Fall 2014

Evolution of Crop Plants - Agro 8023

Course Summary

This course is designed for graduate and undergraduate students in the life sciences. Evolution of Crop Plants is a multidisciplinary examination of crop domestication and improvement. For more than 200 years, the adaptive evolution associated with origins and diversification of domesticated plants and animals has been examined in hopes of achieving a better understanding of natural and artificial selection. Thus, the course is designed to appeal to students interested in several different disciplines including agronomy, crop improvement, or plant genetics as well as students primarily interested in evolutionary biology or population genetics.

While no specific prerequisites are required, prior courses in agricultural or biological sciences will be useful. Of particular value would be prior coursework in evolutionary biology, genetics, or molecular evolution.

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Course Dynamics

The course will be divided into four major units: 1) **Origins of Agriculture**, 2) **Methods for Understanding Domestication and Improvement**, 3) **The Genetic Basis of Agronomic Adaptations**, and 4) **Twenty-first Century Plant Domestication**. Classroom time will be dedicated to mini-lectures on each topic and a discussion of primary literature related to each unit. Students are expected to have read the assigned material before each classroom session.

In addition, groups of students will be responsible for providing short presentations that will offer a more in-depth examination of the general material covered in each unit. For example, in Unit 1, on "Origins of Agriculture," one group might provide a 20 minute presentation on Mesoamerican agriculture. This presentation might include three elements: a) the origins of agriculture in Mesoamerica and major crops from the region, b) worldwide production of crops from the region and the nature of agriculture in the region today, c) the conservation status and ongoing utilization of landrace and wild populations of crop species from the region. Group projects will also provide students the opportunity to better explore topics in which they are interested.

Learning Goals

By completing the requirements of this course, you will:

- Gain a better understanding of the origins of modern agropastoral civilization, including the timing of origin of major crops and the origins of many fundamental technologies that were a direct result of modern, agricultural lifestyles.

- Engage in discussion with other students regarding some of the primary literature that has advanced our understanding of: the origins and spread of agriculture, means of identifying the genetic effects of domestication and improvement, the genetic basis of adaptation to an agronomic environment, and the future of plant domestication and improvement.
- Become more skillful at examining a multifaceted issue from a variety of viewpoints. By integrating historical information with modern analytical and genetic approaches, the study of crop evolution provides an opportunity to employ a multidisciplinary approach to addressing a questions such as the location and time of origin of a domesticated species or identification of loci that contribute most directly to agronomically important phenotypes.

Example of reading material for the course

Fuller DQ, Allaby RG, Stevens C (2010) Domestication as innovation: the entanglement of techniques, technology and chance in the domestication of cereal crops. World Archaeol 42: 13-28.

Innan H, Kim Y (2008) Detecting local adaptation using the joint sampling of polymorphism data in the parental and derived populations. Genetics 179: 1713-1720.

Purugganan MD, Fuller DQ (2009) The nature of selection during plant domestication. Nature 457: 843-848.

Willcox G (2005) The distribution, natural habitats and availability of wild cereals in relation to their domestication in the Near East: multiple events, multiple centres. Vegetation History and Archaeobotany 14: 534-541.

Wright SI, Bi IV, Schroeder SG, Yamasaki M, Doebley JF et al. (2005) The effects of artificial selection on the maize genome. Science 308: 1310-1314.

Course Timeline and Classroom Schedule

Origins of Agriculture

03 Sep	Day 1	Human food and lifestyles prior to agriculture
08 Sep	Day 2	Who studies the evolution of crops?
10 Sep	Day 3	Centers of domestication and the first crops
15 Sep	Day 4	Major centers; Fertile Crescent, Mesoamerica
17 Sep	Day 5	The domestication syndrome
22 Sep	Day 6	Spread of agropastoralism and crop demography
24 Sep	Day 7	Worldwide dissemination of major crops
29 Sep	Day 8	Demic diffusion and infusions of technology
01 Oct	Day 9	Unit Exam

Methods for Understanding Domestication and Improvement

06 Oct	Day 10	Archeological data and radiocarbon dating
08 Oct	Day 11	Group Presentations
13 Oct	Day 12	Archeological data - types of evidence, rates of change
15 Oct	Day 13	Anthropology, linguistics, and ethnobotany
20 Oct	Day 14	QTL mapping in domesticates and wild ancestors

22 Oct	Day 15	Association mapping and domestication
27 Oct	Day 16	Marker and sequence diversity
29 Oct	Day 17	Sequence diversity - inferring crop origins
03 Nov	Day 18	Targets of selection - candidate genes
05 Nov	Day 19	Targets of selection - genome-wide
10 Nov	Day 20	Simulation of domestication history
12 Nov	Day 21	Genomic resources - where now?
17 Nov	Day 22	Unit Exam

The Genetic Basis of Agronomic Adaptations

19 Nov	Day 23	Intentional vs. unintentional selection
24 Nov	Day 24	Standing variation vs. de novo mutation
26 Nov	Day 25	Group Presentations
01 Dec	Day 26	Mutagenesis, transgenics, and reverse genetics
03 Dec	Day 27	Domestication & improvement genes Writing Assignment Due

Twenty-First Century Plant Domestication and Resource Conservation

08 Dec	Day 28	Bio-energy and perennial crops
10 Dec	Day 29	Conservation of genetic resources / Review for final
17 Dec	Day 30	Final Exam - 8:00 - 10:00 am

Attendance

Students are expected to attend each class session and to be prepared to discuss the reading material for that session. Three or more absences are grounds for a failing grade.

Grading

Grades for the course will be based on the breakdown detailed below. Because the course is largely based on classroom discussion and participation, students are expected to have read all material before each classroom session. Preparedness will be assessed with quizzes at the beginning of randomly chosen classroom sessions. The quizzes will be based on the reading assignment for individual classroom sessions. Because these quizzes constitute 25% of the grade for the course, students must attend class and be prepared for each session to be successful in the class.

25%	Reading Quizzes
25%	Unit Tests
20%	Group Presentations
10%	Writing Assignment
20%	Final Exam

Tips for success: The course will emphasize reading and discussion of primary scientific literature. Students who attend class and read the material to be discussed will have no problem answering questions on the reading quizzes.

Grades

Extra work for extra credit is not an option for improving your grade. Letter grades will be determined based on total points (1000) available:

Letter Grade	% of total points
A	93.34 100.00
A -	90.00 93.33
B+	86.67 89.99
B	83.34 86.66
B-	80.00 83.33
C+	76.67 79.99
C	73.34 76.66
C-	70.00 73.33
D+	66.67 69.99
D	60.00 66.66
F	59.99 and below