AGR 6322 Advanced Plant Breeding Sections (26753 and 26755)

Graduate Level – 3 credit hours

Fall 2020

Instructors:

Dr. Esteban Rios
2005 SW 23rd Street Building 350 Off 5
352-294-3795
estebanrios@ufl.edu
Office Hours: Tuesdays 4 to 5 pm. Please feel free to talk to me about any issue relating to the course, and start this process early in the semester.

Dr. Dev Paudel
dev.paudel@ufl.edu
Office Hours: Mondays 4 to 5 pm.

Lecture time: Tuesday period 3 (9:35-10:25); and Thursday periods 3 and 4 (9:35-11:30)

Pre-requisites

AGR5321 – Genetic Improvement of Plants or equivalent plant breeding course; and STA6166 or equivalent.

Course Description

This course focuses on theoretical and practical application of plant breeding, genetics, and statistics to devise effective methods and approaches to lead a successful breeding program. The course builds upon knowledge of biology, molecular genetics, statistics, plant breeding and quantitative genetic theory to highlight real-life challenges that plant breeders face in their journey to develop improved cultivars. Four specific functional areas, which reflect division of labor and resources in breeding programs are addressed: population development, population evaluation and selection, trait integration, and product commercialization and supply.

Learning Objectives

- Students will understand traditional and modern plant breeding concepts, approaches and methods used to develop and release improved cultivars.
- Student will learn how to identify germplasm sources and other methods to create breeding populations.
- Students will estimate population genetic parameters and apply these concepts in plant breeding to maximize the efficiency in creating and managing breeding populations.
- Students will learn the fundamentals of field plot techniques, experimental designs and data analysis commonly used in plant breeding trials.
- Students will develop an understanding of basic strategies pertaining to genomic breeding and advanced tools used to expedite cultivar improvement.
- Students will comprehend the process of cultivar release and commercialization in plant breeding.
- Students will develop a research proposal integrating concepts covered in all four functional areas addressing a breeding project in their crop of choice.
- Students will develop an appreciation of the role of plant breeding in agriculture and society.

Intended Audience

The course is designed for MS and PhD graduate students in the following disciplines: plant breeding, agronomy, horticultural sciences, environmental horticulture, forestry, and plant molecular and cellular biology.

Course Objectives

This course will demonstrate the application of breeding principles to crop improvement through a review of traditional and modern techniques. The focus of the course is to familiarize students with advanced breeding strategies, methods, and techniques in plant breeding, and how to apply those concepts in breeding programs. This course is designed to complement other plant breeding, quantitative genetics, and statistical genetic courses. At the end of this course, students will be able to distinguish multiple approaches to develop breeding populations, including germplasm acquisition, mating designs, and apply population genetic concepts to manage

breeding populations more efficiently. Students will also design and analyze data following experimental designs commonly used in plant breeding trials, particularly to explore genotype by environment interaction. Students will be able to identify novel methods to accelerate crop improvement, including marker assisted selection and genomic approaches. Finally, students will also be challenged to develop a research proposal for a plant breeding project, including a budget, timeline and resources required to operate a successful plant breeding program.

Evaluation

Quizzes

Four quizzes will happen randomly during lectures. They will consist of questions pertinent to the topic being discussed in class. Students are required to email the answer to the instructor during the allotted time period when the quiz is assigned. THERE IS NO MAKE UP OF QUIZZES. Answers for quizzes are reviewed and discussed in class after completion to provide comprehensive feedback.

Paper Discussion

A peer-reviewed scientific publication will be assigned to each student. Students will lead the discussion for the paper, including tables/graphs/figures presented in the manuscript, as well as using other references if needed. Leading students are expected to prepare six questions that will be presented to the class to encourage participation. Each student will receive one-to-one feedback from instructor after their presentation, and the final grade will combine their own discussion and participation. There is no make-up of discussion grades.

Breeding Proposal

A Request for Proposals (RFP) will be presented to students: https://southern.sare.org/Grants/Apply-for-a-Grant/Graduate-Student-Grants/. Students will work individually to write and present orally their proposed work and budget. Students will receive training on proposal writing, budget preparation and proposal submission by the UF-IFAS Shared Services, and they are expected to follow the RFP for formatting, word limits and budget. The breeding proposal will be divided in three parts:

Part 1. Due on Thursday October 8 by 5 PM (EST). It should contain the title, your name and UFID, Statement of Problem, Rationale and Justification (limited to 500 words) and Project Relevance to Sustainable Agriculture (limited to 500 words). Each student will receive feedback from instructor and TA.

Part 2. Due on Thursday October 29 by 5 PM (EST). It should include all the sections presented in Part 1, plus an abstract (250 words), objectives (500 words), and approach and methods (1000 words). Each student will receive feedback from instructor and TA.

Final. Due on Thursday November 12 by 5 PM (EST). It should include all the sections presented in Part 1 and 2, plus timetable (500 words), literature cited (250 words), budget and budget justification. Each student will receive feedback from instructor and TA.

Oral presentation. Each student will present their final project during a 15-minute presentation in class on December 1 and 8 (students will be assigned to those dates). The presentation format is open and students are encouraged to use their preferred delivery method. It will be presented to the whole class through Zoom and its format should follow the final RFP sections. Each student will receive feedback from instructor and TA.

Exam

There will be a final take-home exam on December 4 during normal class time (9:35 to 11:30 AM).

Activity	Number	Points/activity	Total
Quizzes	4	2.5	10
Paper Discussion	1	20	20
Breeding Proposal – Written	1	20	20
Breeding Proposal – Oral	1	20	20
Final Take-home Exam	1	30	30

A >91 B+ 85 to 90 B 80 to 84 C+ 75 to 79 C 70 to 74 D+ 65 to 69 D 60 to 64 E < 60

UF grading policies: https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx.

Software and computer
You will need to use your own laptop for data analyses demos and homework. Different software will be used during the semester. Specific instruction where and how to obtain them will be given in class.

Recommended Literature – specific scientific papers will be assigned as the semester progresses
D.L. Hartle & A.G. Clark – *Principles of Population Genetics*, Fourth Edition. 2006.
D.S. Falconer – *Introduction to Quantitative Genetics,* 2nd edition. 1981.
M.L. Lynch & B. Walsh – Genetics and Analysis of Quantitative Traits. 1998
Mrode, R. A. Linear Models for the Prediction of Animal Breeding Values. Boston, MA :CABI, 2014. Print.

Course Schedule and Topics (Tentative)

Week	Description
	Area: Population development
1	Theme: Basic Concepts in Plant Breeding Day 1: Tuesday Sept 1 a. Introductions, reviewing syllabus, and assessment of expectations b. Basic Concepts in Plant Breeding Day 2: Thursday Sept 3 a. Basic Concepts in Plant Breeding b. Sarah Brewer (PhD candidate): Success story for a breeding proposal. c. Dr. Mickie Swisher: Justification and Project Relevance to Sustainable Agriculture. d. Discussion for breeding proposal: crop, breeding system and methods.
2	Theme: Population Genetics Day 1: Tuesday Sept 8 a. Population Genetics I Day 2: Thursday Sept 10 a. Population Genetics II b. Demo on R and Population Genetics
3	Theme: Population Genetics I Day 1: Tuesday Sept 15 a. Population Genetics III Day 2: Thursday Sept 17 a. Paper discussion on Population Genetics – Leader: TBD b. IFAS Shared Services: writing proposals, budget preparation, and proposal submission.
4	Theme: Quantitative Genetics Review and Mating Designs Day 1: Tuesday Sept 22 a. Mating Designs I Day 2: Thursday Sept 24 a. Mating Designs II b. Paper discussion on Mating Designs – Leader: TBD

5	Theme: Polyploidy and Mating Designs Day 1: Tuesday Sept 29 a. Breeding polyploid and apomictic crops Day 2: Thursday Oct 1 a. Quantitative Genetics Review b. Paper discussion on breeding polyploid crops – Leader: TBD
	Area: Population evaluation
6	Theme: Experimental Designs Use in Plant Breeding Day 1: Tuesday Oct 6 a. Field plot techniques and experimental designs Day 2: Thursday Oct 8 a. Mixed Models and BLUP in plant breeding I b. **Breeding Proposal Part 1 Deadline due at 5 PM.**
7	Theme: Use of BLUP in breeding Day 1: Tuesday Oct 13 a. Mixed Models and BLUP in plant breeding II b. Paper discussion on BLUP – Leader: TBD Day 2: Thursday Oct 15 c. Advanced experimental designs used in plant breeding and data analysis demo. Leader: Dr. José Airton Rodrigues Nunes, Federal University of Lavras, Brazil.
8	Theme: Genotype by Environment - High-Throughput Phenotyping Day 1: Tuesday Oct 20 a. Genotype by Environment Interaction Day 2: Thursday Oct 22 a. Implementing AI and HTP in Plant Breeding. Leader: Dr. Filipe Matias, Research Associate, Department of Horticulture, University of Wisconsin-Madison.
	Area: Molecular and Genomic Breeding
9	Theme: Use of molecular tools in Plant Breeding Day 1: Tuesday Oct 27 a. QTL mapping and Marker Assisted Selection Day 2: Thursday Oct 29 a. Applying Marker Assisted Selection in a Breeding Program. Leader: Dr. Samuel Hutton, UF-IFAS Tomato Breeder. b. Paper discussion on QTL and MAS – Leader: TBD c. **Breeding Proposal Part 2 Deadline due at 5 PM.**
10	Theme: Genomic Breeding Day 1: Tuesday Nov 3 a. Genomic breeding I: Genome-wide Association Studies Day 2: Thursday Nov 5 a. Genomic Breeding II: Genomic Prediction b. Paper discussion on Genome-wide Association Studies– Leader: TBD
11	**NO CLASS Nov 10 and 12. CROP SCIENCE MEETING in Phoenix, Arizona (Virtual).** **Breeding Proposal Deadline due at 5 PM on Nov 12.**

12	Theme: Genomic Breeding Day 1: Tuesday Nov 17 a. Genomic Breeding III: Genomic Prediction b. Paper discussion on Genomic Prediction – Leader: TBD Day 2: Thursday Nov 19 a. Applying Genomic Prediction in a Public Breeding Program. Leader: Dr. Ivone de Bem Oliveira. b. Integrating Crop Modeling and Genomic Prediction in Plant Breeding. Leader: Dr. Charlie Messina, Corteva Agrisciences.
	Area: Product Commercialization, Marketing and Supply
13	Theme: Intellectual Property Protection in Plant Breeding Day 1: Tuesday Nov 24 a. IP in Plant Breeding: Cultivar Release and Marketing. Leader: John Beuttenmuller, Florida Foundation Seed Producers Inc. Day 2: Thursday Nov 26 a. **No class due to Holidays (Happy Thanksgiving!).**
14	Theme: Proposal Presentations Day 1: Tuesday Dec 1 a. Proposal Presentations: 4 students Day 2: Thursday Dec 3 a. **Take-home Exam.**
15	Theme: Final Exam Day 1: Tuesday Dec 8 a. Proposal Presentations: 3 students b. Class wrap-up, feedback on exam and proposals.

ADDITIONAL REFERENCES

- Bernardo, R. 2010. Breeding for Quantitative Traits in Plants. Second Edition. Stemma Press, Minnesota.
- Cameron, N.D. 1997. Selection Indices and Prediction of Genetic Merit in Animal Breeding. CAB International. Wallington, UK.
- Hallauer, A.R.; Carena, M.J. Miranda Filho, J.B. 2010. Quantitative Genetics in Maize Breeding. Springer, New York.
- Henderson, C.R. 1984. Applications of Linear Models in Animal Breeding. University of Guelph.
- Kearsey, M. J. and H. S. Pooni. 1996. The Genetical Analysis of Quantitative Traits. Chapman & Hall, New York.
- Littell, R. C.; Milliken, G.A.; Strop, W.W.; Wolfinger, R.D. and O. Schabenberger. 2006. SAS for Mixed Models. Second Edition. Cary, NC: SAS Institute Inc.
- Mather, K. and J. L. Jinks. 1977. Introduction to Biometrical Genetics. Cornell University Press, Ithaca, New York.

Attendance and Make-Up Work

"Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies that can be found at: https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/

Online Course Evaluation Process

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at https://gatorevals.aa.ufl.edu/students/. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their

Canvas course menu under GatorEvals, or via https://ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students at https://gatorevals.aa.ufl.edu/public-results/.

Academic Honesty
UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (https://sccr.dso.ufl.edu/process/student-conduct-code/) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Software Use
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.

Services for Students with Disabilities
"Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, www.dso.ufl.edu/drc/) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester."

Campus Helping Resources
Health and Wellness:

U Matter, We Care: If you or someone you know is in distress, please contact umatter@ufl.edu, 352-392-1575, or visit https://umatter.ufl.edu/ to refer or report a concern and a team member will reach out to the student in distress.

Counseling and Wellness Center: Visit https://counseling.ufl.edu/ or call 352-392-1575 for information on crisis services as well as non-crisis services.

Student Health Care Center: Call 352-392-1161 for 24/7 information to help you find the care you need, or visit https://shcc.ufl.edu/.

University Police Department: Visit https://police.ufl.edu/ or call 352-392-1111 (or 9-1-1 for emergencies).

UF Health Shands Emergency Room / Trauma Center: For immediate medical care call 352-733-0111 or go to the emergency room at 1515 SW Archer Road, Gainesville, FL 32608; https://ufhealth.org/emergency-room-trauma-center.

Privacy statement
Our class sessions may be audio visually recorded for students in the class to refer back and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live. The chat will not be recorded or shared. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.