

Plant Science 8530

Research with Plant Stress Agents

Syllabus

Course Summary: (3 credits) Students will learn key research strategies for abiotic and biotic stress agents of plants. Students will complete a focused hands-on project. (Pre-requisite: PLNT_S 4500/7500, PLNT_S 7315 or PLNT_S 7320, BIO/PLNT_S 8505, or approval of instructors).

Course Mechanics: During the beginning of the semester students will attend two (75 min) lectures per week which will highlight key aspects of research with diverse abiotic and biotic plant stress agents. During the remainder of the semester, students will complete a laboratory project, as approved by participating faculty.

Course Times: Lectures are on Tuesday and Thursday from 11:00-12:15pm in Mumford Hall 40. Students will work with participating faculty to arrange necessary meeting times and locations for project completion.

Course Coordinator:

Dr. Melissa Mitchum, **Nematodes**
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Participating Faculty: <http://plantsci.missouri.edu/faculty/>

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Dr. Robert Sharp, Drought Office: 3-5 Agriculture Bldg E-mail: SharpR@missouri.edu Phone: 882-1841		

Grades: The course grade will be a composite reflecting exam performance, overall project effort, project outline and write-up, and oral presentation.

Exam	100pts
Independent Project:	
Project outline	25pts
Final written paper	100pts
Oral presentation	<u>100pts</u>
Total	325pts

Grading will be on a +/- scale: $\geq 96\%$ A+; 92-95% A; 90-91 A-; 87-89% B+; 82-86 B; 80-81 B-; 77-79% C+; 72-76 C; 70-71% C-. *No D grade may be awarded to a graduate student, and a grade of F means the work has not satisfied the minimum requirements of the course.*

Semester Schedule:

Week	Dates	Instructor(s)	Topic
1	August 21	Melissa Mitchum	Course Introduction
1	August 23 & 28	Ivan Baxter & David Mendoza Cozatl	Abiotic Stress - Nutrient
2	August 30 & Sept 4	Robert Sharp	Abiotic Stress - Drought
2-3	September 6	Mel Oliver	Abiotic Stress - Desiccation
3-4	September 11 & 13	Melissa Mitchum	Biotic Stress - Nematodes
4-5	September 18 & 20	Jim Schoelz	Biotic Stress – Viruses
4	September 18	TBA	Student-Faculty Project Meetings Completed
5-6	September 25 & 27	Debbie Finke & Heidi Appel	Biotic Stress - Insects
6	September 27	TBA	Project Outlines Due to Faculty Mentors, Projects Initiated
6-7	October 2 & 4	Felix Fritschi	Abiotic Stress - Heat
7	October 9 & 11	Jeanne Mihail & Jim English	Biotic Stress – Oomycota & Fungi
8	October 16	All	Take home exam
8-9	October 23 & 25	Mitchum	Scientific Writing
6-15	Self-selected projects	TBA	TBA
Final		All	Papers Due, Oral Presentations

Reference Textbooks:

George N. Agrios. Plant Pathology, fifth edition. 2005. Published by Elsevier Academic Press.

Lincoln Taiz and Eduardo Zeiger. Plant Physiology, fifth edition. 2010. Published by Sinauer Associates Inc.

Margaret Cargill and Patrick O'Connor. Writing Scientific Research Articles: Strategy and Steps. 2009. Published by Wiley-Blackwell.

*All students will receive a copy of this book.

Readings: A reading list will be posted on blackboard that provides suggestions for foundation reading, as well as optional and/or required readings for each lecture.

Course Website: The course website can be accessed at <<https://courses.missouri.edu>>
click on blackboard
pawprint is your email user name (for example, mitchumm)
password is your email password

You can check the website for lecture presentations, course announcements and required readings.

Individual Projects: Each student must develop and complete an 8-week independent project focusing on a single stress agent or simultaneously on two stress agents. Students are strongly encouraged to develop hypothesis-driven projects integrating at least two stress agents. The topic for the project must be approved by participating faculty by the 4th week of the semester (Sept 13th). Project outlines are due to faculty instructors on September 27th and student projects should be initiated immediately following feedback. An extension of the graduate research topic may be acceptable for the class project. Projects may be selected from suggested topics below. You may propose an alternative project of particular interest as well. Students are expected to work on average a minimum of 6 hours/week on their projects beginning no later than week 6. Projects will be written up in scientific paper format according to The Plant Journal guidelines for full-length research articles (<http://www.wiley.com/bw/submit.asp?ref=0960-7412>). Students should provide a draft electronic copy of their paper to their faculty mentors no later than December 5th. Final papers are due on December 13th. Each student will also present an oral presentation to all faculty and students in the class on December 13th.

Potential Projects:

Projects with fungi & Oomycota (English & Mihail):

- Basic manipulations of fungal/oomycete cultures with approval of instructors

Projects with nematodes (Mitchum):

- Examine the effects of genetic resistance on nematode infection; evaluate the impact of abiotic stress on performance of nematode-resistant germplasm
- Evaluate nematode success on mutant/transgenic plants (test your favorite mutant; integrated projects might include mutants in genes known to play a role in drought or heat tolerance, nutrient acquisition, etc or transgenic plants with enhanced stress tolerance)
- Assess the virulence phenotypes of soybean cyst nematode field populations; evaluate the ability of different populations to withstand abiotic stress exposure
- Test for impacts of drought, nutrient, or heat stress on nematode parasitism

- Examine host preferences of cyst and/or root-knot nematodes
- Test commercial nematode biocontrol agents in greenhouse trials
- Examine the effects of nematode parasitism of roots on aboveground insect pests

Projects with viruses (Schoelz):

- Use a tobacco rattle virus vector to silence plant defense genes. Challenge the silenced plants with a second plant virus and evaluate for resistance and susceptibility
- Inoculation of plant viruses to plants, either as virions or infectious clones, as well as techniques for detection
- Expression of foreign genes in virus vectors

Projects with insects (Appel & Finke):

- Evaluate the impact of abiotic stress (nutrient, drought, heat) on the performance of insect herbivores or the impact of herbivores on plant response to an abiotic stress
- Assess whether the presence of a plant pathogen affects insect herbivore performance and/or behavior or whether herbivore feeding influences the effect of a plant pathogen
- Examine the effects of insect feeding on nematode parasitism of roots or the impact of nematodes on plant response to insects
- Test the ability of biological agents to control herbivores on fertilized and unfertilized host plants

Projects with drought stress (Sharp & Oliver): [Projects will emphasize techniques for imposition of accurate and quantifiable water deficits.]

- Responses of root and shoot growth and metabolism to water deficits in mutants of maize or other grasses (to be decided)
- Impact of specific metabolic inhibitors (to be decided) on root and shoot growth and metabolism in maize or other grasses under water deficits
- Interaction of water deficits and heat stress on root growth in maize or other grasses

Projects with desiccation tolerance (Oliver):

- Assess the desiccation tolerance levels of transgenic *Physcomitrella patens* lines

Projects with heat and/or nutrient stress (Fritschi):

- Influence of high night temperature on soybean seedlings
- Seed germination responses to temperature
- Chlorophyll fluorescence as a tool to screen for heat tolerance
- Thermal imaging of plant canopies
- Photosynthesis and growth responses to manganese availability
- Ammonium in soybean

Projects with nutrient stress (Mendoza-Cozatl):

- Effect of non-essential metals on seed germination (soybean and Arabidopsis).
- Natural variation of non-essential metal accumulation between Arabidopsis ecotypes.
- Variation in micronutrient content of leaves depending on soil mixtures.

Examples of Past Student Projects (2009-2011):

2009

Dante Smith (integrated stress agent project)

Faculty mentors: Drs. Jeanne Mihail, Jim English, and Robert Sharp

The effects of low water potentials on fungal growth and development in maize seedlings

Greg Yeckel (integrated stress agent project)

Faculty mentors: Dr. Melissa Mitchum and Dale Blevins

Interactions between select nutrient deficiencies and the development of the cyst nematode

Heterodera schachtii

Nathan Gross (integrated stress agent project)

Faculty mentors: Dr. Melissa Mitchum

Virus-induced gene silencing as a tool for selecting genes in soybean important for resistance to the soybean cyst nematode *Heterodera glycines*

Jackie Harris (single stress agent project)

Faculty mentor: Dr. Melissa Mitchum

Sampling and identifying plant-parasitic nematodes in central Missouri soils

Jackie Harris (single stress agent project)

Faculty mentor: Dr. Dale Blevins

Initial squash seedling response to imposed nutrient stress

Geon-Hui Son (single stress agent project)

Faculty mentor: Dr. Jeanne Mihail

Collection and identification of anamorphic fungi from *Arabidopsis* and soybean and virulence test of *Alternaria brassicicola*

Geon-Hui Son (single stress agent project)

Faculty mentor: Dr. Jim Schoelz

Comparison of silencing suppressors, P19 and HC-Pro, in GFP expression

2010

Sarah Zukoff (integrated stress agent project)

Faculty mentors: Drs. Robert Sharp and Mel Oliver

The effects of drought, western corn rootworm, and transgenic traits on the development of maize and its most important insect pest

Md. Sariful Islam (integrated stress agent project)

Faculty mentors: Drs. Jeanne Mihail and Jim English

The influence of different growing conditions and media on production of macroconidia of *Fusarium graminearum*

Andres Rodriguez (integrated stress agent project)

Faculty mentors: Drs. Melissa Mitchum and Dale Blevins

Influence of potassium deficiency and nutritional outcome on the development of the plant-parasitic cyst nematodes *Heterodera glycines* and *H. schachtii* in soybean and Arabidopsis

Nam Ji Chul (single stress agent project)

Faculty mentor: Dr. Jim Schoelz

Virus-induced gene silencing of defense genes in *Nicotiana edwardsonii*

Thang Cao La (integrated stress agent project)

Faculty mentors: Drs. Heidi Appel and Felix Fritschi

Effects of drought stress on the performance of beet armyworm feeding on soybean

Ellie Nguyen (integrated stress agent project)

Faculty mentors: Drs. Melissa Mitchum and Heidi Appel

The role of Arabidopsis *SRFR1* (*suppressor of rps4*-RLD) in defense against nematodes and insects

2011

Derek Cottrill (integrated stress agent project)

Faculty Mentors: Drs. Jim English and Jeanne Mihail

Evaluating the impact of nitrogen form on the mycelial growth of four fungal pathogens

Michael Gardner (single stress agent project)

Faculty Mentor: Dr. Jim Schoelz

Involvement of C2CDMT in the infection of cauliflower mosaic virus (CaMV)

Ryan Geisert (integrated stress agent project)

Faculty Mentors: Drs. Heidi Appel, Debbie Finke, and Felix Fritschi

Effects of heat stress on the feeding and survival of the western corn rootworm *Diabrotica virgifera virgifera* on corn plants

Aurelian L. Sennett (integrated stress agent project)

Faculty Mentors: Drs. Mel Oliver and Felix Fritschi

The ability of the desiccation tolerant angiosperm, *Craterostigma plantagineum*, to survive rehydration from desiccation during heat stress

John Smith (integrated stress agent project)

Faculty Mentor: Dr. Melissa Mitchum

Evaluating the effects of temperature and vasculature puncture on the efficiency of a virus induced gene silencing pipeline for identifying genes required for nematode resistance in soybean

Enzhan Son (integrated stress agent project)

Faculty Mentor: Dr. Felix Fritschi

Investigation of the relationship between low temperature tolerance and AOPP herbicide tolerance of seven bermudagrass (*Cynodon* spp.) cultivars

Policy on Cell Phones:

As a courtesy to fellow students and the instructor, all cell phones must be switched off during lecture and lab periods. Exception: if you are a primary care giver for a minor or ill relative, you may have your cell phone on to receive emergency calls. In this case, if your phone rings, you must leave the room without disturbing others and conduct your personal business outside the classroom.

University of Missouri Policy on Academic Dishonesty:

Academic honesty is fundamental to the activities and principles of a university. All members of the academic community must be confident that each person's work has been responsibly and honorably required, developed, and presented. Any effort to gain an advantage not given to all students is dishonest whether or not the effort is successful. The academic community regards academic dishonesty as an extremely serious matter, with serious consequences that range from probation to expulsion. When in doubt about plagiarism, paraphrasing, quoting, or collaboration, consult the course instructor.

The University has specific academic dishonesty administrative procedures. Although policy states that cases of academic dishonesty must be reported to the Office of the Provost for possible action, the instructor may assign a failing grade for the assignment or a failing grade for the course, or may adjust the grade as deemed appropriate. The instructor also may require the student to repeat the assignment or to perform additional assignments.

Assisting Students with Special Needs:

If you need accommodations because of a disability, if you have emergency medical information, or if you need special arrangements in case the building must be evacuated, please inform an instructor immediately.

To request academic accommodations (for example, a notetaker or extended time on exams), students must also register with the [Office of Disability Services](http://disabilityservices.missouri.edu), (<http://disabilityservices.missouri.edu>), S5 Memorial Union, 882-4696. It is the campus office responsible for reviewing documentation provided by students requesting academic accommodations, and for accommodations planning in cooperation with students and instructors,

as needed and consistent with course requirements. For other MU resources for students with disabilities, click on "Disability Resources" on the MU homepage.