

**AGRO 8202, Spring 2020**  
**Breeding for Quantitative Traits in Plants**  
**3 credits**

**INSTRUCTOR:** Dr. Rex Bernardo  
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**SCHEDULE:** 10:15 to 11:25am on Tuesdays and Thursdays, 306 Borlaug Hall. Our class time will comprise small-group problem sets, discussions, computer exercises, and short lectures. You are expected to read the assigned chapter pages **prior to class**. Tests will be held on four Wednesdays (February 12, March 4, April 1, and April 22), with the time to be arranged.

**COURSE COALS:** Most economically important traits in crops are quantitative rather than qualitative. It is therefore fitting that we study how quantitative genetics applies to plant breeding. My goals and expectations in AGRO 8202 are for you 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.

I will emphasize the learning of concepts rather than retention of factual information and formulas that can be easily looked up in a textbook. Small group exercises will focus on problem-solving skills and analytical thinking.

**COURSE DESCRIPTION:** We will study the following major topics: plant breeding and population genetics; creating breeding populations with high means; creating breeding populations with large genetic variances; selection in populations and among crosses; and exploiting DNA marker information in breeding.

The course prerequisites are as follows:

- AGRO 5021 (*Introduction to Plant Breeding*) or equivalent
- STAT 5021 (*Statistical Analysis*) or equivalent
- An attitude of patience and hard work (whining and complaining are not allowed)

A formal list of **Learning Objectives** will guide you throughout the course. The exams will be closely based on these learning objectives.

## TEXTBOOK:

Bernardo, R. 2020. **Breeding for Quantitative Traits in Plants**. 3rd edition, Stemma Press, Woodbury, MN. (Please see the attached disclosure—which I also sent to you by email—regarding a financial interest).

## LAPTOP COMPUTERS:

We will do several computer exercises in class. The software programs run best on Windows.

## GRADING:

Grades will be based on the following:

- **Four 50-minute tests** (50 points each, 200 points total)
- **Attendance and participation** (25 points)
- **Cumulative final exam** (40 points)

Grades will be determined from the total number of points (out of 265) accumulated. The preliminary grading scale is as follows:

A	93 to 100%
A–	90 to 92.9%
B+	87 to 89.9%
B	83 to 86.9%
B–	80 to 82.9%
C+	77 to 79.9%
C	73 to 76.9%
C–	70 to 72.9%
D+	67 to 69.9%
D	63 to 66.9%
S	at least 70%
F	less than 63%

I may decrease (but not increase) the cut-off percentages for each grade.

## CLASS POLICIES (see footnotes for links to official university policies)

**Academic dishonesty** of any kind or degree will not be tolerated<sup>1,2,3</sup>. You are expected not only to exercise academic honesty, but also to strive for the higher standard of being beyond reproach.

**Academic freedom** is embraced in the course<sup>4</sup>. This means you are free to reasonably disagree with what the instructor teaches and to reserve judgment about disputable matters, but you remain responsible for learning the course content.

**Attendance** in each class session is required. If you have a legitimate reason for an absence (e.g., illness, jury duty, family emergency, religious observances, etc.), please inform the instructor prior to the your absence (if possible) or as soon as possible thereafter<sup>5</sup>.

**Discrimination** of any kind or degree will not be tolerated<sup>6</sup>. We respect and honor differences in race, color, creed, religion, national origin, gender, age, marital status, disability, public assistance status, veteran status, sexual orientation, gender identity, and gender expression.

**Office hours** are normally by appointment, but do come by the instructor's office at your convenience to see if he is available.

**Personal electronic devices** hinder learning and are not to be used in class, unless you are asked otherwise by the instructor<sup>7</sup>.

**Sexual harassment** of any kind or degree will not be tolerated<sup>8</sup>.

**Student conduct** is to be of the highest standard<sup>1</sup>. You are expected to unconditionally treat others well. The instructor commits to do the same.

**Students with a documented disability** should inform the Disability Resource Center to make any needed arrangements, and inform the instructor within the first three weeks of the semester to ensure that disability accommodations can be made<sup>9</sup>.

**Students struggling through mental health and stress issues** must seek personal and professional help from multiple support systems—family, friends, University resources<sup>10</sup>, and counselors. Know that you are not alone.

<sup>1</sup> [http://regents.umn.edu/sites/regents.umn.edu/files/policies/Student\\_Conduct\\_Code.pdf](http://regents.umn.edu/sites/regents.umn.edu/files/policies/Student_Conduct_Code.pdf)

<sup>2</sup> <http://policy.umn.edu/education/instructorresp>

<sup>3</sup> <https://communitystandards.umn.edu/avoid-violations/avoiding-scholastic-dishonesty>

<sup>4</sup> <https://policy.umn.edu/education/syllabusrequirements-appa>

<sup>5</sup> <http://policy.umn.edu/education/makeupwork>

<sup>6</sup> [http://regents.umn.edu/sites/regents.umn.edu/files/policies/Equity\\_Diversity\\_EO\\_AA.pdf](http://regents.umn.edu/sites/regents.umn.edu/files/policies/Equity_Diversity_EO_AA.pdf)

<sup>7</sup> <http://policy.umn.edu/education/studentresp>

<sup>8</sup>

[https://regents.umn.edu/sites/regents.umn.edu/files/policies/Sexual\\_Harassment\\_Sexual\\_Assault\\_Stalking\\_Relationship\\_Violence.pdf](https://regents.umn.edu/sites/regents.umn.edu/files/policies/Sexual_Harassment_Sexual_Assault_Stalking_Relationship_Violence.pdf)

<sup>9</sup> <https://diversity.umn.edu/disability/>

<sup>10</sup> <http://www.mentalhealth.umn.edu>

## AGRO 8202, Breeding for Quantitative Traits in Plants Spring 2020

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
7	Tu	Feb 11	5	91-103	Linkage mapping of QTL
	<b>W</b>	<b>Feb 12</b>		<b>Test 1</b>	<b>Classes 1-6</b>
8	Th	Feb 13	5	103-120	Significance tests; other methods for mapping QTL
9	Tu	Feb 18	6	123-134	Genetic variances
10	Th	Feb 20	6	134-143	Covariance between relatives
11	Tu	Feb 25	6	143-153	Heritability; usefulness; linkage and epistasis; QTL results
12	Th	Feb 27	7	155-174	Mating designs and estimating genetic variances
13	Tu	Mar 3	8	175-188	Genotype x environment interaction
	<b>W</b>	<b>Mar 4</b>		<b>Test 2</b>	<b>Classes 7-12</b>
14	Th	Mar 5	8	189-202	Stability analysis; AMMI analysis; QTL x E interaction; envirotyping
		Mar 17			(No class)
15	Th	Mar 19	9	205-217	Inbred and testcross selection
16	Tu	Mar 24	9	217-228	Choosing a tester; selection with major QTL
17	Th	Mar 26	10	229-245	Best linear unbiased prediction
18	Tu	Mar 31	10	245-260	Properties of BLUE and BLUP; BLUP for single crosses and untested candidates
19	Th	Apr 2	11	261-270	GBLUP; RR-BLUP; framework for genomewide selection
	<b>F</b>	<b>Apr 3</b>		<b>Test 3</b>	<b>Classes 13-18</b>
20	Tu	Apr 7	11	270-286	When to use genomewide selection; factors affecting accuracy
21	Th	Apr 9	11	286-298	Number of effective factors; major QTL; QK model; G model
22	Tu	Apr 14	12	299-312	Recurrent selection
23	Th	Apr 16	12	312-321	Increasing the selection response; long-term selection
24	Tu	Apr 21	13	323-342	Heterosis and hybrid prediction
25	Th	Apr 23	14	343-357	Selection for multiple traits
	<b>F</b>	<b>Apr 24</b>		<b>Test 4</b>	<b>Classes 19-24</b>
26	Tu	Apr 28			Reinventing quantitative genetics for plant breeding
27	Th	Apr 30			<i>BreedingGames</i> class competition
	Sa	May 9		<b>Final exam</b>	<b>Comprehensive, open book</b>