UNIVERSITY OF FLORIDA

Horticultural Sciences Department

Genetics & Breeding of Vegetable Crops

HOS 4241C, Class number 20706 (Section 4188) and HOS 5242, Class numbers 20710 (in-person, Section 4389) and 23410 (online, Section 4399)

Spring 2023

Instructor:
Dr. Bala Rathinasabapathi
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Teaching Assistant: Dominick Padilla (e mail dpadilla@ufl.edu)

Office hours: By appointment.

Prerequisites: AGR 3303 or equivalent

Credit hours: 3

Frequency: Offered Spring semester

Meeting Days and Times:
Tue, 1:55 to 2:45 p.m. (period 7) and Thu 1:55 to 2:45 and 3:00 to 3:50 (periods 7 and 8).

Location: BLRB 131 (Blueberry Research Building located behind Fifield Hall)

Course format: Lectures, discussion, student research and student presentations. Students in HOS5242 section 4399 will join the class via Zoom.

Course Description: This course is about breeding new cultivars of vegetable crops. Emphasis will be on traditional and molecular breeding methods for vegetable crops and the influence of scientific research, government policies, industry needs and consumer preferences on vegetable crop improvement.

Learning Objectives:
At the conclusion of this course, the student will be able to:

- Apply traditional breeding methods for the enhancement of vegetable crops.
- Apply molecular methods for breeding vegetable crops.
- Identify and interpret how plant breeding is affected by multiple factors such as scientific research, genetic diversity, germplasm resources and conservation, government policies, needs of the industry and consumer preferences.

- Conduct a vegetable breeding research project that meets specific short-term and long-term goals.

Textbooks: There is no required textbook for this course. **Optional textbooks** are listed below:

"An Introduction to Plant Breeding" by Jack Brown and Peter Caligari, Blackwell Publishing, 2008. ISBN 978-1-4051-3344-9. (Most of the presentations will be based on this, but will be supplemented with additional material)

"Evolution and Selection of Quantitative Traits" by Bruce Walsh and Michael Lynch. Sinauer Associates, 2018. ISBN 978-0-19-883087-0. (This is a comprehensive book for advanced studies. Few of the chapters are relevant for plant breeding)

"Molecular Plant Breeding" by Yunbi Xu, CABI publishing, Oxfordshire, England, 2010. ISBN 13:978-1-84593-982-3 (PB). (This is a reference book which lists key publications related to all topics in this area)

"Breed your own vegetable varieties: The Gardener's and farmer's guide to plant breeding and seed saving" by Carol Deppe, 2nd Edition. Green Books Ltd., Totnes. ISBN 1-890132-72-1.

"Practical statistics for data scientists" by Peter Bruce and Andrew Bruce, O'Reilly ISBN 978-1-491-95296-2.

Assigned Reading List:

Asins, M.J. (2002) Present and future of quantitative trait locus analysis in plant breeding. Plant Breeding, 121:281-291.

Bai Y, Lindhout P. (2007) Domestication and breeding of tomatoes: What we have gained and what can we gain in the future? Ann Bot 100: 1085-1094.

Collard, B.C.Y., Jahufer, M.Z.Z., Brouwer, J.B., Pang, E.C.K. (2005) An introduction to markers, quantitative trait loci (QTL) mapping and marker-assisted selection for crop improvement: The basic concepts. Euphytica 142: 169-196.

Collard, B.C., Mackill, D.J. (2008) Marker-assisted selection: an approach for precision plant breeding in the twenty-first century. Phil. Transc. R. Soc. B 363: 557-572.

Gaskell, G., N. Allum, M. Bauer and W. Wagner. (2008) Biotechnology and the European Public. Nature Biotechnology, 18:935-938. http://biotech.nature.com.

Gray AR, Crisp P. (1977). Breeding system, taxonomy, and breeding strategy in cauliflower, *Brassica oleraceae* var. *botrytis* L. Euphytica 26: 369-375.

Hale AL, Farnham MW, Nzaramba M, Kimbeng CA. (2007) Heterosis for horticultural traits in Broccoli. Theo Appl Gen 115: 351-360.

Jeuken, M.J.W and P. Lindhout. (2004) The development of lettuce backcross inbred lines (BILs) for exploitation of the *Lactuca saligna* (wild lettuce) germplasm. Theor. Appl. Genet. 109:394-401.

Hall BG (2013) Building phylogenetic trees from molecular data with MEGA. Mol. Biol. Evol. 30: 1229-1235.

Rao, G.U., A.B. Chaim, Y. Borovsky and I. Paran. (2003) Mapping of yield-related QTLs in pepper in an interspecific cross of *Capsicum annuum* and *C. frutescens*. Theor. Appl. Genet. 106:1457-1466.

Rommens, C.M. (2004) All-native DNA transformation: a new approach to plant genetic engineering. Trends in Plant Science, 9:1360-1385.

Vilarinho, L.B.O., Silva, D.J.H., Greene, A., Salazar, K.D., Alves, C., Eveleth, M., Nichols, B., Tehseen, S., Khoury Jr., J.K., Johnson, J.V., Sargent, S.A., Rathinasabapathi, B. (2015) Inheritance of fruit traits in *Capsicum annuum*: Heirloom cultivars as sources of quality parameters relating to pericarp shape, color, thickness and total soluble solids. Journal of the American Society for Horticultural Science 140: 597-604.

Tricoli DM, Carney KJ, Russell PF, McMaster JR., Groff DW, Hadden KC, Himmel PT, Hubbard JP, Boeshore ML, Quemada HD. (1995) Field evaluation of transgenic squash containing single or multiple virus coat protein gene constructs for resistance to cucumber mosaic-virus. Bio-Technology 13: 1458-1465.

Zhang, R, X. Yong, K. Yi, H. Zhang, L. Liu and G. Gong. (2004). A genetic linkage map for watermelon derived from recombinant inbred lines. J. Amer. Soc. Hort. Sci. 129:237-243.

Zimmer, C (2008) What is a species? Scientific American 298: 72-79.

Additional or alternative readings may be selected from current literature and will be made available to the students in the form of a photocopy or an electronic file.

Tentative List of Topics:

Orientation (Week 1)	
09 Jan Tue	Introduction, syllabus and discussion topics
11 Jan Thu	Intro to Pepper Breeding program
Nature of Vegetable Crops (Wk 2)	
16 Jan Tue	Nature of vegetable crops and seed sources
18 Jan Thu	Asexual and sexual reproduction in plants
18 Jan Thu	Activity 1. Greenhouse and field visit. Assignment
Mendelian Genetics (Wk 3)	
23 Jan Tue	Qualitative traits and review of Mendelian Genetics
25 Jan Thu	Qualitative traits and review of Mendelian Genetics
25 Jan Thu	Activity 2. Prepare transplants trays and sow seeds
Induced Mutagenesis (Wk 4)	
30 Jan Tue	Crop Genetic Resources and Centers of Origin
01 Feb Thu	Induced mutagenesis
01 Feb Thu	Activity 3. Screening a mutagenized population
01 Feb Thu	Assignment 1 due. Research Proposal outline draft 1
Quantitative Genetics (Wk 5)	
06 Feb Tue	Introduction to Quantitative traits
06 Feb Thu	Variance and analysis of variance
08 Feb Thu	Activity 4. Making a genetic cross - Demonstration
Quantitative Genetics (Wk 6)	
13 Feb Tue	Quantitative Genetics – I
15 Feb Thu	Quantitative Genetics – II
15 Feb Thu	Assignment 2 due. Revised Proposal
Quantitative Genetics (Wk 7)	
20 Feb Tue	Quantitative Genetics – III
22 Feb Thu	Quantitative Genetics – IV
Plant Tissue Culture (wk 8)	
27 Feb Tue	Plant tissue culture and anther culture
29 Feb Thu	Exam 1
Practicals (wk 9)	
05 Mar Tue	Activity 5. Plant tissue culture and anther culture
07 Mar Thu	QTL mapping 1,
07 Mar Thu	QTL mapping 1, demonstrations
10 -17 Mar	Spring Break
DNA markers (wk 10)	
19 Mar Tue	Activity 5. DNA based markers
19 Mar Tue	Assignment 3. Reflective essay due by 5 pm.
21 Mar Thu	Protocols to extract genomic DNA

21 Mar Thu	Activity 6. DNA extraction from peppers
Genome editing (wk 11)	
28 Mar Tue	Plant gene transfer and genome editing
30 Mar Thu	Continue anther culture
Crop specific Info (wkj 12)	
26 Mar Tue	Brassica Breeding
28 Mar Thu	Eggplant Breeding
Presentations (wks 13 and 14)	
02 Apr Tue	Seedless watermelon
04 Apr Thu	Student presentations
09 Apr Tue	Exam 2.
11 Apr Thu	Student presentations
16 Apr Tue	Student presentations
18 Apr Thu	Student presentations
23 Apr Thu	Last day of class/Greenhouse/Field clean up

Class Assignments:

(a) Each student will do the lab exercises set for each week related to vegetable breeding, keep a journal of notes about what has been done and write reports for grade. Even if some of the exercises may be done in groups, each student should write the notebook and reports individually.
(b) Students will develop a research project in vegetable breeding in consultation with the instructor. Opportunities for the choice of the projects will be discussed in class.

Written Report: Lab reports are expected to be typed, double-spaced, and should be no more than 5 pages each. Quantitative data need to be shown in tables or figures and qualitative data using images. Tables and figures should have descriptive legends. Please include your name, date, a title for the exercise, a statement of objective of the exercise, description of what you did, the results observed and a discussion of your results. Include complete citations of any references or websites consulted.

Mid-Course Reflection Essay: Students will write a reflective essay on whatever they have learned prior to Exam 2. The purpose of this essay is to inform the instructor about what sections of this course is useful for your individual learning, what aspects of the methods of teaching are helpful for you and what aspects of teaching are hindering your learning. Also, the student is expected to write their progress in their individual projects and how they are overcoming difficulties faced. The essay is expected to be within 5 pages (single/double spacing, including figures, if any).

Level and expectations in this course: This course is taught for undergraduate students combined with graduate students. Activities assigned to undergraduate students will have only one objective while activities assigned to graduate students will contain 2-3 objectives. Graduate students are required to interpret their observations in the light of previous research work in that

domain based on a literature search, while undergraduate students are expected to write simpler interpretations of their observations and data. Problems using bioinformatics tools (for mapping quantitative trait loci) are assigned only for graduate students while undergraduate students will be taught the concepts but not have to do hands-on exercises regarding mapping. Both graduate and undergraduate students have to make one presentation about their semester-long project and the goals set in these projects will vary between undergraduate and graduate students in that graduate student presentations will be expected in the light of the literature and undergraduate student presentations are expected to be centered on methods used and observed results with less reference to previous research in the field.

Presentation: Each student will be required to present their class assignment as a 20-35 minute PowerPoint presentation (length of time for presentation may depend on the number of students enrolled), allowing time for questions and answers by the audience. Each student will provide fellow students and instructor handouts of their PowerPoint presentation on the day it is scheduled.

Class attendance and participation: Attendance will be noted in each class and will be used toward 5% of the grade. Participation will be graded for 5% of the total grade, based on student's responses to on-line or classroom discussions. Prompts will be posted by the instructors and the students will be asked to post discussions within a set deadline.

Evaluation & Grades: (Students will be evaluated based on the following)

	Percentage of Grade
Class attendance and participation	05
Class assignment - written reports*	15
Mid-course reflective essay	10
Exams 2	20
Project & presentation	50
Total:	100

*The assignments, tests and the final exam will differ in their levels of difficulty between students attending the undergraduate and graduate sections of this course.

Grades for this course will be assigned according to established university policy.
90-100 = A 85-89.9 = B+ 80-84.9 = B 75-79.9 = C+ 70-74.9 = C 65-69.9 = D+ 60-64.9 = D
<60 = E

Course policies and procedures

SPECIAL SAFETY MEASURES:

(a) All the lectures, discussions and reviews will be delivered via Face to Face or Zoom depending upon the section you have registered. During face-to-face meetings and while

conducting their research projects, students should follow appropriate CDC guidelines for safety against COVID-19 pandemic or other infectious diseases.
(b) The student should report to the instructor if safety violations occur during the class period.
(c) If there is a light rain, students will stay at the breeze-way of building 1400, and resume activities when safe. On days when there is heavy rainfall or lightening, the field part of the class will not continue that day and the students will be updated via Zoom or e mail about what they missed and potential make up activities.

(d) **Place, Days, and times for face-to-face meetings**: Face to face meetings will be at PSF4, a classroom near the East parking lot of Fifield Hall. Field work or greenhouse work will be during period 8 of Thursdays.

Grades and Grade Points: For UF policies for assigning grade points, see https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx.

Attendance: Requirements for class attendance are consistent with university policies found at https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx

Make-up work: Reports are due on the dates indicated in the instructions for each activity. Late homework will be accepted with a 10% penalty for each day after the due date for upto one week. *If you are having trouble with homework or class, please see one of the instructors immediately*. Test makeups will be arranged only in the case of an emergency and for absences for medical reasons only as per UF policy listed:
https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/#illnesspolicytext

Online Course Evaluation Process: At the end of the semester, students are expected to provide feedback on the quality of instruction in this course using a standard evaluation tool online at https://evaluations.ufl.edu.

Academic Honesty: As a student at the University of Florida, you have committed yourself to uphold the Honor Code. For more information regarding the Student Honor Code, please see: http://www.dso.ufl.edu/sccr/process/student-conduct-honor-code. All writing should be in your own words and acknowledge sources via proper citation. Do not use AI tools (e.g. ChatGPT) for any of the assignments or exams unless you are instructed to do so for a specific exercise.

Software Use: All faculty, staff and students of the University are required and expected to obey the laws and legal agreements governing software use and the policy is found here: https://hr.ufl.edu/forms-policies/policies-managers/software-copyright-policy/

Services for Students with Disabilities: The Disability Resource Center coordinates the needed accommodations of students with disabilities. Students requesting classroom accommodation must first register with the Dean of Students Office. The Dean of Students Office will provide documentation to the student who must then provide this documentation to the Instructor when requesting accommodation: 0001 Reid Hall, 352-392-8565, www.dso.ufl.edu/drc/

Campus Helping Resources:

University Counseling & Wellness Center, 3190 Radio Road, 352-392-1575, www.counseling.ufl.edu/cwc/
U Matter We Care, www.umatter.ufl.edu/
Career Resource Center, First Floor JWRU, 392-1601, www.crc.ufl.edu/

Student Complaints:
Residential Course: https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf
Online Course: http://www.distance.ufl.edu/student-complaint-process