23/2020	Module 4 – Quiz #4, Discussion #4
9/25/2020	Module 5 – Root exudates and mineral nutrition
9/28/2020	Module 5 – Quiz #5, Discussion #5
9/30/2020	Module 6 – Root system architecture and nutrient acquisition
10/2/2020	Module 6 – Root system architecture and nutrient acquisition/2
10/5/2020	**First Exam (Modules 1-5)**
10/7/2020	Module 6 – Quiz #6, Discussion #6
10/9/2020	Module 7 – Legume-Rhizobia symbiosis/1
10/12/2020	Module 7 – Legume-Rhizobia symbiosis/2
10/14/2020	Module 7 – Quiz #7, Discussion #7
10/16/2020	Module 8 – Mycorrhizal fungi and nutrient acquisition/1
10/19/2020	Module 8 – Mycorrhizal fungi and nutrient acquisition/2
10/21/2020	Module 8 – Quiz #8, Discussion #8
10/23/2020	Module 9 – Plant growth promoting rhizobacteria/1
10/26/2020	Module 9 – Plant growth promoting rhizobacteria/2
10/28/2020	Module 9 – Quiz #9, Discussion #9
10/30/2020	Module 10 – Drought and salt stress/1
11/2/2020	Module 10 – Drought and salt stress/2
11/4/2020	Module 10 – Quiz #10, Discussion #10

11/6/2020	**Mid-Term Exam (Modules 6-10)**
11/9/2020	Module 11 – Heath and flooding stress
11/11/2020	**Veterans Day**
11/13/2020	Module 11 – Quiz #11, Discussion #11
11/16/2020	Module 12 – Metals and emerging contaminants stresses
11/18/2020	Module 12 – Quiz #12, Discussion #12
11/20/2020	Module 13 – Stresses caused by pathogens
11/23/2020	Module 13 – Quiz #13, Online discussion #13
11/25/2020	**Thanksgiving break**
11/27/2020	**Happy Thanksgiving!**
11/30/2020	Module 14 – Modern research techniques for field experiments
12/2/2020	Module 14 – Quiz #14, Discussion #14
12/4/2020	Module 15 – Modern research techniques for laboratory experiments
12/7/2020	Module 15 – Modern research techniques for laboratory experiments
12/9/2020	Module 15 – Quiz #15, Discussion #15
12/15/2020	**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/sccr/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. These evaluations are conducted online at:

- *Course evaluations*, www.evaluations.ufl.edu

Evaluations are typically open during the last two or three weeks of the semester. You will be notified of the specific times when evaluations for this course are open. Summary results of these assessments are available to students at:

- *Evaluations summary,* www.evaluations.ufl.edu/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/