SYLLABUS
PLANT GENETICS AND CROP IMPROVEMENT
Fall Semester 2007

Course Number: AGRN 5100/6100

Course Title: PLANT GENETICS AND CROP IMPROVEMENT

Credit Hours: 3 Credit hours/3 1-hr lectures per week

Prerequisites: BIOL 1030 (Organismal Biology)

Corequisites: None

Instructor: David Weaver
Office - 249 Funchess Hall
Phone - 844-3982
E-mail - weavedb@auburn.edu
Office hours - 1:00-2:00 MWF or anytime I am in my office

Date Syllabus Prepared: May 31, 2007

Textbook: *Principles of Plant Genetics and Breeding* by George Acquaah (available in the Bookstore, about $90). We won't be going through in the same order as the book, so be prepared for that.

Other references: *Principles of Cultivar Development*, *Vol. 1 Theory and Technique* by W. R. Fehr

Principles of Cultivar Development, *Vol. 2 Crop Species* edited by W. R. Fehr

Breeding Field Crops by J. M. Poehlman and D. Sleper

Principles of Plant Breeding by R. W. Allard

Flower and Vegetable Breeding by Leslie

Principles of Crop Improvement by N.W. Simmonds and J. Smart

Course description:

Principles related to mendelian, population, and molecular genetics of plants including inheritance of qualitative and quantitative traits, and plant transformation. Improvement of crop plants including heritability, role of environment, pedigree selection, recurrent selection, the backcross method, and marker-assisted selection.

Course goals: To help students learn and understand

1) basic principles of mendelian (transmission) genetics
2) basic principles of molecular (functional) genetics
3) historical aspects of crop genetics and improvement
4) why and how crops are improved
5) how crop improvement is affected by the environment
6) how crop improvement is affected by genetics
7) the role of statistics, plant pathology and other disciplines in crop improvement

GRADING POLICY (undergraduate students AGRN 5100)

Two 1-hour exams @ 100 pts	= 200 pts
Final exam @ 100 pts	= 100 pts
Term paper	= 100 pts
Homework (10 sets @ 10 pts each)	= 100
Total	= 500 pts

GRADING POLICY (graduate students AGRN 6100)

Two 1-hour exams @ 100 pts	= 200 pts
Final exam @ 100 pts	= 100 pts
Term paper	= 100 pts
Homework	= 100 pts
Oral Research Report	= 50 pts
Total	= 550 pts

The two 1-hour exams will be given approximately 1/3 and 2/3 the way through the semester. The final exam is scheduled for Thursday, December 13, at 8:00 am.

Grades will be assigned according to a ten-point scale, i. e., divide the total points accumulated by the total possible (500 for undergraduates and 550 for graduates) and grades will be assigned according to the following percentage:

90 or above	= A
80	= B
70	= C
60	= D
below 60	= F

Each homework assignment will be assigned a due date, and late homework will not be accepted. No exceptions. If you cannot turn in homework on time because you are out of town or other reason, plan ahead and get it in early.

Help sessions will be scheduled weekly, as needed, and will be scheduled to

accommodate everyone's needs. Otherwise we meet on Wednesdays at 5:00. If this time is inconvenient for some reason, let me know and we will try to find a more suitable time. The purpose of these sessions will be primarily to help with questions regarding homework.

Class attendance is strongly encouraged. You simply cannot do well in this class without regular attendance. There will be no official penalties for poor attendance, other than those you impose upon yourself by missing class.

Academic dishonesty is an offense that will be reported to the Academic Honesty Committee. This includes copying or otherwise submitting homework that was not done by you or plagiarism of any sort. See page 79 of the *Tiger Cub*.

Students needing special accommodations should contact Dr. Kelly Haynes, Director of the Program for Students with Disabilities, 1232 Haley Center. If you have a disability that is already recognized by the Program for Students with Disabilities, please see me within the first week of class.

To do well in this class you need to do four things: Listen to the lectures, read materials assigned in the text and elsewhere, participate in class discussions, and attend class regularly.

The Auburn University Oath of Honor:

"In Accordance with those virtues of Honesty and Truthfulness set forth in the Auburn Creed, I, as a student and fellow member of the Auburn Family, do hereby pledge that all work is my own, achieved through personal merit and without any unauthorized aid. In the promotion of integrity, and for the betterment of Auburn , I give honor to this, my oath and obligation."

COURSE OUTLINE

DNA – The Genetic Code

- What is genetics?
- DNA - the molecule of heredity
- Structure of DNA
- From DNA to phenotype
- The genetic code
- Genetic mutation
- Effect of environment on phenotype

Transmission Genetics: Heritage from Mendel

- History of Mendel's studies
- Molecular analysis of Mendel's work
- Mendel's experiments in modern context
- Further analysis of Mendel's work
- The testcross
- Extending Mendel's model to two or more genes
- Learning to use rules of probability to predict genetic results
- Genetic segregation in human pedigrees
- Allelic interactions other than dominance
- Interactions between genes – Epistasis
- Qualitative vs. Quantitative traits

Chromosomal Basis of Heredity

- Chromosome number
- Mitosis
- Meiosis
- Variations in chromosome numbers in plants
    - Polyploids
    - Euploids
- Autosomes and sex-chromosomes
- More probability and statistics

Gene Linkage and Genetic Mapping

- Genes are located on chromosomes
- Expression of linkage relationships
- Linkage maps – classical and molecular

Population Genetics

- Definition of populations
- Hardy-Weinberg principle
- Using highly polymorphic DNA sequences in DNA typing
- Inbreeding and genetic consequences of self-pollination in plants

Genetics of Complex traits

The nature of complex (quantitative) traits
Calculation of variance
Sources of variation in nature
Modeling the variance
Using variances to determine heritability
Methods of estimating heritability
Using heritability estimates to predict genetic gain

Genetic Diversity

Origin of diversity in nature
Germplasm collection, introduction and storage
Consequences of insufficient genetic diversity

Parent Selection

Factors influencing parent selection
Sources of parental germplasm

Breeding Methods for Self-pollinated Crops

Mass Selection
Bulk Method
Pedigree Method
Single-Seed Descent
Early Generation Testing

The Backcross Method

Backcrossing a dominant trait
Backcrossing a recessive trait

Types of cultivars

Breeding Methods for Cross-pollinated Crops

Recurrent Selection theory
Phenotypic Recurrent Selection
Genotypic Recurrent Selection

Mutation breeding

Mutagenic agents
Types of mutations
Plant material to be treated, other factors

Heterosis

- Genetic basis
- Implications on cultivar development

Development of hybrid cultivars

- Evaluation of combining ability
- Prediction of double-cross hybrid performance
- Production of hybrids through the use of cytoplasmic-genetic male-sterility systems

Breeding for pest resistance

- Specific resistance vs. general resistance
- Mechanisms of resistance
- Tolerance
- Use of resistance genes

Plant transformation

- Role of *A. tumefaciens*
- Engineering of plasmids

Molecular Markers and Their Role in Plant Breeding

- Restriction fragment length polymorphisms (RFLP's)
- Amplified fragment length polymorphisms (AFLP’s)
- Simple Sequence Repeats (SSR’s)