

AGRO 896: An Introduction to Hybrid Breeding

Fall, 2023

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Instructors:

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Note on instructor availability: The instructor strongly encourages participant/instructor interactions. While there are no formal scheduled office hours, please contact the instructors for either in-office or Zoom consultation, and appointments will be made as requested. Also, time is allocated during the weekly Discussions and Workshops (described in the Syllabus) for questions, answers, and discussion of course content.

What:

An on-line course on breeding hybrid crops, focusing on logistics and strategies used by hybrid breeders to create and identify genetically superior hybrids that bring value to producers and end users. The course stresses a comprehensive, end-to-end view of hybrid breeding beginning with seed in breeding inventories, passing through all stages of breeding, including recombination, evaluation, and seed increases, to the final production of commercial seed. While underlying genetic theory is touched upon, the course centers on practical decisions that must be made on the structure, logistics, and management of a hybrid breeding program.

For Whom:

Individuals who want to learn the basics of, or otherwise extend their knowledge of, hybrid breeding. The course is open to upper-level undergraduates, and to graduate students who want to learn about hybrid breeding.

When:

Fall semester of 2023.

How:

The course consists of pre-recorded lectures, multiple projects and assignments, and interactive Zoom held twice each week. Canvas is used to publish course information, pre-recorded lectures, and otherwise exchange files and documents.

Prerequisites:

Required: Permission of Instructor:

Recommendations: Minimum of one semester of undergraduate or graduate level genetics; Minimum of one course in plant breeding;

Credits:

The course is offered as a two-hour credit course.

Course Description:

AGRO 896-Introduction to Hybrid Breeding (AGRO-896 Independent Study) is a two-hour (2 credits) course delivered on-line. The course is an introduction to hybrid breeding, with topics including: (a) Defining a comprehensive and sustainable hybrid breeding program that creates, evaluates, and releases or commercializes genetically improved hybrids, (b) Definitions, and terminology of hybrid breeding, as used to describe germplasm, breeding populations, and breeding families as well as descriptions of the multiple stages of parental line development and hybrid evaluation and advancement; (c) Heterosis and the development and utilization of heterotic groups and germplasm pools for both parental line development and hybrid development; (d) Designing and implementing a comprehensive, end-to-end breeding program that is both reciprocal and recurrent; and (e) Developing and managing the logistical components of a hybrid breeding program. Knowledge and experience are gained through a combination of recorded lectures and interactive workshops centered on real-world hybrid breeding examples. Topics, examples, and projects draw heavily from maize breeding with a strong industry perspective.

-Course Calendar and Schedule-

Semester Details, UNL Calendar, Fall 2023:

Semester begins: 21 Aug
Semester break: 17-18 Oct
Thanksgiving: 23-26 Nov
Semester Ends: 10 Dec
Finals Week: Begins 12 Dec

Course Information:Weekly Meetings of Course:

Tuesdays- Topics Discussions
12:00-1:00

Thursdays- Workshops
12:00-1:30

First *Discussion* Session:
22 Aug 2023

Last *Workshop* Session:
26 Oct 2023

See the spreadsheet entitled "IHB-23F-Course_Outline-896-20230414.2005.xlsx", published in Canvas, for a detailed calendar and listing of Lectures, Topics, and Activities.

-Course Syllabus-

Textbook, Materials, and Technical Requirements:

There is no textbook *per se* required for the course. Recorded Lectures serve as the "textbook" for the course and are "required reading". Other recommended references are listed at the end of this syllabus with other useful resources referenced as the course progresses.

To participate in this course Participants must have access to:

A university E-mail address for communication purposes

An Internet browser

Microsoft Office Suite, including Word, Excel, Access, PowerPoint

Adobe Acrobat Reader, or other means of viewing pdf files.

RealPlayer

Speakers, headphones, or earbuds for listening to lectures

Zoom Client for Meetings, available at zoom.us/download or in the app store for Android or iOS

Ability to download and install statistical software

There is no need of course participants to install specialty software before the course begins.

Also note: Communication and exchange of files and videos is via [Canvas](#) while video conferencing as needed for Discussions and Workshops, is via [Zoom](#). Course participants must be able to navigate both systems.

Course Description

AGRO 896-Introduction to Hybrid Breeding (AGRO-896 Independent Study) is a two-hour (2 credits) course delivered on-line. The course is an introduction to hybrid breeding, with topics including: (a) Defining a comprehensive and sustainable hybrid breeding program that creates, evaluates, and releases or commercializes genetically improved hybrids, (b) Definitions, and terminology of hybrid breeding, as used to describe germplasm, breeding populations, and breeding families as well as descriptions of the multiple stages of parental line development and hybrid evaluation and

advancement; (c) Heterosis and the development and utilization of heterotic groups and germplasm pools for both parental line development and hybrid development; (d) Designing and implementing a comprehensive, end-to-end breeding program that is both reciprocal and recurrent; and (e) Developing and managing the logistical components of a hybrid breeding program. Knowledge and experience are gained through a combination of recorded lectures and interactive workshops centered on real-world hybrid breeding examples and data sets. Topics and projects draw heavily from maize breeding with a strong industry perspective.

Prerequisites:

Required: Permission of Instructor:

Recommendations: Minimum of one semester of undergraduate or graduate level genetics; Minimum of one course in plant breeding.

Learning Outcomes

This course is designed to help each early career plant breeder, i.e., course participant, extend his/her (1) technical knowledge, (2) practical experience, and (3) critical thinking skills in hybrid breeding by:

1. Understanding the wholistic processes of hybrid breeding where the goal is continuous and sustainable release/commercialization of genetically improved hybrids over time and generations;
2. Building knowledge of terminologies and vernaculars commonly used hybrid breeding;
3. Developing and extending his/her knowledge of germplasm pools and the use of those pools in hybrid breeding and product development;
4. Developing and extending her/his ability to design an effective and efficient hybrid breeding pipeline, for both parental line development and hybrid development, under resource constraints;
5. Building knowledge on the implications of intellectual property in hybrid breeding;
6. Enhancing her/his ability to recognize and respect the value of diverse perspectives, backgrounds, and ideas, and to effectively promote and utilize that diversity when making plant breeding decisions and managing a hybrid breeding program.
7. Enhancing her/his ability to think, **think, THINK! Analytically, Logically, and Critically!**

Course Outline

Topics:

The following list are those Topics covered in the course. Please note, adjustments may be made, depending on the interest and/or progress of course participants over the semester.

Note: In the course, each main Topic corresponds to a recorded Lecture.

Course/Lecture Topics:

1. Course Introduction & Expectations
2. Defining “End-To-End” Hybrid Breeding

3. Hybrid Breeding: Terminology and Definitions
4. Germplasm & Inventories:
 - 4.1. Value of heterosis in hybrid breeding
 - 4.2. Heterotic Groups & Germplasm Pools Defined
 - 4.3. Reciprocal improvement of Germplasm Pools
5. Parental Line Development, Part I: Creation of Inbred lines
 - 5.1. Filial development of inbred lines
 - 5.2. Doubled haploid in bred lines
6. Parental Line Development, Part II: Building the Pipeline
 - 6.1. Nursery and stage advancement
 - 6.2. Structure of an evaluation program
7. Hybrid Development: Creation and Evaluation
8. Seed Production: Implications on Decisions
9. Intellectual Property: Types and Implications
10. Course Review and Wrap-up

Assignments and Awards:

Awards and Grading Policy:

General Background:

The instructor's goal is that course participants, regarded as plant breeders while taking this course, not students, develop foundational knowledge of the collective components of an effective and efficient hybrid breeding program. To facilitate this learning process, each participant is required to actively participate in weekly Topic Discussions, actively engage in weekly Workshops, and to complete weekly Written Reflection. In addition to the weekly activities each participant is expected to participate in a group project that will be developed over the duration of the course, culminating with a final report at the end of the course.

Details for assignments and the structure of assignments used of grading/assessment are given in the Assignments and Assessment Document published in Canvas (and reproduced below), available the first day of the course.

Final Letter Grade:

Final letter grade will be awarded using the following scale, based upon percentage of total points earned over all weeks of the course:

Percent Points Earned	Letter Grade
95-100	A+
90-94	A
85-89	B+
80-84	B
75-79	C+

70-74	C
65-69	D+
60-64	D
<60	F

Assignments/Awards: An Overview

Weekly Activities:

Points are awarded for **three weekly activities (1) active participation in Topics Discussions (Tuesdays), (2) active participation in Workshops and Workshop Assignments (Thursdays), and (3) submission of Written Reflections.** Details for the Assignments and Awards are given in the Assignments Document published in Canvas. Please note: While a schedule is given in the Assignments Document for delivery and discussion of topics, adjustments may be made per the collective interest in specific topics.

To encourage active participation during Discussions and Workshops, assignments and associated materials will be published in Canvas on Monday of each week prior to the week's Tuesday Discussion and the week's Thursday Workshop. Participants are expected to view lectures and review other pertinent materials prior to each week's Discussion and Workshop.

Course Project

The last three weeks of the course are dedicated group project. During the last three weeks there are no additional lectures, however both Tuesday and Thursday sessions continue and are devoted to working on the Course Project. (Please note that Written Reflections are also required for each of these three weeks.) Successful completion of the Course Project will result in the award of a possible maximum of 450 points. See the Assignment Document published in Canvas for details on the Course Project.

Additional Notes on Assignments/Awards:

Rubrics for the Awards are created in Canvas, ensuring clear communication of specific expectations of students with respect to assignments and to facilitate consistent assessment by the instructor across activities and students.

To facilitate the learning process, participants are strongly encouraged to interact when working on the assignments, as well as seek help from the instructor, or any other source of information or assistance as is deemed appropriate and needed. However please note: Full credit to sources of information must be always given in any document submitted in response to an assignment, whether that source of information is a publication, a discussion with a colleague, or any other source of formal or informally obtained information.

Lastly, the following table lists the maximum total possible points awarded/

	Points Awarded			
	Discussions & Workshops	Written Reflections	Course Project	Totals
Weekly	45 ¹	45 ¹	NA	90
Totals	450 ²	450 ²	360 ³	1260

¹Points each week, per activity.

²Total possible points, summed across 14 weeks, per activity.

³Total possible points, single award at end of course.

Details on Assignments and Awards are found in the Assignment Document published in Canvas.

Note: All activities described in the Assignment Document must be completed to receive a final grade.

-Student Conduct-

Course Etiquette

Be courteous when submitting assignments and participating in discussions. Offensive materials will be removed from the course web site. Students will be contacted if material is deemed inappropriate by the instructor.

Academic Integrity Policy:

Academic honesty is essential to the existence and integrity of an academic institution. The responsibility for maintaining that integrity is shared by all members of the academic community. To

further serve this end, the University supports a Student Code of Conduct which addresses the issue of academic dishonesty.

Each student is expected to submit answers to problem sets individually. However, students are strongly encouraged to interact when studying the course materials. Time in the weekly Workshops is dedicated to Q&A. Feel free to make full use of libraries, the internet, and other references, including verbal discussion with other students and/or faculty, but always credit sources when citing literature or other sources of information. **Plagiarism is not allowed.**

Diversity:

The University is committed to a pluralistic campus community through Affirmative Action and Equal Opportunity. We assure reasonable accommodation under the Americans with Disabilities Act.

Ethics and Integrity:

The instructors are committed to offering a course that maintains an atmosphere of ethical behavior, individual integrity, and equitable treatment of each person. Expression of ideas from various perspectives acknowledges the dignity of all class members. Please contact the instructor, or any other member of the faculty of the Department of Agronomy & Horticulture with whom you are comfortable should any question of ethical behavior arise.

ADA Statement:

Students with disabilities are encouraged to contact the instructor for a confidential discussion of their individual needs for academic accommodation. It is the policy of the University of Nebraska-Lincoln to provide flexible and individualized accommodation to students with documented disabilities that may affect their ability to fully participate in course activities or to meet course requirements. To receive accommodation services, students must be registered with the Services for Students with Disabilities (SSD) office, 232 Canfield Administration (402-472-3787) or TTY (402-472-0053).