

Remote Course (Online, Synchronous)

Breeding for Quantitative Traits in Plants

Instructor: Rex Bernardo

21 January – 29 April 2025

Via Zoom

Sponsored by the

**Plant Breeding Center and Department of Agronomy and Plant Genetics
at the University of Minnesota**

Target Audience

This semester-long course (Spring 2025) is intended for M.S. and Ph.D. students, postdocs, and industry scientists.

Schedule

We will meet via Zoom at 10:15 to 11:30am Central time on Tuesdays and Thursdays. Our class time will comprise small-group problem sets, discussions, computer exercises, and short lectures. You are expected to **read the assigned textbook pages prior to class.**

Required Textbook

Bernardo, R. 2020. *Breeding for Quantitative Traits in Plants*. 3rd edition, Stemma Press, Woodbury, MN (<http://stemmapress.com>)

Cost

\$1800 for graduate students, postdocs, and faculty

\$2100 for industry participants

We regret that scholarships or reduced fees are unavailable.



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Course Goals

Most economically important traits in crops are quantitative rather than qualitative. We will study of how quantitative genetics applies to plant breeding. The goals and expectations are for each course participant to:

1. Understand fundamental concepts of population and quantitative genetics;
2. Explore how quantitative genetics principles can help a plant breeder design and implement a breeding program; and
3. Appreciate the theory, experimental approaches, and evidence that form the basis for these concepts and breeding strategies.

A detailed schedule of topics is on the next page.

Expected Workload

For each hour that the course meets, participants are expected to spend 2.0–2.5 hours reading and studying outside of class. This translates to 2.5 hours of class time and 5.0–6.25 hours of reading and study time per week.

Online Registration

Online registration begins on December 2, 2024.

Detailed registration information will be provided in a *Second Announcement*.

Payment will be by credit card only (VISA, MasterCard, Discover, or American Express).

Course Credit (or lack thereof) and Tests

This remote course is equivalent to AGRO 8202, *Breeding for Quantitative Traits in Plants*, which is part of the graduate curriculum in Applied Plant Sciences (Plant Breeding/Molecular Genetics) at the University of Minnesota.

This remote course does not carry graduate credit from the University of Minnesota. However, M.S. and Ph.D. students who want to explore arrangements to earn course credit at their local university should contact Dr. Bernardo.

For self-assessment of progress through the course, weekly quizzes and a final exam will be given.

Questions?

Contact Dr. Bernardo by email (bernardo@umn.edu).

Breeding for Quantitative Traits in Plants Spring 2025

Class	Day	Date	Chapter	Pages	Topic
1	Tu	Jan 21	1	3-22	Syllabus; introduction; Hardy-Weinberg equilibrium
2	Th	Jan 23	2	22-37	Linkage; markers; small populations; selection; assortative mating
3	Tu	Jan 28	2	37-53	Inbreeding and relatedness; estimating relatedness with markers
4	Th	Jan 30	3	57-66	Phenotypic and genotypic values
5	Tu	Feb 4	3	66-76	Breeding values and dominance deviations; testcross effects; combining ability
6	Th	Feb 6	4	77-89	Selecting parents to maximize mean performance
	Tu	Feb 11			(No class)
7	Th	Feb 13	5	91-103	Linkage mapping of QTL
8	Tu	Feb 18	5	103-120	Significance tests; other methods for mapping QTL
9	Th	Feb 20	6	123-134	Genetic variances
10	Tu	Feb 25	6	134-143	Covariance between relatives
11	Th	Feb 27	6	143-153	Heritability; usefulness; linkage and epistasis; QTL results
12	Tu	Mar 4	7	155-174	Mating designs and estimating genetic variances
13	Th	Mar 6	8	175-188	Genotype x environment interaction
14	Tu	Mar 11	8	189-202	Stability analysis; AMMI analysis; QTL x E interaction; envirotyping
15	Th	Mar 13	9	205-217	Inbred and testcross selection
16	Tu	Mar 18	9	217-228	Choosing a tester; selection with major QTL
17	Th	Mar 20	10	229-245	Best linear unbiased prediction
18	Tu	Mar 25	10	245-260	Properties of BLUE and BLUP; BLUP for single crosses and untested candidates
19	Th	Mar 27	11	261-270	GBLUP; RR-BLUP; framework for genomewide selection
20	Tu	Apr 1	11	270-286	When to use genomewide selection; factors affecting accuracy
21	Th	Apr 3	11	286-298	Number of effective factors; major QTL; QK model; G model
22	Tu	Apr 8	12	299-312	Recurrent selection
23	Th	Apr 10	12	312-321	Increasing the selection response; long-term selection
24	Tu	Apr 15	13	323-342	Heterosis and hybrid prediction
25	Th	Apr 17			Reinventing quantitative genetics for plant breeding (article and video)
26	Tu	Apr 22	14	343-357	Selection for multiple traits
27	Th	Apr 24			<i>BreedingGames</i> class competition
28	Tu	Apr 29			Wrap up