UNIVERSITY OF FLORIDA

Horticultural Sciences Department

Genetics & Breeding of Vegetable Crops
HOS _4xxx, Section _____ and HOS 5242, Section 04EE
Spring 2019

Instructors:

Dr. Bala Rathinasabapathi,
Professor,
Horticultural Sciences Department,
2247, Fifield Hall
University of Florida, Gainesville, FL 32611
E-mail brath@ufl.edu

Dr. Kevin Folta,
Professor& Chair,
Horticultural Sciences Department,
University of Florida, Gainesville, FL 32611
E mail kfolta@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: Room 4, PSF

Course format: Lectures, discussion, student research and student presentations

Course Description: 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 and molecular breeding methods for the enhancement of vegetable crops.
- Interpret how plant breeding, scientific research, genetic diversity, germplasm resources and conservation, government policies, industry needs and consumer preferences can affect vegetable crop improvement programs.
- Design and present 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.

"Molecular Plant Breeding" by Yunbi Xu, CABI publishing, Oxfordshire, England, 2010. ISBN 13:978-1-84593-982-3 (PB).

"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.

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:

Date	Topics	Instructor(s)
Week 1 , Thu	Introductions, review of class syllabus and discussion topics	BR, KF
Week 1 Thu	Activity 1. Introduction to pepper breeding program	BR
Week 2, Tue	The domestication of plants and genetic diversity in vegetable crops	KF
Week 2, Thu	Qualitative traits and review of Mendelian genetics	BR
Week 2, Thu	Activity 2: Making a genetic cross	BR
Week 3, Tue	Modes of reproduction in vegetable crops	BR
Week 3, Thu	Breeding schemes	BR
Week 3, Thu	Activity 3: Planting a mapping population	BR
Week 4, Tue	Induced mutagenesis	BR
Week 4, Thu	Activity 4: Analysis of quantitative data	BR

Week 4, Thu	Basics of quantitative genetics	BR
Week 5, Tue	QTL mapping	BR
Week 5, Thu	Activity 5: Linkage analysis	BR
Week 5, Thu	Heritability	BR
Week 6, Tue	Genome-wide association mapping	BR
Week 6, Thu	Activity 6: Collection of quantitative data from peppers	BR
Week 6, Thu	Heterosis and sweet corn breeding	BR
Week 7, Tue	Genic and cytoplasmic male sterility	BR
Week 7, Thu	Activity 7: Collection of quantitative data on fruit traits II	BR
Week 7, Thu	Polyploidy and breeding Brassicas	BR
Week 8, Tue	Anther culture and doubled haploids	BR
Week 8, Thu	Activity 8: Anther culture	BR
Week 8, Thu	Seedless watermelon	
Week 9, Tue	Plant tissue culture, embryo rescue, somaclonal variation	KF
Week 9, Thu	Chimeras	KF
Week 9, Thu	Activity 9: Attempts on inter-specific crosses	BR
Week 10, Tue	Spring break - No class	
Week 10, Thu	Spring break - No class	
Week 11, Tue	Genetic transformation	KF
Week 11, Thu	Genome editing technologies	KF
Week 11, Thu	Activity 10: Students work on their projects	
Week 12, Tue	Virus-resistant squash breeding	KF
Week 12, Thu	Vegetable variety patents	KF
Week 12, Thu	Activity 9: Analysis of vegetable variety patents	KF
Week 13, Tu	Potential for transgenic vegetable crops	KF
Week 13, Thu	New breeding objectives in vegetable crops	KF
Week 13, Thu	Activity 11: Students work on their projects	
Week 14, Tue	Student presentation	
Week 14, Thu	Student presentation	
Week 14, Thu	Student presentation	
Week 15, Tu	Student presentation	
Week 15, Thu	Student presentation	
Week 15, Thu	Activity 10: Greenhouse clean up, Seed extraction .	BR
Week 16, Tue	Review for final exam, Last day of class	BR, KF

*Instructors: BR- Bala Rathinasabapathi and KF – Kevin Folta

Class Assignment:

(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 instructors. 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.

Level and expectations in this course: This course is taught 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.

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

	Points	Percentage of Grade
Class attendance and participation	10	10%
Class assignment - written reports*	15	15%
Tests 2	15	15%
Project & presentation	30	30%
Final Exam	30	30%
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

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

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.

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