

**AGR5321C Genetic Improvement of Plants
Spring 2024
Section: GNV1 (class# 10275), REC1 (class# 24455)**

Instructor: Dr. M A Babar

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Review session, 3:30 pm to 5:00 pm (Thursday). A review session, question and answers, etc through zoom. On campus students are welcome to visit the instructor's office at other time as well but it is wise to schedule an appointment (e-mail) to make sure the instructor is available.

Instructor: Dr. F. Altpeter

Office: 3085 McCarty

Office phone: (352) 273-3418

E-Mail: altpeter@ufl.edu

Office or lab visits and Zoom consultations are welcome, appointments by email are recommended for meeting outside of regular office hours.

Review session, 3:30 pm to 5:00 pm every Monday (between March 25th and April 15th)

Zoom link will be provided.

TA: Jordan McBreen

Office: 3-5 pm; Wednesday

Phone: 239-247-3277

E-Mail: jcmcbreen@ufl.edu

Office Hours: Through zoom link.

Class schedule: Online

Prerequisites: AGR 3303 (Genetics) or PCB 3063 (Genetics).

Text: Breeding Field Crops Fifth Edition by Sleper and Poehlman. An outline of lecture notes will be available on the web site prior to the beginning of each major topic.

Course Learning Objectives/Outcomes:

Upon completion of this course, student should be able to

1. Define basic plant breeding terms
2. Apply the basic principles of plant breeding for genetic improvement of plants
3. Describe how total phenotypic variations are partitioned into different components and how the genetic portion is manipulated.
5. Describe how mode of pollination, fertilization, reproduction, and fertility gene manipulation impact the ability to manipulate genetic variation.

6. Understand selection parameters, heritability, and genetic gain concept, and how they are applied for plant improvement.
6. Describe various breeding techniques (including pedigree, bulk, recurrent, double haploid, back cross, shuttle breeding) that can be used in genetic improvement of self- and cross-pollinated crops.
7. Describe various molecular breeding techniques and methods those could be used for genetic improvement of crops

Grading:

There will be four major exams. **Each of these exams will count 100 points = 400 points.** **Exam-1, 2 and 3 will be administered by Dr. Babar and exam-4 by Dr. Altpeter.** The exams are not cumulative. All the exams will be proctored through **Honor lock.** Students will submit three lab reports assigned by Dr. Babar (lab assignment-1 & 2) and Dr. Altpeter (lab assignment-3) with total points of **210 points (each assignment counts 70 points).** Lab assignment-1 will include solving and explaining various problems related to qualitative inheritance; lab assignment-2 will include solving and explaining various problems related to quantitative inheritance. Lab assignment-3 will require you to design an experiment for biolistic gene transfer of recombinant DNA constructs to plants based on information that you can gather from provided instructional videos and research articles. The grade for lab assignments 1 and 2 will be determined from a formal written report. For lab assignment 3, your grade will be determined from your answers to a questionnaire.

Graduate review paper: A review paper (**for Dr. Babar's part**) on a "recent plant breeding techniques" is required to be submitted by March 24 and is worth **90 points.** The topics for the review paper are provided below and students have to select a topic **by January 31.** A formal review paper must be submitted **by March 24.** Students can select one of these topics and write a review paper of 4 pages (without bibliography). Font size is 12 with single spaced line. Students need to use 20-25 citations for writing the review paper. A sample review paper will be posted on canvas.

Review paper topics:

- Multi-variate genomic selection, its limitation and application in plant breeding for genetic improvement of traits.
- Genome wide association mapping, its limitation and application in plant breeding.
- Application of high throughput phenotyping (phenomics) in plant breeding.
- Speed breeding and its application to increase genetic gain.
- Use of machine learning and artificial intelligence in the genetic improvement the crops.

Bonus Quiz Points: Bonus quizzes worth **1 point** each and will be given randomly throughout the semester. These quizzes will be conducted through canvas. **Students will be given 8 minutes to answer the questions.** The instructor will send an email through canvas (24 hours before) when the bonus quiz will be posted. There is no make-up for missing a bonus quiz.

Bonus discussion points: Bonus points can be awarded by posting interesting discussion topics in Canvas related to plant breeding. The discussion topics have to be related to genetic improvement of plants, and students have to write at least **300 words long summary** on the findings and significance of the topics and will send that to instructor for review and approve before posting in canvas. A student can get **1 point** by posting one topic and can't post more than **2 topics**. **A student can get a maximum total of 2 discussion bonus points by posting two interesting plant breeding topics.**

Bonus breeding field tour: A bonus breeding field trip will be organized to visit UF small grain breeding program between **March 25-30**. The date and time of the field trip will be decided after discussion with students. The bonus field trip will be worth 5 bonus points. The grade for the bonus breeding tour will be determined from a formal written short report.

The maximum available total course points (excluding bonus points) are 700.

		Points
Exam	Four	400 (each worth 100 points)
Assignment	Three	210 (each worth 70 points)
Review paper	one	90
Quiz and discussion		12-16 points (Bonus)
Bonus breeding field tour		5 points (Bonus)
Total		700

Makeup Exam: A zero will be given if you miss the scheduled exam. A makeup-exam may be offered at the discretion of the instructor and will only be offered with a legitimate excuse for missing the scheduled exam (medical, family emergency, official university and religious holiday) will be accepted. Excuses for missing upcoming exams should be sent to the instructor for approval at least 24 hours before the scheduled exam.

Exam feedback: 5 questions with the highest percentage of wrong answers will be provided to students after each exam. However, students can meet with instructor and TA to get exam feedback as well.

Assignment feedback: Assignment feedback will be provided through canvas.

Grades will be assigned according to the following scale:

<u>% of available marks</u>	<u>Grade</u>
>90%	A
85% to 89.99%	B+
80% to 84.99%	B
75% to 79.99%	C+
70% to 74.99%	C
65% to 69.99%	D+
60% to 64.99%	D
< 60%	E

Grades and Grade Points Effective May 11, 2009 - Summer A

<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

Passing Grade	A	B+	B	C+	C	D+	D	S
Grade Points	4.0	3.3	3.0	2.3	2.0	1.3	1	0

Participation:

Students are expected to complete each presentation in time.

Course website:

E-Learning system, Canvas to <http://elearning.ufl.edu> is the online source for majority of the course modules. All modules will be uploaded in the “module” section of Canvas. Lab assignments will also be uploaded in the “module” section of Canvas under “Lab assignment” folder. Announcements regarding general course information will be posted in Canvas throughout the semester. Students need to login with GatorLink username and password for access. If you do not have a GatorLink ID go to <http://gatorlink.ufl.edu> or to the Help Desk: 392-HELP for assistance.

Exam objectives:

Exam 1: Basic genetic and breeding principles; contribution of plant breeding; importance of international plant breeding institutions; different reproduction methods and their importance in plant breeding; genetic recombination; monogenic and polygenic traits; discontinuous variation; testing of hypothesis; chromosome numbers and their manipulations in plant breeding.

Exam 2: Continuous variation, concept of heritability and genetic gain; Hardy-Weinberg law of equilibrium and relationship to plant breeding; fertility mechanisms and their manipulation in plant breeding; concepts of breeding environments, characterize breeding goals and selection objectives; concepts of direct and indirect selections; application of genetic gain and heritability

concepts in plant breeding; concept of genetic, environment and genotype-environment interaction effects on traits.

Exam 3: Methods for self-pollinating crop breeding; methods of cross-pollinating crop breeding and their comparison with self-pollinating crop breeding methods; factors affecting selection process (such as environment, selection pressure, pedigree information, trait expression, etc); double haploid breeding technique; development of hybrid varieties, concept of heterosis or hybrid vigor; UF plant breeding programs (corn, peanut, forage, and strawberry).

Exam 4: Introduction to Biotech crops, gene technologies for crop improvement, molecular markers, and marker assisted breeding, transgenic approach of plant improvement.

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Schedule of Lecture Topics and Exams

Lecture	Date	Topic
Week 1	01/08 to 1/12	Introduction; Plant breeders and their work; Contribution of ICAR. Review of Meiosis; Mendel's law of inheritance (Dr. Babar)
Week 2	01/15 to 01/19	Reproduction in crop plants; Heritable variation: gene recombination in plant breeding (Dr. Babar)
Week 3	01/22 to 01/26	Discontinuous variation and plant breeding; variation of chromosome number (Dr. Babar)
	Lab-1 assignment (01/22)	Lab-1 assignment: Probability, discontinuous variation, qualitative inheritance, and test of hypothesis (Dr. Babar)
Week 4	01/29 to 02/02	Continuous variation, polygenic inheritance; heritability, genetic gain (Dr. Babar)
	Exam-1 (01/29)	Exam 1; 90 mins scheduled time; from 5:00 pm of 01/29 to 11:59 pm of 01/30 (Dr. Babar)
Week 5	02/05 to 02/09	Selection objectives; Indirect select in plant breeding; selection efficiency (Dr. Babar)
	Lab-2 assignment (02/05)	Lab-2 assignment: Quantitative traits, heritability, genetic gain, and application in plant breeding (Dr. Babar)
Week 6	02/12 to 02/16	Fertility-regulating mechanisms and their manipulation (Dr. Babar)
Week 7	02/19 to 02/23	Breeding methods for self-pollinating crops (Dr. Babar)
	Exam-2 (02/19)	Exam 2; 90 mins scheduled time; from 5:00 pm of 02/19 to 11:59 pm of 02/20 (Dr. Babar)
Week 8	02/26 to 03/01	Breeding methods for cross-pollinating crops (Dr. Babar)
Week 9	03/04 to 03/07	Breeding methods suitable for hybrid cultivars (Dr. Babar)
		Breeding methods of corn, peanut, forage, and strawberry (Dr. Babar)
	Exam-3 (03/08)	Exam 3; 90 mins scheduled time; from 5 pm of 03/08 to 11:59 pm of 03/09 (Dr. Babar)
Week 10	03/11 to 03/16	Spring break
Week 11	03/18 to 03/22	Introduction to Biotech crops I-IV (Dr. Altpeter)
Week 12	03/25 to 03/29	Introduction to Biotech crops V-VI (Dr. Altpeter)
		Molecular characterization of (transgenic) plants I-II (Dr. Altpeter)
Week 13	04/01 to 04/05	Biotech demonstration videos I-V (Dr. Altpeter)
		Lab-3 assignment: Designing an experiment for biolistic gene transfer of recombinant DNA constructs to plants (Dr. Altpeter)
Week 14	04/08 to 04/12	Molecular markers and Marker-assisted breeding I-III (Dr. Altpeter)
Week 15	04/15 to 04/19	Review session for exam 4 (Dr. Altpeter) via zoom link, Monday April 15 th 3:30 pm-5pm
Week 16	04/22 to 4/26	Exam 4; 90 mins scheduled time; from 8 am of Monday 04/22 to 11:59 pm of Monday 04/22 (Dr. Altpeter)

Note: We will attempt to maintain the exam schedule; however, material may be altered for any given exam depending on time and coverage of lectures.

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:

In 1995, the UF student body enacted an [honor code](#) and voluntarily committed itself to the highest standards of honesty and integrity. When students enroll at the university, they commit themselves to the standard drafted and enacted by students. **The Honor Pledge: We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity.** On all work submitted for credit by students at the university, the following pledge is either required or implied: "**On my honor, I have neither given nor received unauthorized aid in doing this assignment.**" Students should report any condition that facilitates dishonesty to the instructor, department chair, college dean, Student Honor Council, or Student Conduct and Conflict Resolution in the Dean of Students Office. (Source: 2012-2013 Undergraduate Catalog). It is assumed all work will be completed independently unless the assignment is defined as a group project, in writing by the instructor. This policy will be vigorously upheld at all times in this course.

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.

Campus Helping Resources:

Students experiencing crises or personal problems that interfere with their general well-being are encouraged to utilize the university's counseling resources. The Counseling & Wellness Center provides confidential counseling services at no cost for currently enrolled students. Resources are available on campus for students having personal problems or lacking clear career or academic goals, which interfere with their academic performance.

1. *University Counseling & Wellness Center, 3190 Radio Road, 352-392-1575, www.counseling.ufl.edu/cwc/*
 - Counseling Services
 - Groups and Workshops Outreach and Consultation Self-Help Library
 - Training Programs
 - Community Provider Database
2. *Career Resource Center, First Floor JWRU, 392-1601, www.crc.ufl.edu/*

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 accommodations. Students with disabilities should follow this procedure as early as possible in the semester

NOTE: The instructors reserve the right to change any information contained in this and other handouts in this course.