

EC 07-VII Biology of Mineral Nutrition of Plants

Code	EC 07-VII
ECTS credits	4
Attendance time	7 Semester
Language of instruction	Ukrainian
Duration	1
Cycle	Each Winter Semester
Coordinator	Associate Professor, PhD, Andrii Schogolev
Instructor(s)	Associate Professor, PhD, Andrii Schogolev
Allocation of study programmes	Biology
Recommended prerequisites	Cell biology; Structural Botany: Anatomy of Plants Chemistry; Physics; Microbiology; Mycology; Plant Physiology and Biochemistry.
Learning objectives	Soil is the natural environment of plants` mineral nutrition. Fundamentals of soil microbiology. Absorption and transport of minerals by plants. Mineral elements in plants. Fertilizers.
Syllabus	Chapter 1: Soil as a Natural Environment for Mineral Nutrition of Plants and Foundations of Soil Microbiology Topic 1: Physical and Chemical Characteristics of Soil Composition of the soil and its granular absorbing complex Soil pH and chelates Morphology and classification of soils Human activity's influence on soil composition Topic 2: Basics of Soil Microbiology Role of microorganisms in soil formation Environmental factors affecting microorganism development in soil

<p>Types of soil nutrition microorganisms</p> <p>Basic concepts of soil microorganisms' ecology</p> <p>Spatial, taxonomic, and functional structure of microbiological groups</p> <p>Types of relationships between microorganisms</p> <p>Symbiosis of microorganisms with higher plants</p> <p>Participation of microorganisms in substance cycling in nature</p> <p>Topic 3: Nitrogen Fixation</p> <p>Nitrogen cycle in the biosphere</p> <p>Biological nitrogen fixation and its types: free-living, symbiotic, associative</p> <p>Molecular mechanisms of nitrogen fixation</p> <p>Genetic systems participating in symbiosis</p> <p>Factors influencing efficiency of symbiotic nitrogen fixation</p> <p>Topic 4: Associative Nitrogen Fixation and Applied Aspects</p> <p>Discovery and features of associative diazotrophs</p> <p>Mechanism and genetic determination of associative nitrogen fixation</p> <p>Influence of environmental factors on associative nitrogen fixation</p> <p>Applied aspects: genetic engineering, strains of nodule bacteria, biological fertilizers</p> <p>Chapter 2: Absorption and Transport of Mineral Substances by Plants</p> <p>Topic 5: Mechanisms of Absorption of Mineral Substances by Roots</p> <p>Functions and structure of roots</p> <p>Changes in root growth in response to nutrient deficiency</p> <p>Inflow of ions into the cell and root</p> <p>Types of membrane transport: passive and active absorption</p>

Energetic characteristics of the absorption process

Absorption of ions by an intact plant and influence of environmental factors

Role of mycorrhiza in absorption of mineral substances

Topic 6: Transport of Substances in Plants

Movement of ions throughout the plant

Symplast and apoplast: their role in substance transport

Xylem transport: structure, composition of sap, and regulation

Phloem transport: structure, composition of sap, and regulation

Pedestrian cells and circulation of nutrients in plants

Chapter 3: Mineral Nutrients of Plants and Fertilizers

Topic 7: Physiological Role of Elements of Mineral Nutrition

Mineral content in plants and its importance

Nitrogen: physiological role, forms of nutrition, absorption, and regulation

Phosphorus:

Availability of soil phosphorus for plants and its compounds

Transport of phosphate through membranes and phosphorus metabolism

Physiological role in energy metabolism, nucleic acids, phospholipids, coenzymes

External signs of phosphorus deficiency

Sulfur:

Plant sulfur assimilation and mechanism of sulfate reduction

Role of sulfur in metabolism and metabolic disorders due to deficiency

External signs of sulfur deficiency

Potassium:

Physiological role and doses required for plant nutrition

	<p>Role in osmoregulation, cation-anion balance, and stomatal movements</p> <p>External signs of potassium deficiency</p> <p>Calcium and Magnesium:</p> <p>Content in soil and plants, physiological role, and distribution in cell structures</p> <p>Ca²⁺ and intracellular signaling systems, ways of Ca²⁺ transmission-signal</p> <p>External signs of calcium and magnesium deficiency</p> <p>Chlorine, Silicon, and Aluminum:</p> <p>Functions of chlorine in plants and effects of excess</p> <p>Physiological role of silicon and aluminum</p> <p>Microelements:</p> <p>Modern ideas about the role of microelements in plant vital activity</p> <p>Physiological role of boron, iron, copper, zinc, molybdenum, manganese, and cobalt</p> <p>Influence of external factors on absorption of mineral substances</p> <p>Ions and hydration of cytoplasmic colloids, antagonism of ions</p> <p>Topic 8: Characteristics and Use of Fertilizers</p> <p>Root nutrition as a factor in plant productivity management</p> <p>Physiological basis of using mineral fertilizers</p> <p>Classification of fertilizers: mineral, organic, bacterial, simple, and complex</p> <p>Nitrogen, phosphorus, potassium, magnesium, and microfertilizers</p> <p>Ways, doses, and timing of fertilizer application</p> <p>Fertilizers and their impact on plant yield and productivity</p>
Literature	Iutynska H.O. Gruntova Mikrobiolohiya: Navchalnyi posibnyk. Kyiv. Aristei, 2016. 284s.

	<p>Kots S.Ya., Petersen N.V. Mineralni elementy i dobryva v zhyvlenni roslyn. Kyiv. Lohos, 2011.150 s.</p> <p>Kots S.Ya., Malichenko S.M., Krugova O.D. ta in. Fizioloho-biokhimichni osoblyvosti zhyvlennya roslyn biolohichnym azotom. Kyiv. Lohos, 2011. 271 s.</p> <p>Tkachuk S.S., Bohdan T.Z. Azotnyi obmin: adaptatsiya roslyn do umov zhyvlennya. Kyiv. Avers, 2000. 200 s.</p>
Teaching and learning methods	Lecture (3 WH), Laboratory (1 WH)
Workload	<ul style="list-style-type: none"> • Classroom hours: 32 h • Laboratory hours: 16 h • Individual study time/preparation and postprocessing: 72 h <p>Total: 120 h</p>
Assessment	The assessment consists of written examination and preliminary graded study achievements
Grading procedure	The module grade is the sum of preliminary study achievements and the examination grade
Basis for	Ecophysiology of Plants and Microorganisms