**UNIVERSITY OF SARGODHA**

**DEPARTMENT OF SOIL & ENVIRONMENTAL SCIENCES, COLLEGE OF AGRICULTURE**

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COURSE OUTLINE Spring 2020

Course Title: Soil-water-plant relationship

Course Code: SES-402

Credit Hours: 3(3-0)

Instructor: Dr. Mukkram Ali Tahir

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| DESCRIPTION & OBJECTIVES |

Learning objectives

The relationship of plants with soil and water is complex, and each depends on other for growth and conservation of soil and water. Imbalance in these structured ecosystem can result in the reorganization of plant and animal community to the extent that entire ecosystem may change. Anticipated increase in global temperature and air pollution are predicted to have significant effect on soil composition and water availability which, in turn, can affect the survival and growth of natural and agricultural plant community. This course is concerned with the movement of water in the soil-plant-atmosphere continuum and the impact of soil water stress on plant growth. The overall aim of the course is to provide the student with a solid background in the basic concepts of water properties and water dynamics within soil and plant. The specific objectives of the course are:

* Skill development in students to solve applied problems in Plant-Soil-Water Relations.
* Enhance student learning in main water properties and flow processes within the soil-plant-atmosphere continuum.

Learning outcomes

* Understanding the different instruments for measuring soil water availability and water potential components.
* Methods to measure water availability and water potential components.
* Adoption of scientific approach for understanding plant-soil-water relations.
* Ability to write scientific reports for some assignments and to work in team to solve scientific problems.

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| READINGS |

1. Bashir, E. and R. Bantel. 2001. Soil Science. National Book Foundation, Islamabad.
2. Brady, N.C. and R.R. Weil. 2007. The Nature and Properties of Soils. 14th Ed. Pearson Education, Upper Saddle River, NJ, USA.
3. Khan, S.R.A. 200. Crop Management in Pakistan with focus on Soil and Water. Government of Punjab, Agriculture Department, Punjab, Pakistan.
4. Orcutt, D.M. and Nilsen, E.T. 2000. Physiology of plants under stress, Soil and Biotic Factors. John Wiley & Sons, Inc., New York, USA.

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| CONTENTS |

THEORY

1. Functions and Properties of Water
2. Components of Soil and Plant Water Potentials
3. Soil-Plant-Water Relations
4. Movement of Water and Ions in Soil and Plant
5. Water Absorption and Root Stem Pressure
6. Water and Mineral Nutrient Uptake
7. Photosynthesis and Transpiration
8. Soil-Plant Atmosphere Continuum
9. Adaptation of plant to Adverse Soil-Water conditions

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| COURSE SCHEDULE |  |
| Week | Topics and Readings: *Give Reading No from your list of readings above and its Page Nos. relevant to the topic(s) covered each week* | Book and Page No. | Dates |
| 1 | Introduction. Functions of Water. Role of water in germination, growth. Functions of water. Role in photosynthesis, Transpiration and respiration.Functions of water. Role in stomatal opening and closing, Flowering and fruiting, Fruit ripening and seed dormancy. | Crop Management in Pakistan with focus on Soil and Water. Page 193-198.  | **13-01-2020** **to** **17-01-2020** |
| 2 | Functions of water in soil formation, nutrient supply and soil microbial activities. | The Nature and Properties of Soils. Page 47-54. | **20-01-2020** **to** **24-01-2020** |
| Properties of Water. Structure of water, Polarity, Hydrogen bonding, Cohesion and adhesion. | The Nature and Properties of Soils. Page 123-125. |
| Properties of Water. Surface tension, Capillarity, Capillary mechanisms, Specific heat, Viscosity, Heat of fusion.  | The Nature and Properties of Soils. Page 125-128.Crop Management in Pakistan with focus on Soil and Water. Page 190-193. |
| 3 | Components of Soil and Plant Water Potentials. Soil water potential, Matric potential, Osmotic potential. | The Nature and Properties of Soils. Page 128-130. | **27-01-2020** **to** **31-01-2020** |
| Pressure potential, Pneumatic potential, Overburden potential. | Soil Science. National Book Foundation, Page 152-153. |
| Classification of soil water; Gravitational water, Field capacity, Capillary water, Hygroscopic water. | Soil Science. National Book Foundation, Page 152-153. |
| 4 | Water classification from plant point of view; Available water, Unavailable water, Permanent wilting point. | Soil Science. National Book Foundation, Page 156-157. | **03-02-2020** **to** **07-02-2020** |
| Soil-Plant-Water-Relations; Osmosis. | Crop Management in Pakistan with focus on Soil and Water. Page 199. |
| Osmotic pressure, Turgor pressure, Diffusion pressure deficit. | Crop Management in Pakistan with focus on Soil and Water. Page 200-201. |
| 5 | Movement of Water and Ions in Soil and Plant; Saturated and unsaturated flow in soil; water vapor flow in soil. | Soil Science. National Book Foundation, Page 158-159. | **10-02-2020** **to** **14-02-2020** |
| Path of water transport from soil to plant. | Crop Management in Pakistan with focus on Soil and Water. Page 190-193. |
| Path of solute transport. | Crop Management in Pakistan with focus on Soil and Water. Page 201-202. |
| 6 | Mechanisms of water uptake. | Crop Management in Pakistan with focus on Soil and Water. Page 203-205. | **17-02-2020** **to** **21-02-2020** |
| Passive or osmotic absorption. | Crop Management in Pakistan with focus on Soil and Water. Page 206-207. |
| Active absorption. | Crop Management in Pakistan with focus on Soil and Water. Page 207-208. |
| 7 | Movement of water across tissues. | Crop Management in Pakistan with focus on Soil and Water. Page 208-210. | **24-02-2020** **to** **28-02-2020** |
| Factors affecting water absorption in the plants. | Crop Management in Pakistan with focus on Soil and Water. Page 211-213. |
| Mechanisms of solute uptake; Movement of ions from soil to root surface. | Crop Management in Pakistan with focus on Soil and Water. Page 214. |
| 8 | Radial movement of salts into the stele, Movement of ions from roots to shoots. | Crop Management in Pakistan with focus on Soil and Water. Page 215. | **02-03-2020** **to** **06-03-2020** |
| Redistribution of ions within the plants. | Crop Management in Pakistan with focus on Soil and Water. Page 216-217. |
| Factors affecting the salt absorption; Species difference, extent of root system, metabolic activity of tissues.  | Crop Management in Pakistan with focus on Soil and Water. Page 218-19. |
|  | Mid Term Test |  | **09-03-2020** **to** **13-03-2020** |
| 9 | Factors affecting the salt absorption; Internal concentration of salts, Internal sugar concentration, H ion concentration. | Crop Management in Pakistan with focus on Soil and Water. Page 219-20. | **16-03-2020** **to** **20-03-2020** |
| Factors affecting the salt absorption; Respiration, Aeration, Temperature, Light. | Crop Management in Pakistan with focus on Soil and Water. Page 200-21. |
| Factors affecting the salt absorption; Soil moisture content, Concentration and composition of external solution, Interactions between ions. | Crop Management in Pakistan with focus on Soil and Water. Page 221-22. |
| 10 | Photosynthesis; leaf structure, Photosynthetic reaction, Nature of light, Chlorophyll and accessory pigments. | Plant Physiology, Page 163-205. | **23-03-2020** **to** **27-03-2020** |
| Photosynthesis; The structure of chloroplast and photosynthetic membrane, Stages of photosynthesis, Light reactions. | Plant Physiology, Page 163-205. |
| Photosynthesis; Dark reactions, CO2 fixation in C-3 plants; The Calvin cycle. | Plant Physiology, Page 163-205. |
| 11 | Photosynthesis; C-4 photosynthetic pathway, C-4 plants, Economic importance of C-4 pathway. | Plant Physiology, Page 163-205. | **30-03-2020** **to** **03-04-2020** |
| Photorespiration, CAM photosynthesis, Important traits of C-3, C-4 and CAM plants, Photo-assimilate partitioning. | Plant Physiology, Page 305-355. |
| Water use efficiency and transpiration ratio. | Plant Physiology, Page 105-145. |
| 12 | Soil-Plant-Atmosphere Continuum. | Plant Physiology, Page 163-205. | **06-04-2020** **to** **10-04-2020** |
| Adaption of Plants to Adverse Soil-Water Conditions; Water shortage and plant growth. | Physiology of plants under stress, Page 21-46. |
| Water deficit, Strategies to tolerate water stress.  | Physiology of plants under stress, Page 21-46. |
| 13 | Water deficit; decreased leaf area, leaf abscission, enhanced root growth, stomatal closure during water deficit.Waterlogging and plant growth; factors responsible for waterlogging, characteristics of submerged soils. Physical effect of flooding on soils, Thermodynamic sequence of soil reduction, accumulation of soil gases. | Physiology of plants under stress, Page 21-46. | **13-04-2020** **to** **17-04-2020** |
| 14 | Chemical effects of flooding, organic matter decomposition under flooding.End products of aerobic and anaerobic decomposition of organic matter. Nutrient interactions under flooding. | Physiology of plants under stress, Page 21-46. | **20-04-2020** **to** **24-04-2020** |
| 15 | Plant response to saline and sodic conditions, how salinity affect plant growth.Mechanisms of tolerance to salinity; mitigation of ion toxicity, maintenance of ionic balance.Mechanisms of response to salts; osmotic adjustment and management of oxidative stress. | Physiology of plants under stress, Page 177-236. | **27-04-2020** **to** **01-05-2020** |
| 16 | Mechanisms of tolerance to salinity; mitigation of ion toxicity, maintenance of ionic balance.Mechanisms of response to salts; osmotic adjustment and management of oxidative stress. | Physiology of plants under stress, Page 177-236. | **04-05-2020** **to** **08-05-2020** |

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| RESEARCH PROJECT |

*State here the prerequisites of the assigned research project including term paper or lab assignment etc.*

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| ASSIGNMENT CRITERIA |

*Write here the distribution of marks. You can chose any or all from the below for the purpose*

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| Sessional Marks |
| Attendance | Presentation | Projects | Participation | Quiz test | Total |
| 2 | 1.5 | 1.5 | 1.5 | 1.5 | 8.0 |
| Final Exam |
| Mid Test | Sessional | Theory |  | Total Marks |
| 18 | 12 | 30 |  | 60.0 |

RRRULES AND REGULATIONS

* *Students are evaluated throughout the semester using tools such as assignments, projects, presentations, tests, quizzes and lab practical etc., according to the necessity of the course and concerned instructor.*
* *At the end of semester, final examination of the course is also held which account for a certain percentage towards the course.*
* *A minimum of 75% attendance is required by the students to be eligible to sit in the final examination. A student having less than 75% of the attendance shall be dropped from the course and have to repeat the course whenever the course is offered again.*
* *In case a student remains absent from the class for seven consecutive lectures, his/her name shall be dropped from the course.*
* Moreover, for research work, the assessment of the progress shall be made regularly through the academic performance reports and evaluation of the written work/report and the defense/viva examinations are also conducted under the prescribed manner.