CPSC 466 – Genomics for Plant Improvement
University of Illinois at Urbana-Champaign

SYLLABUS & COURSE SCHEDULE: Fall 2013

Room: 607 IGB
Time: 11:00-11:50 AM MWF

Instructor: Dr. Stephen P. Moose

Office: 389 Edward R. Madigan Laboratory
Phone: 244-6308
e-mail: smoose@.illinois.edu

Office Hours: after class or by appointment

Teaching Assistant: Christine Lucas
Office: 385 Edward R. Madigan Laboratory
Email: cjlucas@illinois.edu

Altering the phenotypes of plant species to generate more abundant and superior sources of food, feed, fiber, fuel, medicine, or industrial products has been a fundamental human activity since the dawn of agriculture. Stability and inheritance of phenotypes are primarily controlled by genomes, hence a greater understanding of genomes and their biological functions increases the efficiency of plant improvement. Just as knowledge of the principles of heredity and evolution powered dramatic gains in agricultural productivity during the 20th century, advances in plant biology and genomic science are driving crop improvement efforts in the 21st century.

Successful application of genomics to plant improvement requires merging knowledge about how genomic information is generated to the practice of plant breeding, disciplines which may emphasize different aspects of the relationships between genotype and phenotype. This course intends to bridge this gap by focusing content on recent research articles that illustrate how current genomic biology impacts the three key elements of the plant improvement process: characterizing and assembling genetic variation, evaluation of phenotypes, and selection of superior genotypes. Students will apply the information learned in "dry laboratory" exercises where they develop their own strategies to use available functional genomics datasets in plant improvement applications.

Course Content. Genomics is a rapidly moving and dynamic field that has blossomed during the computer era. Although a number of recent textbooks are available that cover some course topics, many of the genomic applications to plant improvement continue to evolve. Thus, a collection of recently published articles in scientific journals will be the primary source of course content, which are available through the course website within the Illinois Compass on-line course system (https://compass2g.illinois.edu). **IT IS EXPECTED THAT STUDENTS WILL READ THE COURSE MATERIALS FOR EACH CLASS PERIOD PRIOR TO COMING TO CLASS**. A portion of each class period will be devoted to a discussion of the topics presented in the articles, and all students are encouraged to present questions they have about the topic.

Homework assignments. Six short homework assignments will be turned in for grading on each Monday the class meets, where students apply content covered the previous week to the improvement of a plant/crop trait of their own choosing. Graduate students may choose a topic related to their thesis research if desired. These assignments are intended to build toward the final Review Paper described in the following section. Each assignment is worth 20 points.

Review Paper on Genomics-Driven Plant Improvement. Each student will prepare a paper in the format of a *Trends in Plant Science* review article that summarizes strategies for applying genomics to the improvement of their chosen plant/crop trait. **The paper is due Wednesday, December 18.** The article will be graded on the following elements (20 points each, 80 points total):

1. Definition of the opportunity and impacts for improving the chosen trait
2. Summary of current knowledge and genomics studies about trait biology
3. Critical evaluation of genomics strategies to increase efficiency of trait improvement
4. Clear concise writing style, formatting, and images appropriate for a review article

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Grading:

Homework assignments (6, each worth 20 points)	120 points	60 %
Review Article on Genomics-Driven Plant Improvement	80 points	40 %
Total	**200 points**	

I do not use the plus-minus grading system and intend to use a straight scale of 180 or greater points = A, 160-179 points = B, 140 -159 points = C, 120-139 points = D, <120 points = F.

Late assignments. Turning in homework assignments or the review article late is not acceptable. If you are having difficulty with an assignment or have a well-justified reason for submitting an assignment late, you should contact either the teaching assistant or Dr. Moose before the assignment is due. You should start on assignments as early as feasible, and a portion of the Friday class period will typically be dedicated for the TA and Dr. Moose to provide assistance with the homework assignments due the following Monday.

Academic Integrity. All work in this course is expected to be the student's own. "It is the responsibility of the student to refrain from infractions of academic integrity, from conduct that may lead to suspicion of such infractions, and from conduct that aids others in such infractions" – Code of Policies and Regulations, Section 33. All students are responsible for knowing policies regarding academic integrity. Suspected infractions of academic integrity will be addressed as mandated by the Code.

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Week	Topic
1	**Introduction to the Plant Breeding Process and Genomics**
Mon 10/21	Overview of molecular breeding, the cultivar development process, and genetic gain.
Wed 10/23	Sequence-based gene discovery and comparative genomics approaches
Fri 10/25	Demonstration of "in silico" gene discovery strategies
Mon 10/28	**Assignment 1: Databases for discovery of plant improvement genes**
2	**DNA Sequence Variation and Genetic Diversity**
Mon 10/29	Molecular marker development and genotyping methods
Wed 10/31	Applications of molecular markers to plant improvement
Fri 11/1	Demonstration of identifying sequence variation for molecular markers
Mon 11/4	**Assignment 2: Genetic diversity analysis of plant improvement genes**
3	**Gene Expression Variation**
Mon 11/4	mRNA profiling – overview of methods and applications to plant improvement
Wed 11/6	Molecular phenotyping, regulatory networks, and systems biology approaches
Fri 11/8	Demonstration of RNA profiling data analyses
Mon 11/11	**Assignment 3: RNA expression profiling of plant improvement genes**
4	**Epigenomic Variation**
Mon 11/11	Small RNAs and chromatin remodeling
Wed 11/13	Phenotypic impacts of epigenomic variation
Fri 11/15	**Class meets in W115 Turner Hall!** Analysis of epigenomic datasets.
Mon 11/18	**Assignment 4: Epigenomic variation of plant improvement genes.**
5	**Integrated Molecular Phenotyping**
Mon 11/18	Genetic mapping and quantitative trait loci
Wed 11/20	Marker-assisted selection strategies – targeted intervals and genomic selection
Fri 11/22	Demonstration of integrated molecular phenotyping and genetic mapping
Mon 12/2	**Assignment 5: Genetic mapping of plant improvement genes**
6	**Directed Genetic Variation**
Mon 12/2	Forward and reverse genetics methods
Wed 12/4	Transgenic product development
Fri 12/6	Strategies for Design of Transgenic Products
Mon 12/9	**Assignment 6: Functional analysis of plant improvement genes**
7	**Commercializing Genetic Improvements**
Mon 12/9	Biotechnology regulation and intellectual property issues
Wed 12/11	Future prospects for genomics-driven plant improvement, course evaluations
Wed 12/18	**REVIEW ARTICLE DUE**