

Ministry of Higher Education and Scientific research



**Department of Forestry**  
**College of Agricultural Engineering Sciences**  
**Salahaddin University-Erbil**

**TREES PHYSIOLOGY Course Book**  
**Grade 3**

**Lecturers' names:**  
**Assist Prof. Dr. Sirwa Anwar Qadir (theoretical part)**  
**Miss. Evan Enayat Muhammad (practical part)**

**2023- 2024**  
**Fall semester**

<b>1. Course name</b>	Trees Physiology
<b>2. Lecturer in charge</b>	Assist. Prof. Dr. Sirwa Anwar Qadir M. Sc. Assist Lecturer: Evan Enayat Muhammad
<b>3. Department/ College</b>	Forestry /Agricultural Engineering Sciences
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<b>5. Time (in hours) per week</b>	<b>Theory: 2</b> <b>Practical: 3</b>
<b>6. Office hours/ week</b>	2 hours/ week 3 hours/ week
<b>7. Course code</b>	
<b>8. Teacher's academic profile</b>	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 UniversitiTeknologi Malaysia (UTM) July 2017. I have published 9 journal articles, 1 book chapter, research projects, seminars and broad conference.  <b>Dr. Sirwa A. Qadir</b>  For further information, visit: <a href="https://sites.google.com/a/su.edu.krd/sirwa-anwar-qadir/">https://sites.google.com/a/su.edu.krd/sirwa-anwar-qadir/</a>
<b>9. Keywords</b>	Forest Tree Physiology, plant kingdom, plant cell, living components of the cell, chloroplast, water relations, passive transport, active transport, kinetic energy, photosynthesis, dark reaction, light reaction, respiration, stress physiology, plant hormones.
<b>10. Course overview:</b>	
<b>Theoretical part:</b>	

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 C<sub>3</sub>, C<sub>4</sub>, and CAM photosynthesis, photorespiration, and N<sub>2</sub> fixation. Environmental (stress) physiology, development, differentiation, endogenous rhythms, flowering, and secondary metabolites will be covered only briefly.

**Practical part:**

Preparing and carrying out experiments in plant physiology as in studying colloidal solutions and its characteristics, and phenomenon such as osmosis, diffusion, permeability and describing water relations such as; absorption, diffusion, study of all the internal activities of plants—those chemical and physical processes associated with life as they occur in plants. This includes study at many levels of scale of size and time. At the smallest scale are molecular interactions of photosynthesis and internal diffusion of water, minerals, and nutrients. At the largest scale are the processes of plant development, seasonality, dormancy, and reproductive control.

**11. Course objective:**

The students will develop fundamental knowledge in plant cells, tissues and organs. In brief, the students who complete this course:

- Familiarize the students with the importance of plant for all living organisms, through supporting them with oxygen as well as being the only source of food on the earth.
- Students will be able to have knowledge for transport and translocation of water and solutes, biochemistry and metabolism, and growth and development.
- Students will have a fundamental knowledge about Physiological adaptations play as great a role in the evolutionary struggle for life of a plant as morphological ones.
- In the light of the explosive growth of our understanding of physiological processes in plants resulting from technological advances in the field of molecular biology,

**12. Student's obligation**

- All students are required to take notes or/and writing up lectures throughout the course as the instructor/lecturer will not provide any hand-out either in word or PowerPoint document.
- The attendance and completion of all; Exams, Assignments (homework) and Quiz.
- 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.

#### 14. Assessment scheme

##### Theoretical part:

- Mid-term theoretical exam: 10%
- Weekly quiz and attendance: 5
- Final theoretical exam: 50 %

##### Practical part:

- Laboratory participation: homework and weekly quizzes 5%
- Reports 5 %
- Seminar 5%
- Practical exam: 20 %.

#### 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 and Zeiger, Eduardo (2010). *Plant physiology*; 5th ed; Sinauer Associates,.
- 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.
- Witman, F. H., David F. B. & Robert M. D.(1971), *Experiments in plant physiology*, van nostrandreinhold company.
- Nobel PS. 1991. Physicochemical and Environmental Plant Physiology. London, UK: AcademicPress. Book chapter:
- Steudle E. 1994. The regulation of plant water at the cell, tissue, and organ level: role of active processes and compartmentation. In: Schulze E-D, ed. The Regulation of Plant Water at

## 17. The Topics:

### Theoretical part:

#### Week 1: What is Tree Physiology?

##### REPRODUCTION AND GERMINATION

- Germination
- Inducing Germination
- Seed Germination

#### Week 2: Water in plant life

- The importance of the water for plants
- The pathway for water movement through the plant
- The Kinetic Theory of Matter

#### Week 3: Permeability of cell membrane and transport types

- Simple Diffusion or passive diffusion
- Osmosis
- The significance of osmosis to plant
- Facilitated Diffusion
- Active transport: moving against a gradient
- Active transport mechanism:
- Types of active transport

#### Week 4: TREE ROOT PHYSIOLOGY

- Water potential
- Absorption and water flow through plants
- Root Parts
- Water dynamics in soil-plant-atmosphere system
- Field capacity (FC) and Wilting point (WP)

#### Week 5: TREE TRUNK PHYSIOLOGY

- Trunk parts
- Ascension of water through the plant: Vascular system
- Xylem transport
- Apical Dominance
- Branches
- Branch Growth
- Evolutionary Design
- Co-dominant Stems
- Co-dominant

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- Acute Crotches
- Sway Factor
- Emergence above the Forest Canopy
- Crown Formation

#### **Week 6: PHYSIOLOGY OF LEAVES**

- Chlorophyll
- Photosynthesis
- Respiration
- Transpiration Stomata
- Transpiration serves three essential roles
- Distribution of Glucose
- Glucose

#### **Week 7 and 8: TOTAL TREE PHYSIOLOGY**

- Air Temperature
- Growing Season
- Oxygen Deficiency
- Soil Temperatures
- Water Stress
- Implication of Climate Change
- Nutrients
- Nutrient Absorption
- Solar Radiation
- Root Tolerance

#### **Week 9: Midterm exam**

#### **Week 10: TREE RESPONSES**

- Light
- Temperature
- Water
- Carbon Dioxide (CO<sub>2</sub>) Concentration
- Wind
- Electrophysiology
- Cooperative Protection
- Response Summary

#### **Week 11: Tree Movements**

- Tropism
- Gravitropism
- Chemotropism
- Nastic Movements

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- Photoperiodism
- Nyctinastic Movements

### **Week 12: Seasonal Responses**

- Senescence
- Dormancy
- Fallen Leaves
- Biostimulants

### **Week 13: Tree Growth Regulators**

- Tree Enzymes
- Tree Hormones
- Auxins
- Synthetic Auxins

### **Week 14: Gibberellins**

- Ethylene
- Cytokines
- Abscisic Acid
- Other Growth Regulators

### **Week 15: Secondary metabolites**

- Terpens
- Glycosides
- Phenylpropanoids

### **Practical part:**

#### **Week 1: Solutions, Suspensions and Emulsions**

- Exp. 1: Preparation of true solutions
- Exp. 2: Preparation of Suspension and emulsions.
- Exp. 3: Preparation of colloidal solutions.

#### **Week 2 and 3: The characteristics of colloidal molecules through lab experiments:**

- Exp. 1: Tyndall phenomenon.
- Exp. 2: Proving the presence of electric charges on colloidal molecules.
- Exp. 3: Adsorption.
- Exp. 4: Viscosity.
- Exp. 6: Brownian movement

#### **Week 4: Preparation of Solutions (Molarity, Molality and Normality)**

- Exp. (1): Practice about preparing molar solutions, with calculating examples about Molar (M) solutions.
- Exp. (2): Practice about preparing normal solutions, with calculating examples about Normal (N) solutions.

**Week 5: Preparation of Solutions: (Percentage Concentration % and Parts per million solutions ppm), for fertilizers, mineral nutrients and plant hormones.**

- Exp. (1): Practice about preparing types of percentage concentrations %, with calculating examples about it.
- Exp. (2): Practice about preparing part per million solutions (ppm), with calculating examples about it.
- Exp. (3): Practice about preparing dilutions of different kinds of solutions, with calculating examples about it.

**Week 6: 1<sup>st</sup> Exam**

**Week 7 & 8: Diffusion (Study the process of diffusion and some of the factors which influence this phenomenon).**

- Exp. (1): Simple Diffusion of Gases.
- Exp. (2): Diffusion of solid Material in Liquids.
- Exp. (3): Diffusion of solid materials through solid medium
- Exp. (4): Diffusion of Liquids
- Exp. (5): The effect of particle size on the diffusion: "The diffusion of I2 and starch from the solid membrane of gelatine"
- Exp. (6): The rate of diffusion of any substance through semi permeable membrane depends on the size of particle.

**Week 9: OSMOSIS**

- Exp. (1): Clarify Osmosis (using potato tubers).
- Exp. (2): Clarify Osmosis by the measurement of tissues weight.
- Exp. (3): Determining the water potential of plant tissues (the water potential of the cell at a concentration which no changes appear in the shape of the curve)
- Exp. (4): Determining the water potential of cells by plasmolysis.

**Week 10: Permeability**

- Exp. 1: some physical factors affecting the permeability of plasma membrane (high, moderate and freezing temperature).
- Exp. 2: the effect of some chemical agents on the permeability of plasma membrane (acids, alkaloids and some organic compounds like ether or benzene).

**Week 11: Imbibition**

- Exp. 1: the change of weight and volume after imbibition.
- Exp. 2: the production of thermal energy during imbibition.
- Exp. 3: the pressure force that produced from imbibition.

**Week 12: Transpiration**

- Exp. 1: Proofing the presence of stomata on leaf surface using hot water.
- Exp. 2: Comparing the rate of stomatal and cuticular transpiration by four leaves method.
- Exp. 3: observing the water produced during transpiration using cobalt chloride papers.

**Week 13: 2nd Exam**

**Week 14: Analysis of chlorophyll and test of starch in tree leaves**



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- Analysis of chlorophyll:
- Method 1: hand---held chlorophyll meter
- Method 2: Estimation of chlorophyll pigments from the plant samples by acetone, extraction method.

### Week 15: Plant Growth Regulators

- Experiment about foliar application of a Plant Hormone (Gibberellin).

### 18. Examinations and Style of Questions:

#### Theoretical part:

#### 1. Fill in the blanks:

- Through the ----- process plants transmit to the atmosphere the majority of the water absorbed from soil.

**Answer: transpiration**

#### 2. compositional questions: (includes asking words; what, why, how, write, explain and numerate)

**Why** water has a high specific heat capacity.

**Answer:** Water has a high heat capacity, because in order to raise the temperature of water, it takes much more energy to raise the temperature of water compared to other solvents because hydrogen bonds hold the water molecules together.

#### 3. Choose the correct answer:

-----are linear molecules with multiple conjugated double bonds.

(A. Chlorophyll a, B. chlorophyll d, C. xanthophyll, D. carotinoids)

**Answer: carotinoids**

#### Practical part sample questions:

#### 1. Define Adsorption.

**Adsorption:** Adsorption is the adhesion of molecules of gas, liquid, or dissolved solids to a surface. This process creates a film of the adsorbate (the molecules or atoms being accumulated) on the surface of the adsorbent.

#### 2. Plasmolysis has two types, which are: -----and -----.

**Answer:** temporal and permanent.

What are the differences between true solution, suspensions and colloids?

**Answer:**

Property	True solutions	Colloidal solutions	Suspensions
Particle size	Less than $10^{-7}$ cm	Between $10^{-7}$ cm and $10^{-5}$ cm	Greater than $10^{-5}$ cm

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Visibility of particles	Invisible to naked eye not visible under powerful microscope	Invisible to naked eye. Visible under powerful microscope	Easily visible
Sedimentation of particles	Do not settle down	Settle down under high centrifugation	Settle down due to gravity
Filtration through filter paper	No residue is formed	No residue is formed	Residue is formed

**21. Peer review**

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I approve that the course is comprehensive and cover all the aspects of the course.

Name: Dr. Narin M. W.

Degree: Ph.D. Lecturer

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