UNIVERSITY OF FLORIDA

Horticultural Sciences Department

Genetics & Breeding of Vegetable Crops

HOS 4241C, Class number 17556 (Section 4188) and HOS 5242, Class numbers 17557 (in-person, Section 4389) and 18729 (online, Section 4399)

Spring 2026

Instructor:
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Office hours: By appointment.

Prerequisites: AGR 3303 or equivalent or instructor permission via e mail

HOS4241C meets the **'Lab skills and Information Skills'** requirement for the Plant Science (PLS) major.

Credit hours: 3

Frequency: Offered Spring semester of odd years,

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 154 (Blueberry Classroom 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.

Course Objective: Students will learn all aspects of vegetable crop breeding including the importance and biology of vegetable crops, traditional and modern methods of breeding and acquire hands on skills related to vegetable crop breeding. It is expected that at least 80% of the students attending this course will reach proficiency in the contents of this course to receive a B or above grade.

Student Learning Objectives (SLOs):

At the end of this course, the student will be able to:

1. Articulate the importance of vegetables in our food supply and the role of breeding
2. Describe traditional breeding methods for the enhancement of vegetable crops.
3. Describe molecular biological methods for breeding vegetable crops.
4. Identify and interpret how plant breeding is affected by multiple factors such as scientific research, genetic diversity, germplasm resources and conservation, government policies, industry needs and consumer preferences.
5. Be able to read, analyze and apply plant breeding-related ideas to develop new breeding projects.
6. 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.

Caradus, J.R. (2023) Perceptions of plant breeding methods – from 'phenotypic selection' to 'genetic modification' and 'new breeding technologies'. New Zealand J. Agric. Res. 67:621-669.
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.

Fugimoto, R., Uezono, K., Ishikura, S., Osabe, K., Peacock, J., Dennis, E.S. (2018) Recent research on the mechanism of heterosis is important for crop and vegetable breeding systems. Breeding Sci. 68: 145-158.

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.

Halpin-McCormick, A., Lucas, S., Keach, J., Kantar, M.B., Motomura-Wages, S., Miyasaka, S.C. (2024) Evaluating Sweetpotato varieties and accessions in Hawaii. HortTechnology 34: 448-458.

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.

Van Ooijen JW. (1999) LOD significance thresholds for QTL analysis in experimental populations of diploid species. Heredity (Edinb).83 (Pt 5):613-24. doi: 10.1038/sj.hdy.6886230.

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.

**Days for student presentations will be adjusted based on the number of students in the course.*

Module 1. Orientation (Week 1)	
13 Jan Tue	Introduction, Syllabus & Veg Crops
15 Jan Thu	Project-based learning
15 Jan Thu	Activity 1. Visit Online resources, Greenhouse and Field Visits
Module 2. Nature of Vegetable Crops (Wk 2)	
20 Jan Tue	Crop Genetic Resources and Centers of Origin
22 Jan Thu	Pollination, Fertilization and Meiosis
22 Jan Thu	Activity 2. Prepare transplant trays and seed sowing
Module 3. Mendelian Genetics (Wk 3)	
27 Jan Tue	Qualitative traits and Mendelian Genetics
29 Jan Thu	Qualitative traits and Mendelian Genetics
29 Jan Thu	Activity 3. Data collection on Qualitative Triats of Peppers
Module 3 (Contd.) Induced Mutagenesis (Wk 4)	
03 Feb Tue	Induced mutagenesis
05 Feb Thu	Research Proposal Discussion
05 Feb Thu	Activity 3. Screening a mutagenized population
05 Feb Thu	Assignment 1 due. Research Proposal outline draft 1
Module 4. Quantitative Genetics (Wk 5)	
10 Feb Tue	Introduction to Quantitative traits
12 Feb Thu	Variance and analysis of variance
12 Feb Thu	Activity 4. Making a genetic cross – Demo & Activity
Module 4. (Contd.) Quantitative Genetics (Wk 6)	
17 Feb Tue	Quantitative Genetics – I
19 Feb Thu	Quantitative Genetics – II
19 Feb Thu	Assignment 2 due. Revised Research Proposal
Module 5. Markers, Linkage & QTL mapping (Wk 7)	
24 Feb Tue	SNP Markers
26 Feb Thu	Linkage mapping and QTL mapping
26 Feb Thu	Linkage mapping and QTL mapping using R-Qtl
Module 6. Doubled Haploids & Hybrid vigor (Wk. 8)	
03 Mar Tue	Plant tissue culture
04 Mar Thu	Hybrid vigor and F1 hybrids
04 Mar Thu	Activity 5. Anther culture – Lab
Module 7. Transgenic Crops & Genome editing (Wk 9)	
10 Mar Tue	Transgenic crops
12 Mar Thu	Genome editing
12 Mar Thu	Activity 6. DNA marker analyses - Laboratory demonstration
12 Mar Thu	Exam 1 (via Canvas)
14 -22 Mar (Wk. 10)	*Spring Break*
Module 8. Crop-Specific Topics (Wk 11)	
24 Mar Tue	Pepper Breeding
26 Mar Thu	Lettuce breeding
26 Mar Thu	Assignment 3. Reflective essay due by 5 pm.
26 Mar Thu	Activity 7. Seed extraction. Field clean up.
Module 8. Crop-Specific Topics (Wk 12)	
31 Mar Tue	Cucurbit breeding
02 Apr Thu	Student presentations
07 Apr Tue	Student presentations
09 Apr Thu	Student presentations
Presentations (Wks 13 & 14)	
14 Apr Tue	Student presentations
16 Apr Thu	Student presentations
16 Apr Thu	Exam 2 (Via Canvas)
21 Apr Tue	Exam 2 - Results discussion

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. The instructor will provide seeds or transplants for these projects.

Written Report: Lab reports are expected to be typed, double-spaced, and should be no more than 5 pages each. There will be 6 activity reports. Quantitative data needs to be shown in tables or figures, and qualitative data should be presented as images. Tables and figures should have descriptive legends. Please include your name, date, 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 students are 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).

Review Quizzes: One review quiz per module will be set in Canvas with multiple choice questions. Completion of the review quiz is necessary to open access to the subsequent modules.

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-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 instructors with handouts of their PowerPoint presentation on the day it is scheduled.

Exam Objectives: Exam 1 will test student's competency in the content of modules 1 to 5 and Exam 2 will test student's competency in the content of modules 6 to 8 using short-answer questions. Students should write their answers in full sentences using their own words.

Instructor feedback: The instructor will provide rubric for each of the assignments and provide feedback within one week after the submission date. The rubric will be posted via Canvas. The 'research project proposal' and 'presentation file' (Power Point or equivalent) can be improved prior to final submission if draft versions are sent to the instructor on time to receive instructor feedback.

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)

	Grade Points
Class attendance	025 (2.5%)
Class assignment - written reports* (SLOs 5 & 6)	150 (15%)
Reflective essay (SLO 4)	100 (10%)
Exams 2 (SLOs 1-4)	200 (20%)
Review Quizzes (10 x 2.5) (SLOs 2-4)	025 (2.5%)
Project & Presentation (SLOs 5 & 6)	500 (50%)
Total:	1000 (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. Percent grade and the letter grades are: 92-100 = A, 87-91 = A-, 83-86 = B+ 79-82 = B- 75-78 = C+ 70-74 = C 67-71 = D+ 60-67 = D <60 = E

Course policies and procedures

A Canvas course portal will be used to share articles and copies of Power Point files and links to podcasts and websites. The instructor will also post updates and announcements via this portal.

Privacy Policies for online tools:

- UF's Online Privacy Policies: https://policy.ufl.edu/policy/online-internet-privacy-statement/
- Canvas: https://canvas-student.net/privacy
- VoiceThread: https://voicethread.com/privacy/
- Mediasite: https://sonicfoundry.com/privacy-policy/

(a) All the lectures, discussions and reviews will be delivered via Face to Face or Zoom depending upon the section you have registered.
(b) The student should report to the instructor if safety violations occur during the class period.

(c) If there is 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 lightning, 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 make up activities.
(d) Activities: Field work or greenhouse work will be during period 8 of Thursdays. Student attendance in these activities is mandatory and will be used for participation grade. Plant tissue cultures will be done at the instructor's laboratory facility.

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 up to one week. *If you are having trouble with homework or class, please see one of the instructors immediately*. Test makeup 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://gatorevals.aa.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: https://policy.ufl.edu/wp-content/uploads/2021/12/4-040_2021-12-06.pdf. 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 accommodation needed for 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: https://osa.med.ufl.edu/support/disability-resource-center/

Campus Helping Resources:
University Counseling & Wellness Center, 3190 Radio Road, 352-392-1575 https://counseling.ufl.edu/
U Matter We Care, www.umatter.ufl.edu/
Student Complaints: https://em.ufl.edu/complaint
Career Resource Center, First Floor JWRU, 392-1601, https://career.ufl.edu/