



ЦЕНТЪР ЗА ОБУЧЕНИЕ – БАН

1000 София
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TEMPLATE FOR A SPECIALIZED DOCTORAL COURSE (in English)

Basic Information:

Course Title: Photosynthesis in a changing environment – a physiological and ecological approaches

Lecturer: Prof. Violeta Velikova. D.Sc.

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Total Teaching Hours: 30 h

Annotation (up to 150 words)

Photosynthesis is one of the most important processes that supports the Earth's primary production. The precise understanding of how photosynthesis responds to environmental changes is crucial to predict how single plants and entire agro- or ecosystems will be affected. Finally, photosynthesis studies are the cornerstone for the development of new crops better suited for novel purposes, primarily high yield for biomass.

The course provides a base on how photosynthesis may be influenced by environmental changes. Structural and functional aspects of the photosynthetic apparatus are examined in the context of responses to environmental stimuli; attention is given to the processing of light energy by thylakoids, metabolic regulation, gas exchange. To better understand photosynthesis *x* environment interactions concepts for phenotyping of dynamic plant traits is developed.

The aim of the course is to introduce to advanced graduate students, PhD students and wide range of scientists with research interests in environmental effects on photosynthesis, plant productivity and biodiversity.

Course content (brief description by topics or modules)

Topic / Module 1: Introduction to photosynthesis – basic principles of photosynthesis; structure and functions of chloroplasts; light and dark phases of the photosynthetic process.

Topic / Module 2: Physiological mechanisms of photosynthesis – Photosystems I and II, the electron transport chain and ATP synthesis; the role of enzymes and metabolic pathways; gas exchange and carbon metabolism (C₃, C₄, and CAM plants).

Topic / Module 3: Impact of abiotic factors on photosynthesis – the effects of light, temperature, water regime, mineral nutrition, and CO₂ concentration on photosynthetic activity.

Topic / Module 4: Photosynthesis and abiotic stress – plant responses to drought, high and low temperatures, salinity stress, and environmental pollution. Mechanisms of protection and adaptation.

Topic / Module 5: Methods for studying photosynthesis – modern physiological and ecological methods: measurement of gas exchange, chlorophyll fluorescence, remote sensing, and laboratory techniques.

Teaching and assessment methods

- Seminars and discussions;
- Practical exercises and laboratory demonstrations;
- Analysis of scientific publications;



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- Independent work by PhD students (preparation of reports, presentations, or short analyses).

The assessment of PhD students is carried out through a combination of **continuous assessment** (discussions, presentation and analysis of a scientific article) and a **final exam** (a written exam evaluating theoretical knowledge and analytical skills).

Competencies acquired as a result of training (3–5 points)

- Knowledge of the main physiological and biochemical mechanisms of photosynthesis; understanding of the influence of key abiotic factors on the photosynthetic process;
- Ability to interpret experimental data related to photosynthetic activity;
- Application of basic methods for studying photosynthesis and the physiological status of plants;
- Ability to critically analyze scientific information in the field of plant physiology and ecology;
- Skills in applying an interdisciplinary approach to studying interactions between plants and the environment.

Literature:

1. Taiz, L and E. Zeiger. Plant Physiology. 2002. Third Edition. Fourth edition, 2006 – on line.
2. Flexas J, Loreto F, Medrano H (Eds.) Terrestrial Photosynthesis in a Changing Environment. A Molecular, Physiological and Ecological Approach. Cambridge University Press 2012
3. Hou HJM, Najafpour MM, Moore GF, Allakhverdiev SI (Eds.) Photosynthesis: Structures, Mechanisms, and Applications. Springer International Publishing AG 2017

Additional information (optional) (e.g., special requirements, laboratory equipment, prior knowledge)

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