THE UNIVERSITY OF BRITISH COLUMBIA
Plant Science

PLNT 542: GRAPEVINE AND BERRY CROP BIOLOGY

Winter Term 1 (SEP – DEC 2016)
11AM-12:30 PM Tuesday and Thursday in FNH 40 or MacMillan 342

I. INSTRUCTIONAL TEAM

Instructor: Dr. Simone Diego Castellarin
Room 211, FNH Bldg, 2205 East Mall
Office phone: 604-827-2667
Office Hours: Tuesday, 10:00 – 11:30 am

II. COURSE OVERVIEW

The goal of the course is to provide students with a deep understanding of grapevine biology and of the major biological features of other important berry crops for British Columbia such as blueberry, cranberry, and raspberry. It exhaustively explores the most important aspects of grapevine genetics, morphology, and physiology.

III. COURSE PREREQUISITES:

The prerequisite is documented expertise and knowledge in one of three subjects—plant genetics and genomics, plant physiology, or horticulture.

IV. RATIONALE

The wine grape is the most economically-important fruit crop on the planet. In Canada, the grape and wine industry has grown significantly in the past few decades, gaining both domestic and international recognition. Furthermore, the Canadian wine industry employs more than 31,000 people in Canada, welcomes more than 3 million tourists each year, and generates close to $6.8 billion in revenue. British Columbia is the second largest producer of grapes in Canada. The number of BC wineries has grown exponentially from 17 wineries in 1990 to 273 wineries in 2014, with more than 75 varieties being cultivated in about 4,000 hectares of agricultural land.

Beside grapes, British Columbia is a major producer of other berry crops such as blueberry, cranberry, and raspberry in Canada. Particularly, blueberry is the 7th BC commodity with $138,748,000 receipts (56% share of national receipts) and cranberry is the 16th BC commodity with $ 41,430,000 receipts (36% share of national receipts).

Grapevine and berry crop biology will provide a solid background on grapevine biology and basic knowledge on the major biological features of other berry crops cultivated in British Columbia. Grapevine and berry crop biology will benefit LFS and BIOL students who wish to pursue a career as viticulturists or winemakers, as well as to LFS, BIOL, and FRST students who have an interest in learning how general principles of plant genetics, genomics, biology, and physiology that they have learned in previous courses are related to the production of grapes and other major berry crops. Also, Grapevine and Berry Crop Biology will meet the interest of LFS, BIOL, and FRST students who want to learn more about grape and wine production.

V. LEARNING OBJECTIVES

Upon completion of this course, students will be able to:

1. Outline the morphological and genetic differences among wild and domesticated grapevines, cultivars, clones, and rootstocks.
2. Describe the major morphological features of cultivated grapevines, identifying how the morphological traits affect the way grapevines are cultivated.
3. Predict how the vegetative and reproductive growth cycles are affected by changes in environment.
4. Evaluate how major aspects of grapevine physiology (water and nutrient uptake, carbon uptake and assimilation, portioning of assimilates) affect grapevine cultivation and fruit quality.
5. Critically evaluate the major determinants of yield formation and fruit quality in the vineyard.
6. Interpret how the biology that underlies fruit composition impacts grape and wine quality.
7. Describe the major genetic and genomic features of other important berry crops such as blueberry, cranberry, and raspberry.
8. Compare the morphological, physiological, and molecular characteristics of berry fruits from different taxonomic families.
9. Outline how the morphology and physiology of berry crops affect their production systems in commercial productions.
10. Evaluate how the major environmental factors affect fruit composition and quality.
11. Predict the yield and quality potential of grapevine in different climatic scenarios.
12. Critically evaluate literature related to grapevine and berry crop biology for identifying new opportunities for grapevine and berry crop production systems.

VI. COURSE FORMAT

There will be two 75-minute lectures per week. The course will include five laboratory classes and one field trip. Resource materials will be posted on the course UBC Connect website.

VII. ASSESSMENT, EVALUATION, AND GRADING

Class participation 5%
Class quizzes 15%

Midterm exam 20%
Mini report 10%
Final exam 25%
Review project 25% (10% presentation to the class and 15% written report)

Description of the evaluation and grading criteria

Class participation. Class participation will be assessed using responses to questions.

Class quizzes. Two class quizzes will be held during the course. Further information on the topics and format will be posted on UBC Connect. Each quiz will be based on one research article related to a major topic previously explored in class. Students are requested to carefully read the articles before the day of the quiz and be prepared for questions on the topics discussed in the articles. Each quiz will equally contribute towards the course grade.

Midterm exam. The midterm exam will include a combination of multiple choice and short-answer questions related to the topics explored in the class thus far in the term.

Mini report. The instructor will select one specific topic for the students to explore. Students will work individually. Students will research the most relevant scientific publications on the topic using search engines (Web of Science, Google Scholar, PubMed), read the abstracts of the publications and select two of them. The students are expected to carefully read the two articles and to prepare a two-page report (Times New Roman font, 12pt, 2.54 cm margins, single spaced). The first page should contain title, author name and date, followed by the report. The report should identify the objectives of the studies, describe and compare the methodologies adopted to carry out the experiments, present and compare the results reported in the two articles. The second page should present a list of the most relevant publications on the topic (put an asterisk in front of the two articles that are discussed in the report). The report should be sent via email to the Instructor before midnight on the Friday of Week 12.

Final exam. The final exam will include a combination of multiple choice and short-answer questions. The exam will be comprehensive, covering material presented throughout the term. However, topics explored after the midterm exam will be emphasized.

Review project. The instructor will evaluate and grade the student's presentation and written report. See instructions for the review project below.

VIII. REQUIRED AND RECOMMENDED READINGS AND WEBSITES

Required readings will include the course instructor's lecture notes and selected scientific papers (both will be posted on Connect).

Reference Textbooks

Keller M (2010) The Science of the Grapevines: Anatomy and Physiology. Elsevier Inc, Burlington, MA, USA. (Optional)

Folta KM, Kole C (2011) Genetics, genomics and breeding of berries. CRC Press, Broken Sound Parkway, NW, USA (Optional, good resource for topics related to berry crop genetics and genomics)

Peer-reviewed Journals

Journals are available online at UBC libraries; e.g., Planta, the Journal of Experimental Botany, Plant Physiology, the American Journal of Enology and Viticulture, and the Australian Journal of Grape and Wine Research. Students will be notified of assigned readings of selected papers in support of the instructor's lecture notes.

IX. TENTATIVE COURSE SCHEDULE

Subject to change -- Please check the UBC Connect website for updated information.

Week #	Activity	Topic
1 Sep 8	Lecture	Botanical classification and geographical distribution of the grapevine. American and Eurasian species. The domesticated grapevine.
2 Sep 13	Lecture	Genetic origin of rootstocks, cultivars and clones. Where and how the major cultivars were selected. Grapevine genomics.
2 Sep 15	Lecture	Genetic origin of rootstocks, cultivars and clones. Where and how the major cultivars were selected. Grapevine genomics.
2 Sep 17	Field Trip	Visit of Glasshouse Estate Winery, Langley, BC. 23449 0 Avenue, V2Z 2X3 Langley, Canada
3 Sep 20	Laboratory	Morphological structures of the grapevine (roots, trunk, branches, shoots, leaf, tendril, growing tip, buds, flower, bunch, and berry). Sectioning and microscopy analyses of canes, shoots, buds.
3 Sep 22	Laboratory	Morphological structures of the grapevine (roots, trunk, branch, shoots, leaf, tendril, growing tip, buds, flower, bunch, and berry). Sectioning and microscopy analyses of berries.
4 Sep 27	Guest Lecture	Guest Lecture. Simran Bains (Westberry Farms): Blueberries the global story.
4 Sep 29	Laboratory	Morphological structures of the grapevine (roots, trunk, branch, shoots, leaf, tendril, growing tip, buds, flower, bunch, and berry). Sectioning and microscopy analyses of berries.
5 Oct 4	Laboratory	Blueberry, cranberry, and raspberry genetics and genomics.
5 Oct 6	Class quiz/Laboratory	See description in section VII for the quiz/ David McArthur: Raspberry biology.
6 Oct 11	Lecture	David McArthur: Blueberry biology.
6 Oct 13	Lecture	David McArthur: Cranberry and Raspberry biology.

7 Oct 18	Midterm exam	See description in section VII.
7 Oct 20	Lecture	Grapevine vegetative cycle. Major phenological stages and climate requirements for the vegetative growth.
8 Oct 25	Lecture	Grapevine reproductive cycle. Major phenological stages and climate requirements for reproductive growth.
8 Oct 27	Lecture	Grapevine phenology in BC areas.
9 Nov 1	Lecture	Grapevine and berry crop yield determination. The biology that underlies yield formation in grapevine. Yield potential and its realization in the vineyard.
9 Nov 3	Lecture	Grapevine physiology. Managing water and nutrient uptake, transpiration, photosynthesis.
10 Nov 8	Lecture	Berry ripening. Outline of the main elements of molecular and physiological regulation of ripening in the grapevine as well as in blueberry, cranberry, and raspberry.
10 Nov 10	Lecture	Berry composition. Description of the major metabolic pathways that determine fruit quality in grapevine as well as in blueberry, cranberry, and raspberry. Analysis of the molecular pathways that control phenolic and aroma accumulation in these crops.
11 Nov 15	Class quiz/Lecture	See description in section VII/Berry composition. Description of the major metabolic pathways that determine fruit quality in grapevine as well as in blueberry, cranberry, and raspberry. Analysis of the molecular pathways that control phenolic and aroma accumulation in these crops.
11 Nov 17	Laboratory	Berry composition. Sugar, acid, anthocyanin analyses in grapes blueberry, cranberry.
12 Nov 22	Graduate student/guest speaker presentations	Berry composition. Description of the major metabolic pathways that determine fruit quality in grapevine as well as in blueberry, cranberry, and raspberry. Analysis of the molecular pathways that control phenolic and aroma accumulation in these crops.
12 Nov 24	Graduate student/guest speaker presentations	Environmental cues and grape and berry crop production.
13 Nov 29	Graduate student/guest speaker presentations	Environmental cues and grape and berry crop production.
13 Dec 1	Graduate student/guest speaker presentations	Environmental cues and grape and berry crop production.

IX. STUDENT'S REVIEW PROJECT

Students must work individually. The objective of the assignment is to study and critically assess one of the proposed topics in grapevine physiology, viticulture, and berry biology and to present the findings of the research to classmates. Note that these are intended to be scientific presentations to an audience with a good background in plant biology, and both the content and style of the student's presentation should reflect this.

Workflow for the assignment
1) Select one of the proposed topics (see the list below). Avoid duplications among students.
2) Discuss with the instructor how you would like to develop your review project on the topic.
3) Collect scientific and technical papers related to your topic.
4) Study the papers carefully and critically analyze them.
5) Prepare a written report on your research (maximum 4 pages, references excluded).
6) Prepare a 30 min presentation for the class. Be prepared to answer class questions.
7) Present your research to the class. Take advantage of criticism that is raised in order to improve your report.
8) Submit your report by midnight of the day before the final exam.

Possible research topics for the review (more topics will be eventually provided in class)
1) Effect of water deficit on berry development.
2) Effect of water deficit on the accumulation of phenolic compounds in grapes.
3) Effect of water deficit on the accumulation of aroma precursors in grapes.
4) Effect of cluster exposure to sunlight on fruit development in grapevine.
5) Effect of cluster exposure on the accumulation of phenolic compounds in grapes.
6) Effect of cluster exposure on the accumulation of aroma precursors in grapes.
7) Effect of temperature on berry development.
8) Effect of berry temperature on the accumulation of phenolic compounds in grapes.
9) Effect of berry temperature on the accumulation of aroma precursors in grapes.
10) Effect of extremely low temperatures on grape cultivation: cold hardiness and freezing tolerance in grapevine.
11) Effect of leaf area:crop weight ratio on fruit composition in grapevine.
12) Chilling requirements in berry crops.
13) Major environmental factors that affect blueberry fruit composition.
14) Major environmental factors that affect cranberry fruit composition.
15) Major environmental factors that affect raspberry fruit composition.
16) Impact of climate change on berry crop productions.

X. ACADEMIC INTEGRITY

"The academic enterprise is founded on honesty, civility, and integrity. As members of this enterprise, all students are expected to know, understand, and follow the codes of conduct regarding academic integrity. At the most basic level, this means submitting only original work done by you and acknowledging all sources of information or ideas and attributing them to others as required. This also means you should not cheat, copy, or

mislead others about what is your work. Violations of academic integrity (i.e., misconduct) lead to the breakdown of the academic enterprise, and therefore serious consequences arise and harsh sanctions are imposed. For example, incidences of plagiarism or cheating may result in a mark of zero on the assignment or exam and more serious consequences may apply if the matter is referred to the President's Advisory Committee on Student Discipline. Careful records are kept in order to monitor and prevent recurrences." From http://senate.ubc.ca/vancouver/curriculum-submission-guide/cat1-curriculum/new-course-approval

A more detailed description of what constitutes academic misconduct (cheating, plagiarism, etc.) and of its consequences may the integrity, may be found in the Academic Calendar at http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,54,111,959 and http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,54,111,