**AGR5321C Genetic Improvement of Plants**
**Spring 2025**
**Section: AME1 (18741), GNV2 (class# 24094), REC1 (class# 19350)**

## ***Instructor: Dr. M A Babar***

Office: 2005 SW 23rd St, Bldg # 350, Room # 102, Gainesville, FL 32608
Phone: 352-273-2213
E-Mail: mababar@ufl.edu

***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 another 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
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 24th and April 21st)***
**Z**oom link will be provided for review sessions.

***TA: Sudip Kunwar***

Office: 3-5 pm; Wednesday
Phone: 239-247-3277
E-Mail: skunwar@ufl.edu

***Office Hours:*** Through Zoom link.

***Class schedule:*** ***95%*** **Online and 5% In-person**

***Prerequisites:*** AGR 3303 (Genetics) or PCB 3063 (Genetics) or equivalent course.

***Text:*** Breeding Field Crops Fifth Edition by Sleper and Poehlman. An outline of lecture notes will be available on the website before the beginning of each major topic.

## ***Course Objectives:***

Introduce concepts and applied aspects of plant breeding and molecular biology that allow students to describe and discuss the available strategies for crop improvement.

## ***Course Learning Outcomes:***

Upon completion of this course, students should be able to:

1. Students will be able to explain the impact of plant breeding on society and global food security.
2. Students will be able to explain the basic principles of plant breeding and how to apply them for the genetic improvement of plants.
3. Students will be able to analyze total phenotypic variations and partition them into different components.
5. Students will be able to apply fertility regulation mechanisms for crop variety development.
6. Students will be able to explain how heritability and genetic gain concepts are applied to the genetic improvement of plants.
6. Students will be able to determine which plant breeding techniques are suitable for cultivar development of specific crops.
7. Describe and distinguish various molecular breeding techniques and biotechnology methods that can be used for the genetic improvement of crops.

## ***Grading:***

There will be four major exams. **Each of these exams will count as 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. **Exam 1 will be an in-person proctored exam while exams 2, 3 & 4 will be proctored through Honor Lock.** Students will submit three reports assigned by Dr. Babar (assignment-1 & 2) and Dr. Altpeter (assignment-3) with total points of **210 points (each assignment counts 70 points).** Assignment 1 will include solving and explaining various problems related to qualitative inheritance; assignment 2 will include solving and explaining various problems related to quantitative inheritance. 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 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 a bibliography). The font size is 12 with single-spaced lines. 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 and its limitations.
- Speed breeding and its application to increase genetic gain and limitations.
- Use of machine learning and artificial intelligence in the genetic improvement the crops, and its limitations.

**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.** 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 the genetic improvement of plants, and students have to write at least **a 300-word long summary** on the findings and significance of the topics and will send that to the instructor for review and approval 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 24-28**. 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:***

| % of available marks | Grade |
|---|---|
| >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 |

## ***Requirement for Learner Interaction:***

Learner interaction is required during course review sessions and during contributions in the online discussion forum.

## ***Instructor response plan:***

The instructor strives to provide frequent feedback and short response times. Same-day response to emails and discussion postings can be expected, and feedback on assignments, and exam grades will typically be provided within three business days of the submission. Grading of Assignments will take 5-8 business days from submission due to the time required for reviewing the long essay answers in these assignments.

## ***Attendance and Participation:***

Students are expected to log on in on time to scheduled synchronous review sessions and have cell phones turned off and cameras turned on. Students are expected to be prepared (have completed modules and read papers prior to discussion) and participate in class discussions during synchronous review sessions, ask questions and push for clarity. Bonus points are available for initiation of a student led discussion on a plant breeding/biotechnology topic in the online discussion forum in Canvas.

## ***Course website:***

E-Learning system, Canvas to http://elearning.ufl.edu is the online source for the majority of the course modules. All modules will be uploaded in the "module" section of Canvas. Assignments,

quizzes, exams, and discussions will also be uploaded in the "module" section of Canvas. 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.

## ***Technology requirements:***

Required peripherals include a working webcam, microphone, and speakers attached or built into the computer. Headphones are not permitted during proctored exams.
For video conferencing, you will need Zoom.
It is recommended to have a minimum Internet speed of 5 Mbps for video conferencing. You can test your internet speed here https://www.bandwidthplace.com/speed-test
Adobe Acrobat Reader software is the free global standard for viewing and printing PDF documents. It is the only PDF file viewer that can open and interact with all types of PDF content.
The proctoring service Honorlock used during online exams requires the use of the web browser Google Chrome and the Chrome extension for Honorlock.
A guide how to use Honorlock can be found here.
A cross-platform multimedia player that plays most multimedia files.
Information how to gain free access to journal articles at the University of Florida is provided here.
Microsoft 365 office for assignments and powerpoint for presentations.

University of Florida students have access to discounted software.

This link provides information regarding technology requirements and skills you may need to use Canvas: https://community.canvaslms.com/t5/Canvas-Basics-Guide/What-tools-and-computer-skills-do-I-need-to-use-Canvas/ta-p/446129. Minimum computer requirements can be found here: https://ufonline.ufl.edu/resources/computer-requirements/

## ***Minimum technical skills required before engaging in this online course include:***

Being able to use the learning management system Canvas as explained in the previous section, using email with attachments, creating, editing, formatting and submitting files in commonly used word processing program formats (such as Microsoft Word or Google Docs), downloading and installing software, following tutorials for software use, using the video conferencing platform zoom including screen sharing and chat functions. Basic computer skills, including understanding fundamental operations like file management, using menus and toolbars, and navigating between different applications. Ability to perform online research using a variety of search engines and library databases.

## ***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, the 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, marker-assisted breeding, and transgenic approach of plant improvement.

## ***Assignment objectives:***

**Assignment 1:**
In this assignment, students will learn

- How to derive a genetic hypothesis for qualitatively inherited traits,
- Use of the statistical method to prove the hypothesis,
- How to make a genetic interpretation on inheritance patterns for qualitative traits.

**Assignment 2:**
In this assignment, students will learn

- How to estimate genetic and phenotypic variances, heritability, genetic gain, realized heritability, and correlated response,
- How to make a genetic interpretation on inheritance patterns for quantitative traits.

**Assignment 3:**
This Assignment will make you familiar with

- Retrieving sequences from Genbank (NCBI),
- Using the Snapgene software that displays restriction enzyme sites in specific sequences,

- Designing primers to PCR amplify sequences and at the same time incorporate new restriction sites to clone the PCR amplified sequence in a specific recombinant DNA vector,
- Setup a biolistic gene transfer experiment for the transformation of wheat.

**AGR 5321 - Genetic Improvement of Plants**
**Spring 2025**

***Schedule of Lecture Topics and Exams***

| Lecture | Date | Topic |
|---|---|---|
| Week 1 | 01/13 to 1/17 | Introduction; Plant breeders and their work; Contribution of ICAR. Review of Meiosis; Mendel's law of inheritance (**Dr. Babar**) |
| Week 2 | 01/20 to 01/24 | Reproduction in crop plants; Heritable variation: gene recombination in plant breeding (**Dr. Babar**) |
| Week 3 | 01/27 to 01/31 | Discontinuous variation and plant breeding; variation of chromosome number (**Dr. Babar**) |
| | **Assignment-1** | **Assignment 1 is Due on January 29, 2025 (Dr. Babar)** |
| | **Exam 1 (01/31)** | **Exam 1; 90 mins in-person from 3-5 pm (Dr. Babar)** |
| Week 4 | 02/03 to 02/07 | Continuous variation, polygenic inheritance; heritability, genetic gain (**Dr. Babar**) |
| Week 5 | 02/10 to 02/14 | Selection objectives; Indirect selection in plant breeding; selection efficiency (**Dr. Babar**) |
| Week 6 | 02/17 to 02/21 | Fertility-regulating mechanisms and their manipulation (**Dr. Babar**) |
| | **Assignment-2** | **Assignment 2 is due on February 19, 2025** (**Dr. Babar**) |
| | **Exam-2 (02/21)** | **Exam 2; 90 mins via Honor Lock; will open at 6 am and will close at 8 pm (Dr. Babar)** |
| Week 7 | 02/24 to 02/28 | Breeding methods for self-pollinating crops (**Dr. Babar**) |
| Week 8 | 02/03 to 03/07 | Breeding methods for cross-pollinating crops (**Dr. Babar**) |
| Week 9 | 03/10 to 03/12 | Breeding methods suitable for hybrid cultivars (**Dr. Babar**) |
| | | Breeding methods of corn, peanut, forage, and strawberry (**Dr. Babar**) |
| | **Exam-3 (03/12)** | **Exam 3; 90 mins via Honor Lock; will open at 6 am and will close at 8 pm (Dr. Babar)** |
| | **03/13-03-14** | Introduction to Biotech crops I-II (**Dr. Altpeter**) |
| Week 10 | 03/17 to 03/21 | **Spring break** |
| Week 11 | 03/24 to 03/28 | Introduction to Biotech crops III-VI (**Dr. Altpeter**) |
| Week 12 | 03/31 to 04/04 | Molecular characterization of (transgenic) plants I-II (Dr. Altpeter) |
| | | Biotech demonstration videos I-III (Dr. Altpeter)<br>**Lab-3 assignment**: Designing an experiment for biolistic gene transfer of recombinant DNA constructs to plants (Dr. Altpeter) |
| Week 13 | 04/07 to 04/11 | Biotech demonstration videos IV-V (Dr. Altpeter)<br>**Lab-3 assignment (continued)**: Designing an experiment for biolistic gene transfer of recombinant DNA constructs to plants (Dr. Altpeter) |
| Week 14 | 04/14 to 04/18 | Molecular markers and Marker-assisted breeding I-III (**Dr. Altpeter**) |

| | | |
|---|---|---|
| Week 15 | 4/21. Biotech review session | Review session for exam 4 (**Dr. Altpeter**) Monday April 21st, 3:30 pm to 5pm |
| | Exam 4 (04/23) | **Exam 4; 90 mins via Honor Lock on Wednesday 4/23rd, 6am to 8pm (Dr. Altpeter)** |

***Note: We will attempt to maintain the exam schedule; however, material may be altered for any given exam depending on the 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.**

**Note: Instructional materials for this course consist of only those materials specifically reviewed, selected, and assigned by the instructor(s). The instructor(s) is only responsible for these instructional materials.**