Syllabus HCS 7625, Plant Breeding and Biotechnology
Instructors: John Finer and Leah McHale

CLASS MEETINGS:  Monday, Wednesday and Friday, 10:20 - 11:15
Room 244 Kottman Hall (Columbus Campus)
Room 123 Williams Hall (Wooster Campus)

1. INSTRUCTORS:  Dr. Leah McHale
Soybean Genetics and Breeding
Department of Horticulture and Crop Science
OARDC/The Ohio State University
312B Kottman Hall
Columbus, OH 43210
Tel. 614-292-9003 (from Wooster; 8-2-9003)
e-mail: mchale.21@osu.edu
http://hcs.osu.edu/mchalelab/home

Dr. John Finer
Plant Transformation
Department of Horticulture and Crop Science
OARDC/The Ohio State University
1680 Madison Ave.
Wooster, OH 44691
Tel: 330-263-3880 (from Columbus; 5-3880)
e-mail: finer.1@osu.edu
http://www.oardc.ohio-state.edu/plantranslab/

II: PREREQUISITE:  Undergraduate breeding or genetics course, or consent of instructor.

III. TEXTBOOKS:  NONE
(Carmen, selected journal articles, books, see reference list)

IV. METHODS OF EVALUATION:

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Points</th>
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<tr>
<td>Breeding and Genetics Mini-Proposal</td>
<td>100 pts</td>
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<tr>
<td>GMO Position Paper</td>
<td>100 pts</td>
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<tr>
<td>Misc short assignments (x4)</td>
<td>100 pts</td>
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<tr>
<td>Mid-term exam</td>
<td>100 pts</td>
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<tr>
<td>Final exam</td>
<td>100 pts</td>
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<td>Total</td>
<td>500 pts</td>
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Paper Guidelines:
Two papers (one in breeding/genetics and one in transgenics) will be assigned during the class. The breeding/genetics papers will follow a proposal format for genetics and breeding for plant improvement. For the GMO position paper, the student will critically evaluate the potential benefits and detriments from release of a transgenic, which has been deregulated. The topic for each assignment is subject to approval by instructors.
The papers must be your own work. Parameters: 5-8 pages, double-spaced not including title page; either 11-12 pt. character font. The student must cite references, the majority of which are original research papers. Paper format should follow style of a scientific publication. Web-based references, that are not peer-reviewed, should be avoided and will not be accepted.

Short Miscellaneous Assignments: Periodically, special assignments will be given, with specific guidelines and a short turn-around time (25 points each x4). Assignment format should follow style of a scientific publication, with appropriate references and citations. Specific guidelines will be provided for each short assignment.

Make-up assignments and exams: The mid-term examination will cover genetics and breeding and the final examination will cover transgenics. “Make-ups” must be rescheduled before time of the regular exam. Either a pre-approved absence (by instructor) or evidence of illness/emergency (requires document with physician’s signature and exact time of visit) will be required. During exams, students are not to leave the classroom. Please plan accordingly and be prepared to remain in the classroom for the total time required to complete the examination.

Late assignments: Unless otherwise instructed, assignments are due at the beginning of the class time on the due date. For each period missed, 20% of the total points possible will be deducted from the grade.

V. ORGANIZATION OF THE COURSE:

A. Distribution and use of class time: The class will meet for three, 55 minute periods per week (Monday, Wednesday and Friday, 10:20-11:15). The class period will primarily be lecture and discussion-based with time for questions related to the lecture and upcoming course activities. Additional time may be devoted to web-based exercises, in class group discussion, and reading of original scientific literature.

At the beginning of certain class periods, questions pertaining to class organization, upcoming activities, and/or guest lectures will be addressed.

VI. RATIONALE:

This course will serve as a general introduction to the principles of plant breeding and biotechnology. Breeding and biotechnology are central to anyone who works with plants as most cultivated plants have been impacted using breeding and biotechnological approaches. We will examine concepts relevant to students in plant breeding, genetics, biotechnology, crop sciences, and allied fields of plant pathology and entomology. The course content will present a broad range of applicable information pertaining to modification and improvement of a wide range of crops, including both agronomic and horticultural crop species important in temperate and tropical areas.

Specific objectives will include the following:

A. To develop general familiarity with the overall science of plant breeding and biotechnology, especially as it relates to the improvement of agronomic and horticultural crops.
B. To understand how directed selection for crop improvement is affected by plant mating systems, available genetic variation, environmental influences, selection strategies, transgenic approaches and the social context.

C. To gain an appreciation and understanding of the processes involved in natural evolution and directed selection and manipulation by humans.

D. To become familiar with prominent techniques for directed plant improvement.

E. To assist the development of critical thinking, and to improve skills in written and oral analysis of specific topics related to crop breeding.

F. To lay the foundation for the study of more advanced plant breeding, biotechnology and molecular biology methodology and quantitative genetics e.g. molecular–marker assisted determination of quantitative trait locus variation.

VII. CLASS MEETINGS:

Introduction and Overview of Plant Breeding and Biotechnology (Aug 21)
1. Introduction to the class, syllabus and course expectations.
2. Course mechanics, backgrounds, content and change
3. Brief history and justification

Plant Genetics Review (Aug 23, 26, 28)
1. Genetic Structure; Alleles, Genes and DNA
2. Polyploidy
3. Biology of plant reproductive systems
4. The pipeline of plant breeding
5. Discussion of “plant breeding mini-proposal” assignment

Genetic Analysis in Plant Breeding (Aug 30, Sep 4, 6, 9, 11)
1. Introduction to genetic analysis
2. Mendelian inheritance and segregation
3. Quantitative traits and heritability
4. Genetic mapping
5. Examples from OSU research
6. Genetic and Genomic tools and resources

Crop Evolution and Domestication (Sep 13, 16, 18)
1. Centers of origins and domestication syndrome
2. Types of selection and effects on allele frequency
3. Genetic drift and bottlenecks
4. Genetic diversity, conservation & application

Traits of Interest and Breeding Objectives (Sep 20, 23)
1. Breeding Objectives
2. Traits of interest for Field Crops
3. Traits of interest for Fruits and Vegetable Crops
4. Traits of interest for Ornamentals and Turf
5. Feasibility of trait
6. Choice of cultivar type

Methods of Plant Breeding (Sep 25, 27, 30, Oct 2)
1. The cycle of selection
2. Gains from selection
3. Development of inbred cultivars
4. Development of commercial hybrids
5. Genomic selection

Additional topics & review (Oct 4, 7)
1. Products, impacts, and risks of plant breeding.
2. Overview and review of plant breeding material.

Midterm Exam: Oct 9

Plant Molecular Biology Review and Genes of Interest (Oct 11, 14)
1. Gene identification, DNA cloning and plasmid construct design
2. Useful gene overview

Non-regulated Commercial Transgenics (Oct 16, 18)
1. Flavr Savr tomato, History
2. Roundup-Ready soybeans
3. Bt cotton and corn
4. Virus-resistant papaya
5. Other deregulated products

Recently Released and Future Commercial Transgenics (Oct 21, 23)
1. Roundup-Ready bluegrass
2. Herbicide resistant crops
3. Trends and future direction

Gene Transfer Methods (Oct 25, 28)
1. Transgenic Approaches: Agrobacterium
2. Direct DNA uptake

Transformation optimization (Oct 30)
1. Targeting specific tissue or organelles
2. High throughput transformation systems, Agroinfiltration

Regulating transgene expression (Nov 1, 4, 6, 8)
1. Markers
2. Transient versus stable expression
3. Transgene stacking considerations
4. Levels of gene expression (1 period)
5. Gene silencing (1 period)
6. Genome editing (1 period)

Model transformation systems, Arabidopsis and ovule/pollen transformation (Nov 11)
1. Microspore and egg transformation
2. Immature ovule injection
3. Chromosome injection
4. Apex or meristem transformation

The Rush to Publish – non-repeatable reports of gene transfer (Nov 13)
   1. Macroinjection
   2. Whole tissue electroporation, etc

Regulatory considerations for transgenics: laboratory and commercial
   1. University, state and federal regulations for transgenics (Nov 15)
   2. Intellectual property (Nov 18)
   3. Public perception of genetically modified plants (Nov 20)
   4. Horizontal gene transfer and transgene escape (Nov 22)
   5. Registration and commercialization – procedures and costs (Nov 25)

Additional Topics, Transgenics Overview and Review (Dec 2)

Final Exam, Thurs, Dec 5, 10:00-11:45

Reference texts for Plant Breeding and Biotechnology:


Plant Breeding, (2008), Brown and Caligari, Blackwell Publishing


Principles of Cultivar Development (1987), Walter R. Fehr; with the assistance of Elinor L. Fehr and Holly J. Jessen, Macmillan, New York, NY, V.1 and 2

Principles of Plant Genetics and Breeding (2007), George Acquaah, Blackwell Publishing, Malden, MA.

VIII. ADDITIONAL RESOURCES:

   A. Articles in scientific journals. (Please note that graduate students will be required to read and cite at least five original articles published during the
last ten years from at least two of the listed journals as part of the special topic paper.)

BMC Plant Biology
Crop Science
Genetics
Genome
In Vitro Cellular and Developmental Biology – Plant
Journal of Heredity
Journal Am. Soc. Horticultural Science
Journal of Molecular Breeding
Journal of Plant Pathology
Molecular Breeding
Phytopathology
Plant Biotechnology Journal
Plant Breeding
Plant Cell Reports
Plant Disease
Proceedings National Acad. Science
Science
The Plant Genome
Theoretical and Applied Genetics

The journals are available in the University libraries or via the Web:

B. Annual Reviews, and other texts for reference include:
   Annual Review of Genetics
   Advances in Genetics
   Annual Review of Plant Pathology
   Plant Breeding Reviews
   Trends in Plant Science

   Hybridization of Crop Plants
   W. R. Fehr and H. Hadley (Ed.)
   American Soc. Agronomy
   CSSA, Publishers (1980)

   Plant Population Genetics, Breeding, and Genetic Resources

   Principles of Cultivar Development
   Walter R. Fehr; with the assistance of Elinor L. Fehr
   and Holly J. Jessen
   Macmillan, New York (1987) V.1 and 2

   Principles of Plant Breeding
   Robert W. Allard
IX. ACCOMODATIONS FOR STUDENTS WITH DISABILATIES:

In accordance with University policy, students with chronic disabilities are encouraged to inform the instructor at the beginning of the term. The instructor and student will work with the Office of Disability Services (150 Pomerene Hall, 1760 Neil Ave., Columbus, Ohio 43210, http://www.ods.ohio-state.edu/ Tel: 614-292-3307) to provide appropriate accommodations. No special accommodations will be made for students who do not inform the instructor in a timely fashion or who do not involve the Office of Disability Services, except that temporary disabilities will be accommodated as needed.

X. CODE OF CONDUCT:

Students will be trusted to act in good faith for exams, written assignments, etc. If students breach that trust, this will be reported through the appropriate channels to the University Committee on Academic Misconduct (http://oaa.osu.edu/coam.html). You must not copy other students work or previously published work in exams or other assignments. If you use or quote published material in your writing, it must be clearly identified as a quotation and the source must be identified. For additional information, see the Code of Student Conduct (http://studentaffairs.osu.edu/resource_csc.asp).

1) Respect of others (including instructors and guests) is required of everyone in the classroom at all times.

2) Students are expected to adopt the honor system during assignment preparation and exams. This system requires no cheating during exams, and reporting of any observed, suspected violations. Suspected violations will be handled in accordance with university procedures on misbehavior and academic dishonesty as described in the Student Handbook and Faculty Rules.
3) Plagiarism is not allowed. Suspected misconduct will be handled in accordance with established university policy.

A word about Plagiarism:
What is it?
(Verb) – plagiarize: to steal and pass off as one’s own (the ideas or words of another)
What are the consequences?
To be determined by committee review (Committee on Academic Misconduct)….usually 0 points for the assignment.

If questions remain, see: www.lima.osu.edu/academics/writing/PlagiarismPresentation.ppt

Laptop Use Policy
   Laptop and tablet use during class is permitted for note taking purposes. Use of a laptop computer or tablet during class that results in a distraction to your classmates is not permitted. Laptop or tablet use for e-mailing and surfing is not permitted. Inappropriate use of electronic devices will result in removal of the student from the classroom.

Cell Phone Policy
   As a courtesy to your classmates, if you use a cell phone, please either turn off these devices or make them completely silent (no vibration), before you enter the classroom. If an emergency situation arises where you must be accessible, please immediately exit the classroom with the device to minimize disturbing your classmates. Cell phone use (including texting, surfing) is not permitted during class and will result in removal of the student from the classroom.

The syllabus serves only as a guide and is valid on the date of issue. Dates, times and topics may change due to new developments and unforeseen circumstances.