Department of Forestry
College of Agriculture
Salahaddin University-Erbil

ADVANCED TREES PHYSIOLOGY Course Book

For
M.Sc. students

Assist Prof. Dr. Sirwa Anwar Qadir

2023- 2024
Fall semester

1. Course name	Advanced Forest Trees Physiology
2. Lecturer in charge	Assist Prof. Dr. Sirwa Anwar Qadir
3. Department/ College	Forestry / Agriculture
4. Contact	e-mail: sirwa.qadir@su.edu.krd Mobile: 096407504701276
5. Time (in hours) per week	**Theory: 2**
6. Office hours/ week	6 hours/ week
7. Course code	
8. Teacher's academic profile	BSc (Bachelor of Science) from Biology department/ College of Science, at Salahaddin University, Erbil, Iraq in July 1999. At 2000 to 2003 Lab assistant at Plant protection Dept. After obtaining MSc (Master of Science) at the college of Education/ Biology department in July 2006 in Plant Physiology, I cooperated as a lecture in Agriculture college, Salahaddin University for a period of 7 years. I have been received Ph. D in plant physiology in an inter-ship program at both Salahaddin University and Universiti Teknologi Malaysia (UTM) July 2017. I have published 14 journal articles, 1 book chapter, research projects, seminars and broad conference. **Sirwa A. Qadir** For further information visit: https://sites.google.com/a/su.edu.krd/sirwa-anwar-qadir/
9. Keywords	Forest Tree Physiology, soil water, transpiration, photosynthesis, dark reaction, light reaction, respiration, stress physiology, plant hormones.

10. Course overview:

The field of plant physiology is concerned with the functional and mechanistic aspects of plants or, essentially, how the plant works at the molecular level. This course will cover water relations (osmosis, water uptake, endodermal structure, xylem transport, mechanisms of stomatal action, transpiration), plant growth regulation (hormones and photomorphogenesis), ion and sucrose (phloem) transport, and those biochemical processes that are unique to plants, including C3, C4, and CAM photosynthesis, photorespiration, and N2 fixation. Environmental (stress) physiology, development, differentiation, endogenous rhythms, flowering, and secondary metabolites will be covered only briefly.

11. Course objective:

I. To develop an understanding of the physiology of forest trees, with special emphasis on carbon and

water relations and:
(a) unique morphological and physiological adaptations that set trees unique;
(b) integration of physiological function across levels of biological organization from the cell to the landscape;
(c) Interactions among the environment (including forest management), physiology, and tree and forest productivity.
II. To become familiar with current issues in physiological researches.
III. To become familiar with current experimental and measurement approaches used in physiological research.

12. Student's obligation

- All students are required to take notes from lectures throughout the course.
- The attendance and completion of workloads and exam.
- The time and date of exams will not be changed after being fixed by the lecturer and the students' representative.

13. Forms of teaching

Different forms of teaching conducted to gain the objectives of the course, such as:

- Using white board to clarify any related subject
- PowerPoint presentation including video show
- Writing up important notes.
- Necessary video tutorials learning.

14. Assessment scheme

- Workloads (preparing a review paper)
- Seminars and presentations prepared by the student.
- Final exam:

15. Student learning outcome:

At the end of the course the students will be able to:

1. Understand the basic processes of plant development, function and reproduction and their regulation at a molecular and cellular level.
2. Assimilates with critical insight and in depth analysis, the main themes of plant physiology at the molecular level (transport, photosynthesis, metabolism, mineral nutrition, hormonal regulation and photomorphogenesis).
3. An appreciation of the adaptive responses of plants to endogenous and environmental signals.
4. Plant function and performance in relation to the environment.
5. Plant responses to various biotic and abiotic factors.
6. The role of plants in global nutrient and carbon cycling.

16. Course Reading List and References:

- Campbell, Neil A., Reece, Jane B (2011). *Campbell Biology;* 9th ed.Pearson.
- Taiz, Lincoln. , Zeiger, Eduardo (2010). *Plant physiology;* 5th ed; Sinauer Associates.
- Lambers, H., F.S. Chapin III and T.L. Pons. 2008. Plant Physiological Ecology, Second Edition. Springer-Verlag, New York. 610 p.
- Pallardy, S.G. 2007. Physiology of Woody Plants, Third Edition. Academic Press, San Diego. 480 p.
- Both books are readily available used and new online.
- Scott, P (2008). *Physiology and Behaviour of Plants*, Wiley Ridge, I, Plants, OU Worldwide.
- Hopkins W. G. and N.P A. Huner (2009). *Introduction to Plant Physiology*. 4th ed John Wiley & Sons, Inc.

17. The Topics:

Week 1:

1. Water and nutrients in plant
1. Water balance of plant

1.1. Water potential
1.2. Absorption by roots
1.3. Transport through the xylem
1.4 Leaf water and transpiration

Week 2:

1.5 Transpiration
1.5.1 The rate of transpiration is influenced by environmental factors
1.6. Plant water status
1.7 Influence of extreme water supply
1.7.1 Drought
1.7.2 Flooding

Week 3:

2. Nutrient supply of plant
2.1. Essential nutrients
2.2. Nutrient uptake
2.3. Solute transport
2.4. Nutritional deficiencies.

Week 4 & 5:

3. Roots, Soils, and Nutrient Uptake
3.1 The Soil as a Nutrient Reservoir
3.1.1 Colloids are a Significant Component of Most Soils
3.1.2 Colloids Present a Large, Negatively Charged Surface Area
3.1.3 Soil Colloids Reversibly Adsorb Cations from the Soil Solution
3.1.4 The Anion Exchange Capacity of Soil Colloids is Relatively Low

Week 6:

3.3 Root-Microbe Interactions

3.3.1 Bacteria Other than Nitrogen Fixers Contribute to Nutrient Uptake by Roots

3.3.2 Mycorrhizae are Fungi that Increase the Volume of the Nutrient Depletion Zone Around Roots

Week 7 & 8:

4. Physiology of plant growth and development

4. 1. Cell wall biogenesis and expansion

4. 2. Overview of plant growth and development

5. Regulation of plant growth and development

5.1. Environmental factors

5.2. Plant hormones

5.3. Auxins

5.4. Gibberellins

5.5. Cytokinins

5.6. Ethylene

5.7. Abscisic acid

5.8. Brassinosteroids

6. Synthetic and microbial plant hormones in plant production

Week 9:

5. Photosynthesis:

5.1 The Light reactions

5.1.1 Photosynthesis in higher plants.

5.1.2 Organization of the photosynthetic apparatus.

5.1.3 Organization of light-absorbing antenna systems.

5.1.4 Mechanisms of electron transport.

5.2 The calvin cycle

5.2.1 CO2-concentrating mechanisms ii: the c4 carbon cycle.

5.2.2 CO2-concentrating mechanisms iii: crassulacean acid metabolism

Week 10:

6. Respiration

6.1 Glycolysis: a cytosolic and plastidic process

6.1.1 Glycolysis Converts Sugars to Pyruvic

6.1.2 The Oxidative Pentose Phosphate Pathway is an Alternative Route for Glucose Metabolism

6.1.3 The Fate of Pyruvate Depends on the Availability of Molecular Oxygen

6.2 Oxidative Respiration is Carried out by the Mitochondrion

Week 11:

7. Plant stress physiology

7.1 The basic concepts of plant stress, acclimation, and adaptation

7.2. The light-dependent inhibition of photosynthesis

7.3. Temperature stress
7.4. Imbalances in soil minerals
7.5. Developmental and physiological mechanisms against environmental stress.

Week 12:

8. Tropisms and Nastic Movements: Orienting Plants in Space
8.1 Phototropism: Reaching for the sun
8.2 Gravitropism
8.3 Nastic movements

Week 13:

9. Photoperiodism
9.1 Measuring time: controlling development by photoperiod and endogenous clocks Photoperiodism
9.2 Critical day length define long day and short day responses
9.3 Phytochrome and cryptochrome are the photoreceptors for photoperiodism.

Week 14:

10 Seed Development and Germination
10.1 Seeds are Formed in the Flower
10..2 Seed Development and Maturation
10.3 Seed Germination
10.4 The Level and Activities of Various Hormones Change Dramatically During Seed Development
10.5 Many Seeds Have Additional Requirements for Germination

Week 15:

10. Secondary metabolites
10.1 Terpens
10.2 Glycosides
10.3 Phenylpropanoids