APPLIED PLANT BREEDING

APBI 318
Winter 2014 TERM 1

Instructors: Andrew Riseman, Associate Professor, Plant Breeding and Agroecology

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Course Location and Times:
Lectures – MacMillan Building, Rm 342 9:00-10:00 Tuesday
Tutorial/Lab – MacMillan Building, Rm 342 10:00-12:00 Tuesday and Thursday

Course Description:
This course will give students working knowledge of small-scale classical (e.g., non-biotechnological) plant breeding and associated issues (e.g., plant reproductive biology). It will use a hands-on, application-oriented approach to enhance student understanding of the techniques and procedures involved in managing seed inventories (i.e., seed production, storage), designing and implementing a simple plant breeding program, and evaluating the impact of selection on breeding populations and desired outcomes. [3-1-0]

Learning Outcomes:
Upon successful completion of this course, the students should be able:

- To design and implement a simple plant breeding program;
- To predict the potential for successful plant improvement for a particular breeding objective, given the nature of the plant species and the genetic inheritance of the trait;
- To create and manage plant populations in terms of specific genetic composition;
- To develop genetic hypotheses and apply the appropriate statistical methods for their evaluation
- To process seed for either seed saving or part of a breeding project.

Reading List:
There is no required text for this course. Instead, students will engage with a course-specific manual, supplemental readings, and the primary literature.

Library Resources (non-reserved):
Textbooks:
Allard, R.W. 1960. Principles of Plant Breeding John Wiley and Sons, NY
Chahal, G.S. and Gosal S.S. 2002 Principles and Procedures of Plant Breeding. Biotechnological and conventional approaches. Alpha Science, Pangbourne, UK
Falconer, D.S. 1981. Introduction to Quantitative Genetics. 2nd ed. Longman NY
Raven, P.H. et al. 1992. Biology of Plants. 5th ed. Worth Publishers
Simmonds, N.W. 1979. Principles of Crop Improvement Longman, London

Journals

Theoretical and Applied Genetics	Nature Biotechnology
Genome	Plant Cell Reports
Plant Breeding	Molecular and General Genetics
Plant Cell, Tissue and Organ Culture	Can. J. Plant Science
J. American Soc. Hort Science	HortScience
Crop Science	Heredity
Experimental Agriculture	Euphytica

There are also many relevant resource sites on the Internet. However, the credibility of the content must be assessed considering the expertise and agenda of the source, as well as the currency of the information.

Course Format:
The course will include lectures, journal club/class discussions, a term project, and laboratories.

Activities/labs
GreenGenes Breeding Simulation, “Two Minute Talks”, Pollen viability, Seed viability, Seed harvest, cleaning, and storage.

Evaluation Procedures:
Students will be evaluated based on their comprehension of course material, participation, and their ability to apply this information in addressing relevant problems in plant breeding and crop improvement.

Homework (4 assignments @ 5% each)		20%
GreenGenes Project		15%
2-Minute Talk	-	P/F
Laboratory Reports (5% each)		15%
Term Project		40%
Participation		10%
Crossword Puzzle (Bonus)		up to 5%
Overall:		100%

Academic Honesty
Academic honesty is a core value of scholarship. Cheating and plagiarism (including both presenting the work of others as your own and self-plagiarism), are serious academic offences that are taken very seriously in Land & Food Systems. By registering for courses at UBC, students have initiated a contract with the university that they will abide by the rules of the institution. It is the student’s responsibility to inform themselves of the University regulations. Definitions of Academic Misconduct can be found on the following website: http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,54,111,959#10894

If you are unsure of whether you’re properly citing references, please ask your instructor for clarification before the assignment is submitted. Improper citation will result in academic discipline.

Course Schedule:

Date (Day), Topic and Due dates	**HOUR 1 Activities**	**HOUR 2 Activities**	**HOUR 3 Activities**
Sept 02 (Tuesday)	Imagine Day-No Class		
Sept 04 (Thursday)	Course introduction and goals; Student introductions and statement of goals	Lecture- Pre-plant breeding Birth of Plant Breeding, Paradigm Shifts and controversies	
Sept 09 (Tuesday)	Lecture 1- Plant domestication	Lecture 2- Megasporogenesis	Class discussion- Breeding Projects
Sept 11 (Thursday)	Seed cleaning at UBC Farm	Seed cleaning at UBC Farm	
Sept 16 (Tuesday)	Lecture 3- Microsporogenesis	Class discussion- Evolution of Sexual Diversity in Plants	Class discussion Breeding Projects
Sept 18 (Thursday)	Seed cleaning at UBC Farm	Seed cleaning at UBC Farm	
Sept 23 (Tuesday)	Pollen Lab	Pollen Lab	Pollen Lab
Sept 25 (Thursday)	Seed cleaning at UBC Farm	Seed cleaning at UBC Farm	
Sept 30 (Tuesday)	Lecture 4- Flower, Pollen, Fertilization	Lecture 5- Seed Physiology	Pollen Lab
Oct 02 (Thursday) Pollen Lab Due	Seed cleaning at UBC Farm	Seed cleaning at UBC Farm	
Oct 07 (Tuesday)	Lecture 6- Pollination Systems	Seed viability lab	Class discussion Breeding Projects
Oct 09 (Thursday)	Seed cleaning at UBC Farm	Seed cleaning at UBC Farm	
Oct 14 (Tuesday):	Lecture- Fertilization, and Seed Physiology	Seed viability lab	Seed viability lab
Oct 16 (Thursday) Seed Viability Lab Due Term Project Topic Due	Lecture- Qualitative genetics/Linkage	Introduction to GreenGenes	
Oct 21 (Tuesday): Seed Lab Due	Lecture- Chi Square and Non-Normal Segregation (Linkage, Lethality and	Practice word problems	Class discussion Breeding Projects

	Epistasis) problems Selection pressure, heritability		
Oct 23 (Thursday)	Lecture- Inbreeding depression, Heterosis	Class discussion	
Oct 28 (Tuesday) Greengenes Report Due	Lecture- Quantitative Genetics, Population Variance, Gene Frequency	Class discussion	
Oct 30 (Thursday)	Lecture- Breeding Self Pollinated Crops: Mass, Pure, Bulk	Class discussion	
Nov 04 (Tuesday)	Lecture- Breeding Cross Pollinated Crops: Pedigree, SSD, BC/Recurrent Selection, Hybrid	Class discussion	
Nov 06 (Thursday)	Lecture- Genetic Engineering and Marker Assisted Selection	Class discussion	
Nov 11 (Tuesday)	Remembrance Day- UBC Closed	Class Remembrance Day- UBC Closed	Remembrance Day- UBC Closed
Nov 13 (Thursday)	Lecture- Breeding for Disease Resistance	Class discussion	
Nov 18 (Tuesday)	Two Minute Talks	Two Minute Talks	Two Minute Talks
Nov 20 (Thursday)	Lecture- Conducting Field Trials and Field Plot Technique	Class discussion	
Nov 25 (Tuesday)	Lecture- Plant Breeding and Sustainability	Class discussion	
Nov 27 (Thursday)	Pot Luck Course wrap up	Pot Luck Course wrap up	

APBI 318 Grading Rubric for 2-minute Talks

	Excellent	Good	Satisfactory	Unsatisfactory
Presentation and Communication	Clear speaking voice at ease with the audience Dressed for a presentation Makes eye contact with the audience Answers questions very well	Clear speaking voice Dressed for a presentation Answers questions well	Reading from PowerPoint or overhead Speaking too quickly or too slowly	Disorganized Unprepared
Use of Technology	PowerPoint or overheads clear with graphics or other usual visual tools Have a backup incase the technology fails	PowerPoint or overheads clear and easy to read Have a backup incase the technology fails	PowerPoint or overhead use: some spelling and grammar errors; print too small; points not clear	No PowerPoint or overhead use PowerPoint or overhead use that is sloppy i.e., spelling and grammatical errors
Overall Coherence of the Presentation	Presentation is well organized and has a clear introduction, meaningful substance, and concise ending/ conclusion	Presentation is well organized but lacks either a clear introduction, meaningful substance, or concise ending/ conclusion	Presentation has some organization but lacks a clear introduction, meaningful substance, and concise ending/ conclusion	Presentation is disorganized and without structure

APBI 318- Applied Plant Breeding
Term Project Description

Each student will select a crop species that is either grown at the UBC Farm or should be considered for production and write paper that details the development of a breeding program for it. Please have your choice of crop ready by October 2. I will go through them and check for duplications so that a final decision can be agreed upon by October 16. It would be a good idea to have at least one or few alternative crops in mind in case of duplication.

Your term project should include the following sections:

- Title page: Title, name and student number; executive summary of project (~1/2 page); and 6-8 key words (10%).
- Introduction (~1-2 pages) (20%)
    - Economic (e.g., sales, value added), environmental (e.g., ecological services), and/or social (e.g., pedagogy, ritual) importance of growing this crop compared to other similar crops (10%);
    - Environmental requirements for crop production (i.e., feasibility assessment) (5%);
    - Extent of its current cultivation (local, regional, national, and international) (5%);
- Literature review (~1-3 pages) Relevant literature, including the most recent publications (last 5 years) should be consulted and cited as appropriate (20%).
    - Basic botany including family, order, class, genus, species, etc. with scientific and common names; characterization of flower (e.g., perfect), fruit (e.g., capsule), and pollen (e.g., bi-nucleate) (5%).
    - Evolutionary background of the crop and cytogenetic relationship with its related wild/cultivated species (2.5%);
    - If known, the genetic control of important traits (1.5%);
    - Pertinent Canadian and International breeding programs including their locations (1%);
    - Current commercial breeding objectives (5%);
    - Reproduction system (i.e., outcrosser or selfer) and typical breeding methods used on this crop (5%).
- Breeding program description (? pages) (45%)
    - Vision: detail your ideal plant/cultivar profile (10%);
    - Variation: germplasm sources, cultivar/accession lists, and acquisition strategies (5%);
    - Techniques (5%)
    - Crossing techniques
    - Pollination control techniques (i.e., mechanical, spatial, temporal)
    - Description of the selection pressure environment relevant to your ideal cultivar
    - Seed harvest, cleaning, and storage techniques
    - Breeding strategy and selection criteria (15%)
    - General description of recommended breeding strategy (e.g., MS, Pedigree, SSD)
    - Planting design and isolation requirements
    - Year-by-year activities (e.g., when to increase heterozygosity, when to increase homozygosity, and when to select)
    - Seed production requirements (i.e., number of plants per generation required to achieve goals)
    - Cultivar stabilization and stock seed production procedures (10%)
- References (5%)