

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Izbor iz fiziološke ekologije rastlin
Course title:	Selection in Physiological Plant Ecology

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Doktorski študij Ekološke znanosti, 3. stopnja		1. ali 2.; 1st or 2nd	1.- 4.; 1st-4th
Doctoral Study Ecological Sciences, 3rd degree			

Vrsta predmeta / Course type Izbirni/Elective

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Lab. vaje Laboratory work	Terenske vaje Field work	Samost. delo Individ. work	ECTS
18	4		8		150	6

Nosilec predmeta / Lecturer: Andreja URBANEK KRAJNC

Jeziki /	Predavanja / Lectures:	slovenski / slovene
Languages:	Vaje / Tutorial:	slovenski / slovene

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Poznavanje fiziologije rastlin na ravni dodiplomskega študija

Prerequisites:

Knowledge of physiological plant ecology at graduate level

Vsebina:

V predmetu so podrobno obravnavana izbrana poglavja iz vpliva naravnih in antropogenih stresnih dejavnikov na fiziološke procese v rastlini s poudarkom na funkcijskih motnjah celičnega metabolizma in odzivom rastlin na stresne dejavnike na nivoju celic in cele rastline

A) Funkcijske motnje celičnega metabolizma

- Toksični efekti kisika na rastline

Tvorba prostih kisikovih radikalov, reakcije v celici;

Content (Syllabus outline):

The lecture focuses on selected chapters on the impact of natural and anthropogenic stress factors on physiological processes in plants with the special emphasis on functional disturbances of cell metabolism and the response of plants to stress factors on the cellular and the whole plant level.

A) Functional disturbances of cell metabolism

- Toxic effects of oxygen on plants

Formation of reactive oxygen species and reactions in the cell

- Motnje v metabolizmu ogljika
Vplivi okoljskih dejavnikov na fotosintezo, fotorespiracijo, dihanje ter pretok in porabo ogljikovih hidratov v rastlini
- Motnje v mineralni prehrani
Vpliv okolja na presnovo mineralov; motnje v preskrbi; vpliv na simbiozo z rizosfernimi mikroorganizmi; podrobneje so izpostavljene motnje v privzemu, asimilaciji ter transportu žvepla, amonija in nitrata ter vgradnja v ogljikove spojine

B) Odzivi rastlin na stresne dejavnike
Obrambni in reparaturni mehanizmi, detoksifikacija prostih kisikovih radikalov z antioksidanti in encimi; sinteza, kompartmentacija in vloga antioksidantov; aktualna dognanja o vlogi glutationa, askorbinske kisline, tokoferola in karotinoidov v obrambi pred oksidativnim stresom

Posebni poudarek je na predstavitvi lastnih raziskav v okviru naslednjih učnih sklopov:

1. Daljinski transport vode v drevesu
(Fiziološko ozadje ksilemskega toka, povezava med ksilemskim tokom, evapotranspiracijo in fotosintezo, principi meritev vodnega statusa rastlin, meritve ksilemskega toka s TDP (thermal dissipation probe, tipalo termičnega odvoda) in HPV (Heat pulse velocity) senzorji, predstavitev rezultatov merjenja ksilemskega toka v smreki po napadu podlubnikov in okužbi z glivo *Ceratocystis polonica*).
2. Vloga metabolizma žvepla v rastlinah in prilagoditvi na abiotični/biotični stres v kmetijskih ekosistemih
3. Biokemične in strukturne spremembe rastlinskih tkiv kot posledica fizioloških motenj na hortikulturnih rastlinah
Vloga antocianskih vakuolarnih vključkov (AVI, anthocyanic vacuolar inclusions) na barvo cvetov in plodov v povezavi s pomanjkanjem kalcija
Programirana celična smrt v povezavi s fiziološkimi motnami
4. Bioindikacija onesnaževanja okolja

- Disturbances in carbon metabolism
The influence of external factors on photosynthesis, photorespiration, respiration, the translocation and utilization of photosynthates in plants
- Disturbances in mineral nutrition
Habitat-related aspects of mineral metabolism; the disturbances in supply; the impact on symbiosis with the microorganisms in rhizosphere; the chapter focuses on the disturbances in the uptake, assimilation and transport of sulphur, ammonium ions and nitrate and their incorporation into carbon compounds

B) The response of plants to stress factors
Defense and reparatory mechanisms, detoxification of reactive oxygen species with antioxidants and enzymes; synthesis, compartmentation and function of antioxidants; recent advances in the role of glutathione, ascorbate, tocoferol and carotinoides in defense against oxidative stress

Specialempphasis is placed on presenting our own research within the following learning packages:

1. Long distance transport of water in trees (Physiological background of xylem flow, link between xylem flow, evapotranspiration and photosynthesis, principles of sap flow measurement techniques with TDP (thermal dissipation probe) and HPV (Heat pulse velocity) sensors. Presentation of our own results of sap flow measurements in spruce affected by bark beetles and *Ceratocystis polonica* infection).
2. The impact of sulfur metabolism in plants and adaptation to abiotic/biotic stress in agricultural ecosystems
3. Biochemical and structural changes in plant tissues as a result of physiological disorders in horticultural crops
The impact of anthocyanic vacuolar inclusions (AVIs) on the color of flowers and fruits and alterations

Reakcijski in akumulacijski indikatorji, kazalci in testni organizmi, metode biomonitoringa, vloga glutationa v detoksifikaciji težkih kovin.

5. Termogeneza aroidnih vrst: fiziološko ozadje termogeneze (regulacija, vloga alternativne oksidaze, vloga salicilne kisline in etilena, hlapni sekundarni metaboliti) ultrastrukturne posebnosti tkiv spadiksa in površine spate, ekološki aspekt termogeneze, 4 tipi termogeneze (morfološke in fiziološke posebnosti, časovni potek gretja posameznih tipov termogeneze), predstavitev znanstvenih objav in raziskovalnega delana rodovih *Alocasia*, *Colocasia* in *Arum*, predstavitev rezultatov raziskav v okviru mednarodnega projekta INEA (International Network for Edible Aroids).

caused by calcium deficiency
 Programmed cell death in relation to the physiological disorders
 4. Bioindication of pollution impacts
 Response and accumulation indicators, indicators and test organisms, biomonitoring methods, the role of glutathione in the detoxification of heavy metals.
 5. Termogenesis of aroid species: physiological background of thermogenesis (regulation, the role of alternative oxidase, the role of salicylic acid and ethylene, volatile secondary metabolites); ultrastructural characteristics of spadix and the surface of the spathe, ecological aspect of thermogenesis, 4 types of thermogenesis (morphological and physiological characteristics, the time course of heating process in different thermogenesis types), presentation of scientific publications and research on the genera *Alocasia*, *Colocasia* and *Arum*, presentation of research results within the international project INEA (International Network for Edible Aroids).

Temeljni literatura in viri / Readings:

- Hamlyn G. Jones: Plants and Microclimate, A Quantitative Approach to Environmental Plant Physiology, 2013, Cambridge University Press.
- Sadras V. O., Calderini D. F., Crop Physiology, 2009, Academic Press.
- Larcher, W., 1991: Physiological Plant Ecology. Springer, Heidelberg.
- Taiz, L., E. Zeiger, 2012: Plant Physiology. Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts.
- Varma, A., R. P. Beckett, I. Kranner, 2002: Protocols in Lichenology: Culturing, Biochemistry, Ecophysiology, and Use in Biomonitoring. Springer, Heidelberg.

Znanstvene revije:

The Plant Cell

Plant Cell and Environment

Plant and Cell Physiology

Journal of Plant Biotechnology

Trends in Plant Science

Trees-Structure and Function

Botany

Forest Ecology and Management

Cilji in kompetence:

- Posebna pozornost je posvečena izbranim odzivom rastlin na izbrane okoljske dejavnike
- Obravnava izbranih toksičnih učinkov kisika
- Obravnava funkcijskih motenj celičnega metabolizma
- Obravnava izbranih simptomov poškodb na nivoju celic in celega organizma
- Obravnava v izbrane obrambne in reparativne mehanizme
- Obravnava izbranih analitičnih metod v ekofiziologiji in stresni fiziologiji rastlin

Objectives and competences:

- Special attention is paid to the selected responses of plants to stress factors
- Illustration of selected toxic effects of oxygen
- selected functional disturbances in cell metabolism
- Illustration of selected injury patterns and symptoms on cell and whole plant level
- selected defense and reparatory mechanisms
- selected analytical measurements in ecophysiology and stress physiology of plants

Predvideni študijski rezultati:

Znanje in razumevanje:

- Znanje in razumevanje odziva rastlin na izbrane okoljske dejavnike
- Razumevanje toksičnih učinkov kisika
- Poznavanje stresnih faktorjev, prepoznavanje simptomov poškodb in osnovnih obrambnih in reparativnih mehanizmov
- Usvojitev izbranih metod v ekofiziologiji

Prenosljive/ključne spretnosti in drugi atributi:

- Pridobitev vrhunškega znanja o principih in metodah v ekofiziologiji in stresni fiziologiji rastlin ter uporaba le tega v praksi

Intended learning outcomes:

Knowledge and Understanding:

- Top-level knowledge and understanding of the response of plants to stress factors
- Top-level understanding of toxic effects of oxygen
- Top-level knowledge of stress factors, identification of injury patterns and symptoms, understanding the basic defense and reparatory mechanisms
- Methods and ecophysiological equipment

Transferable/Key Skills and other attributes:

- Achieving top-level knowledge about the principles and methods in ecophysiology and stress physiology for good practice

Metode poučevanja in učenja:

- Predavanja
- Izbrane fitofiziološke raziskave z uporabo biokemičnih in fizioloških metod v laboratoriju in na terenu s poudarkom na morfologiji in funkciji rastlin pod vplivom okolja
- Samostojno delo

Learning and teaching methods:

- Lectures
- Selected phytophysiological research using biochemical and physiological methods in laboratory and in field with special attention to environmental impacts to plant morphology and functions
- Independent work

Načini ocenjevanja:

Delež (v %) /

Weight (in %) **Assessment:**

<ul style="list-style-type: none"> • Seminarska naloga in njena predstavitev • Laboratorijski dnevnik • Pisni izpit 	<p>30%</p> <p>20%</p> <p>50%</p>	<ul style="list-style-type: none"> • Seminar essay and its defense • Diary of laboratory results • Written exam
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Reference nosilca / Lecturer's references:

MECHORA, Špela, ŽERDONER ČALASAN, Anže, FELICIJAN, Mateja, URBANEK KRAJNC, Andreja, AMBROŽIČ-DOLINŠEK, Jana. The impact of selenium treatment on some physiological and antioxidant properties of *Apium repens*. *Aquatic botany*, ISSN 0304-3770. [Print ed.], 2016, 1-8, doi: [10.1016/j.aquabot.2016.12.002](https://doi.org/10.1016/j.aquabot.2016.12.002).

TURINEK, Maja, BAVEC, Martina, REPIČ, Milan, TURINEK, Matjaž, URBANEK KRAJNC, Andreja, MOELLERS, Christian, TRES, Alba, BAVEC, Franc. Effects of intensive and alternative production systems on the technological and quality parameters of rapeseed seed (*Brassica napus* L. 'Siska'). *Journal of the science of food and agriculture*, ISSN 0022-5142. [Print ed.], 2016, vol. 96, iss. , v tisku, doi: [10.1002/jsfa.8088](https://doi.org/10.1002/jsfa.8088).

URBANEK KRAJNC, Andreja, JANŽEKOVIČ, Ignac, ŠOBER, Andreja, IVANČIČ, Anton. The impact of interspecific hybridization on the chemical compositions of oil pumpkin seeds. *Phyton*, ISSN 0079-2047, 2016, vol. 56, fasc. 1, str. 61-75, ilustr., doi: [10.12905/0380.phyton56\(1\)2016-0061](https://doi.org/10.12905/0380.phyton56(1)2016-0061).

SADAR, Nadja, URBANEK KRAJNC, Andreja, TOJNKO, Stanislav, TIJSKENS, Leopold M. M., SCHOUTEN, Rob E., UNUK, Tatjana. Development and distribution of quality related compounds in apples during growth. *Scientia horticulturae*, ISSN 0304-4238. [Print ed.], December 2016, vol. 213, no. , str. 222-231, graf. prikazi, doi: [10.1016/j.scienta.2016.10.038](https://doi.org/10.1016/j.scienta.2016.10.038).

FELICIJAN, Mateja, KRISTL, Janja, URBANEK KRAJNC, Andreja. Pre-treatment with salicylic acid induces phenolic responses of Norway spruce (*Picea abies*) bark to bark beetle (*Ips typographus*) attack. *Trees*, ISSN 0931-1890, 2016, vol. 30, iss. 6, str. 2117-2129, doi: [10.1007/s00468-016-1438-x](https://doi.org/10.1007/s00468-016-1438-x). [COBISS.SI-ID [4287020](https://www.cobiss.si/id/4287020)], [JCR, SNIP, WoS do 22. 2. 2017: št. citatov (TC): 0, čistih citatov (CI): 0, Scopu do 22. 2. 2017: št. citatov (TC): 0, čistih citatov (CI): 0]

MECHORA, Špela, SOTLER, Metka, URBANEK KRAJNC, Andreja, AMBROŽIČ-DOLINŠEK, Jana. How selenium affects *Berula erecta*. *Water, air and soil pollution*, ISSN 0049-6979. [Print ed.], 2016, vol. 227, iss. 12, str. 1-12, doi: [10.1007/s11270-016-3150-2](https://doi.org/10.1007/s11270-016-3150-2).

NOVAK, Metka, URBANEK KRAJNC, Andreja, LAH, Ljerka, ZUPANEC, Neja, KRAŠEVEC, Nada, KRIŽMAN, Mitja, BOHLMANN, Joerg, KOMEL, Radovan. Low-density *Ceratocystis polonica* inoculation of Norway spruce (*Picea abies*) triggers accumulation of monoterpenes with antifungal properties. *European journal of forest research (Print)*, ISSN 1612-4669, Jul. 2014, vol. 133, no. 4, str. 573-583, ilustr., doi: [10.1007/s10342-013-0772-4](https://doi.org/10.1007/s10342-013-0772-4).

URBANEK KRAJNC, Andreja, NOVAK, Metka, FELICIJAN, Mateja, KRAŠEVEC, Nada, LEŠNIK, Mario, ZUPANEC, Neja, KOMEL, Radovan. Antioxidative response patterns of Norway spruce bark to low-density *Ceratocystis polonica* inoculation. *Trees*, ISSN 0931-1890, 2014, vol. 28, iss. 4, str. 1145-1160, doi: [10.1007/s00468-014-1025-y](https://doi.org/10.1007/s00468-014-1025-y).

URBANEK KRAJNC, Andreja, TURINEK, Maja, IVANČIČ, Anton. Morphological and physiological changes during adventitious root formation as affected by auxin metabolism : stimulatory effect of auxin containing seaweed extract treatment. *Agricultura*, ISSN 1580-8432. [Print ed.], nov. 2013, vol. 10, no. 1/2, str. 17-27, ilustr. [COBISS.SI-ID [3641132](https://www.cobiss.si/id/3641132)]

URBANEK KRAJNC, Andreja, KRISTL, Janja, IVANČIČ, Anton. Application of salicylic acid induces antioxidant defense responses in the phloem of *Picea abies* and inhibits colonization by *Ips typographus*. *Forest Ecology and Management*, ISSN 0378-1127. [Print ed.], 2011, letn. 261, št. 3, str. 416-426, doi: [10.1016/j.foreco.2010.10.027](https://doi.org/10.1016/j.foreco.2010.10.027).

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URBANEK KRAJNC, Andreja, IVANUŠ, Anja, KRISTL, Janja, ŠUŠEK, Andrej. Seaweed extract elicits the metabolic responses in leaves and enhances growth of pelargonium cuttings. *European journal of horticultural science*, ISSN 1611-4426, 2012, letn. 77, št. 4, str. 170-181. [COBISS.SI-ID [3355436](#)]