EXTENDED LECTURE OUTLINE

CPH6 311 Fundamentals of Crop Physiology (2+1)

Sl No	Contents in detail
1	**Introduction:** Definitions of plant physiology and crop physiology. Importance of crop physiology. Relationship of crop physiology with other branches of crop science.
2	**Plant-water relations:** Overview of plant cell organelles and their functions. Structure of water, functions and properties of water. Concept of diffusion, osmosis and imbibition. Definition and concept of water potential. Components of water potential in plant cells and soils. Water in soil, forms of water in soil and available water. Concepts of water saturation, field capacity, permanent wilting point and available soil moisture.
3	**Water absorption:** Concept of active and passive absorption. Symplastic, apoplastic and transmembrane movement of water in plants. Internal and external factors influencing water absorption in plants. Theories and mechanisms explaining ascent of sap (water translocation). Soil-plant-atmosphere continuum. Internal and external factors influencing water translocation in plants.
4	**Transpiration:** Definition, types of transpiration in plants. Significance of transpiration. Transpiration in relation to crop productivity. Transpiration ratio. Stomatal physiology: Structure of stomata, types and stomatal movement. Theories explaining stomatal movement. Factors affecting transpiration rate. Guttation. Concept of cavitation and embolism. Water use efficiency and its relevance. Water use efficiency in C3, C4 and CAM plants. Anti-transpirants: definition, different types of Anti-transpirants with examples.
5	**Mineral nutrition:** Definition, importance of plant nutrients. Arnon's criteria of essentiality. Classification of essential nutrients based on requirements. Essential and beneficial elements. Functions of essential elements (physiological role and biochemical functions, and mobility in the phloem). Mechanisms of ion uptake: theories explaining ion uptake; passive and active transport of mineral elements; membrane transporters and carriers. Soil, root and microbe interactions for ion uptake. Concept of soilless cultivation and its importance. Hydroponics, aeroponics and sand culture. Functions, deficiency and toxicity symptoms of various nutrients. Correction measures for nutrient deficiency symptoms. Foliar nutrition and root feeding - significance. Diseases or disorders associated with nutrients in plants. Factors influencing nutrient availability in soil.
6	**Photosynthesis:** Brief outline of photosynthetic apparatus, quantum requirement and quantum yield. Function of chloroplast. Examples of different photosynthetic pigments (chlorophyll, carotenoids, phycobilins etc.). Difference between chlorophyll a and chlorophyll b. Red drop and Emerson enhancement effect. Pigment system I and II. Introduction to light reaction of photosynthesis, light absorption by photosynthetic pigments and transfer of energy. Source of O_2 during photosynthesis: Hill's reaction. Brief introduction to cyclic and non-cyclic photophosphorylation. Production of assimilatory powers. Mechanism of carbon fixation in C3, C4 and CAM plants. Steps in carbon fixation: Chemio-osmotic theory and ATP production. Kranz leaf anatomy in C4 plants and its relevance. Difference between C3, C4 and CAM pathways. Internal and

	external factors influencing photosynthesis in plants. Carbon dioxide compensation and saturation point, light compensation and saturation point, Warburg's effect. Relationship between photosynthesis and crop productivity. Plant responses to elevated CO_2, and climate change. Starch and sucrose synthesis. Source and sink concept. Pattern of translocation of assimilates. Phloem loading and unloading. Difference between apoplastic and symplastic phloem loading. Photorespiration. Significance and steps involved in photorespiration.
7	**Respiration:** Definition and significance of respiration, structure of mitochondria and its function. Respiratory substrates and Respiratory quotient, types of respiration, Steps in aerobic respiration (Glycolysis, Krebs Cycle, ETC), Anaerobic respiration/ fermentation. Alternative respiration /pentose phosphate pathway. Cyanide resistance respiration in plants. Internal and external factors influencing rate of respiration in plants. Relationship between respiration, photosynthesis and yield.
8	**Plant growth and development:** Definitions of growth, development and differentiation. Plant growth pattern and growth curve. Determinate and indeterminate growth habits. Monocarpic and polycarpic species with examples. Growth and yield parameters and their measurements. Measurement and Formulae used for determining Leaf area Index (LAI), Leaf area duration (LAD), Specific leaf area (SLA), Crop Growth rate (CGR), Net assimilation rate (NAR), Relative growth rate (RGR), Harvest Index (HI).
9	**Plant growth regulators and hormones:** Endogenous and synthetic growth-regulating substances. Discovery and site of synthesis of different plant hormones. Synthetic growth regulating substances, growth retardants, growth inhibitors, pinching agents. Importance of plant growth regulators in modulating crop growth. Physiological importance of different plant hormones such as Auxin, Gibberellin, Brassinosteroid, Cytokinin, ABA, Ethylene etc., Biosynthesis and mode of action of major plant hormones, applications of plant growth regulators in agriculture, horticulture and industry.
10	**Photoperiodism and vernalization:** Definition, classification of plants based on photoperiodic response. Introduction to Photoperiodic induction, site of photo-inductive perception. Phytochrome and its importance. Temperature and its effect on flowering phenomena. Introduction to vernalization (vernalization, de-vernalization, etc.), meaning, classification (seasonal, sequential, etc.), relation with abscission and its significance. Physiological and biochemical changes during senescence, Concept of stay-greenness, hormonal regulation of senescence.

Suggested books for references:

1. Plant Physiology (3rd Edition) - Taiz and Zeiger, Publisher: Sinauer Associates; 3 edition (2002)
2. Plant Physiology and Development, Sixth Edition; Eduardo Zeiger, Editor. Sunderland, Massachusetts U.S.A. Eduardo Zeiger, University of California, Los Angeles. ISBN 978-1-60535-255-8
3. Plant Physiology (4th Indian Edition) - Salisbury and Ross
4. Introduction to Plant Physiology - Hopkins
5. Advanced Plant Physiology - Wilkins
6. Plant Physiology - Devlin and Witham, Publisher: Boston W. Grant Press
7. Introductory Plant Physiology - Noggle and Fritz