UNIVERSITY OF FLORIDA

Horticultural Sciences Department

Genetics & Breeding of Vegetable Crops
HOS 4932, Section 2F07 and HOS 5242, Section 04EE
Spring 2017

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

Dr. Jugpreet Singh,
Post-doctoral associate,
Horticultural Sciences Department,
2241, Fifield Hall,
University of Florida, Gainesville, FL 32611
E-mail jugpreetsingh@ufl.edu

Office hours: By appointment.

Prerequisites: AGR 3303 or equivalent

Credit hours: 3

Frequency: Offered Spring semester

Meeting 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 big data, 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 proiect 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.

"Breeding vegetable crops" Edited by Mark J. Bassett, AVI Publishing Company, Westport, Conn. 1986.

Assigned Reading List:

Kihara, H. 1951. Triploid watermelons. Proc of the American Soc Hort Sci. 58: 217-230.

Olsson G. 1960. Species crosses within the genus Brassica. 2. Artificial *Brassica napus* L. Hereditas 46: 351-386.

Liu et al (2014) The *Brassica oleracea* genome reveals the asymmetrical evolution of polyploidy genomes. Nature Communications 5: Article number 3930.

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.

Farinho, P. Coelho, J. Carlier, D. Svetleva, A. Monteiro and J. Leitao. 2004. Mapping a locus for adult plant resistance to downy mildew in broccoli (*Brassica oleracea* convar. *italica*). Theor. Appl. Genet. 109:1392-1398.

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.

Martin, G.B., Brommonschenekel, S.H., Chunwongse, J., Frary, A., Ganal, M.W., Spivey, R., Earle, E.D., Tanksley, S.D. 1993. Map-based cloning of a protein-kinase gene conferring disease resistance in tomato. Science 262: 1432-1436.

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.

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

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

Holland, J.B. 2004. Implementation of molecular markers for quantitative traits in breeding programs - challenges and opportunities. Proceedings of the 4th International Crop Science Congress, 1-13. www.cropscience.org.au.

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.

Mohan, M., S. Nair, A. Bhagwat, T.G. Kirshna, M. Yano, C.R. Bhatia and T. Sasaki. 1997. Genome mapping, molecular markers and marker-assisted selection in crop plants. Molecular Breeding. 3:87-103.

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.

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.

Sakata, Y., N. Kubo, M. Morishita, E. Kitadani, M. Sugiyama and M. Hirai. 2006. QTL analysis of powdery mildew resistance in cucumber (*Cucumis sativus* L.). Theor. Appl. Genet, 112:243-250.

Elshire RJ, Glaubitz JC, Sun Q, Poland JA, Kawamoto K, Buckler ES, Mitchell SE. 2011. A robust, simple genotyping-by-sequencing (GBS) approach for high diversity species. PLoS ONE 6: e19379.

Shi, M.M. 2001. Enabling large-scale pharmacogenetic studies by high-throughput mutation detection and genotyping technologies. Clinical Chemistry 47:164-172.

Tiwari, K.R., G.A. Penner and T.D. Warkentin. Identification of coupling and repulsion phase RAPD markers for powdery mildew resistance gene er-1 in pea. Genome, 41:440-444.

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.

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

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

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)*
Jan 5, Thu	Introductions, review of class syllabus and discussion topics	BR, KF, JS
Jan 5, Thu	Activity 1. Introduction to pepper breeding program	BR
Jan 10, Tue	The domestication of plants and genetic diversity in vegetable crops	JS
Jan 12, Thu	Qualitative traits and review of Mendelian genetics	BR
Jan 12, Thu	Activity 2: Making a genetic cross	BR
Jan 17, Tue	Modes of reproduction in vegetable crops	BR
Jan 19, Thu	Breeding schemes	BR
Jan 19, Thu	Activity 2: Making a genetic cross, Planting a mapping popul.	BR
Jan 24, Tue	Induced mutagenesis	BR
Jan 26, Thu	Activity 3: Analysis of quantitative data	BR, JS
Jan 26, Thu	Basics of quantitative genetics	JS
Jan 31, Tue	QTL mapping	JS
Feb 2, Thu	Activity 4: Linkage analysis	JS
Feb 2, Thu	Heritability	JS
Feb 7, Tue	Genome-wide association mapping	JS
Feb 9, Thu	Activity 5: Collection of quantitative data from peppers	BR

Feb 9, Thu	Heterosis and sweet corn breeding	JS
Feb 14, Tue	Genic and cytoplasmic male sterility	JS
Feb 16, Thu	Activity 6: Collection of quantitative data on fruit traits II	BR
Feb 16, Thu	Polyploidy and breeding Brassicas	BR
Feb 21, Tue	Anther culture and doubled haploids	BR
Feb 23, Thu	Activity 7: Anther culture	BR
Feb 23, Thu	Seedless watermelon	
Feb 28, Tue	Plant tissue culture, embryo rescue, somaclonal variation	
Mar 2, Thu	Chimeras	
Mar 2, Thu	Activity 7: Attempts on inter-specific crosses	
Mar 7, Tue	Spring break - No class	
Mar 9, Thu	Spring break - No class	
Mar 14, Tue	Genetic transformation	KF
Mar 16, Thu	Genome editing technologies	KF
Mar 16, Thu	Activity 8: Students work on their projects	KF
Mar 21, Tue	Virus-resistant squash breeding	BR
Mar 23, Thu	Vegetable variety patents	KF
Mar 23, Thu	Activity 9: Analysis of vegetable variety patents	KF
Mar 28, Tue	Potential for transgenic vegetable crops	KF
Mar 30, Thu	New breeding objectives in vegetable crops	KF
Mar 30, Thu	Activity 10: Students work on their projects	KF
Apr 4, Tue	Student presentation	
Apr 6, Thu	Student presentation	
Apr 6, Thu	Student presentation	
Apr 11, Tue	Student presentation	
Apr 13, Thu	Student presentation	
Apr 13, Thu	Activity 10: Greenhouse clean up.	
Apr 18, Tue	Review for final exam, Last day of class	BR, JS, KF

*Instructors: BR- Bala Rathinasabapathi, JS- Jugpreet Singh 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.

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	30	30%
Class assignment - presentation	30	30%
Final Exam	30	30%
Total:	100	

Grades for this course will be assigned according to established university policy.
90-100 = A 85-89 = B+ 80-84 = B 75-79 = C+ 70-74 = C 65-69 = D+ 60-64 = D <60 = E

Course policies and procedures

1 Homework: Reports are due on the dates indicated in the instructions for each activity. Late homework will be accepted with a 20% penalty for each day after the due date. If you are having trouble with homework or class, please see me immediately.

2. Test makeups will be arranged only in the case of an emergency and not for absences for any other reasons.

3. Follow all safety regulations in and out of the classroom.

4. By registering for classes, every student has signed the following statement: "I understand that the University of Florida expects its students to be honest in all their academic work. I agree to adhere to this commitment to academic honesty, and understand that my failure to comply with this commitment may result in disciplinary action up to and including expulsion from the University". Honor Code violations in this course will not be tolerated, and may result in the assignment of a failing grade. Students observing an Honor Code violation should report them to the instructor immediately.

5. All faculty, staff and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate.

6. During the class, students should follow habits most promoting learning and least disturbing to fellow students. These include not reading material irrelevant to the class, conversations unrelated to what is being discussed, late arrivals and abrupt walking out of the classroom and engaging in activities that could disrupt the classroom atmosphere including the improper use of electronic devices.

7. Resources are available on-campus for students having personal problems or lacking clear career and academic goals which interfere with their academic performance. These resources include: University Counseling Center (392-1575), Personal counseling at Student Mental Health (392-1171), Sexual Assault Counseling (392-1161) and Career Resource Center (392-1601).

8. Students who need special accommodations due to a disability are requested to communicate their needs to the instructor so that necessary arrangements could be made.