



Univerza v Mariboru

Fakulteta za naravoslovje
in matematiko

UČNI NAČRT PREDMETA / COURSE SYLLABUS

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| 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 Fieldwork | Samost. delo Individ. work | ECTS |
|------------------------|--------------------|------------------|------------------------------|----------------------------|-------------------------------|------|
| 18 | 4 | | 8 | | 150 | 6 |

Nosilec predmeta / Lecturer: Andreja URBANEK KRAJNC

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|-------------------|-------------------------------|---------------------|
| 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, motnje v

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, disturbances



metabolizmu ogljika, motnje v mineralni prehrani

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 glutaciona, 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 motnjami
4. Bioindikacija onesnaževanja okolja
Reakcijski in akumulacijski indikatorji, kazalci in testni organizmi, metode biomonitoringa, vloga glutaciona v detoksifikaciji težkih kovin.
5. Termogeneza aroidnih vrst: fiziološko ozadje

in carbon metabolism, disturbances in mineral nutrition

Habitat-related aspects of mineral metabolism; 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 presentation of 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 (AVI) on the color of flowers and fruits and alterations 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



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).

- Inventarizacija, morfološke in biokemijske raziskave bele murve, reintegracija morikulture

the detoxification of heavy metals.
5. Termogenesis of faroid 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).

- Inventarisation, morphological and biochemical analyses of white mulberry, reintegration of moriculture

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.
- Taiz, L., E. Zeiger, I. M. Moller, A. Murphy 2015: Plant Physiology. 6th Edition. Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts.
- Sadras V.O. & Calderini D.F. 2009. Crop Physiology, Academic Press, Elsevier.
- Larcher W., 2003. Physiological Plant Ecology. 4th Edition. Springer, Berlin.

Znanstvene revije:

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
Annals of Botany
Physiologia Plantarum
Plant Physiology and Biochemistry



Journal of Plant Physiology
Plant Pathology

Cilji in kompetence:

- Posebna pozornost je posvečena izbranim odzivom rastlin na izbrane okoljske dejavnike
- Poznavanje daljinskega transporta vode
- Prepoznavanje izbranih toksičnih učinkov kisika
- Poznavanje funkcijskih motenj celičnega metabolizma
- Vpogled v simptome poškodb na nivoju celic in celega organizma
- Obravnava v izbrane obrambne in reparativne mehanizme
- Poznavanje pomena termogeneze v biologiji cvetenja
- 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
- Knowledge of water long distance transport
- Illustration of selected toxic effects of oxygen
- selected functional disturbances in cell metabolism
- Knowledge of injury patterns and symptoms on cell and whole plant level
- An insight into the defense and reparatory mechanisms
- Knowledge of the role of thermogenesis in floral biology
- 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
- Osvojitev izbranih metod v ekofiziologiji

Prenesljive/ključne spretnosti in drugi atributi:

- Pridobitev vrhunskega 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:

Learning and teaching methods:



- 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

- 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

Delež (v %) /

Načini ocenjevanja:

Weight (in %) /

Assessment:

- Seminarska naloga in njena predstavitev
- Laboratorijski dnevnik
- Pisni izpit

25%
25%
50%

- Seminar essay and its defense
- Diary of laboratory results
- Written exam

Reference nosilca / Lecturer's references:

URBANEK KRAJNC, Andreja, UGULIN, Tina, PAUŠIČ, Andrej, RABENSTEINER, Johannes, BUKOVAC, Vesna, MIKULIČ PETKOVŠEK, Maja, JANŽEKOVIČ, Franc, BAKONYI, Tamás, BERČIČ, Rebeka Lucijana, FELICIJAN, Mateja. Morphometric and biochemical screening of fold mulberry trees (*Morus alba* L.) in the former sericulture region of Slovenia. *Acta Societatis Botanicorum Poloniae*, ISSN 2083-9480, 2019, vol. 88, no. 1, str. 1-

22. <https://pbsociety.org.pl/journals/index.php/asbp/article/view/asbp.3614>, doi: [10.5586/asbp.3614](https://doi.org/10.5586/asbp.3614). [COBISS.SI-ID [4562220](https://www.cobiss.si/record/4562220)]

ŽEBELJAN, Aleksandra, VICO, Ivana, DUDUK, Nataša, ŽIBERNA, Bojana, URBANEK KRAJNC, Andreja. Dynamic changes in common metabolites and antioxidants during *Penicillium expansum*-apple fruit interactions. *Physiological and molecular plant pathology*, ISSN 0885-5765, 2019, vol. 106, no. In progress, str. 166-174, ilustr., doi: [10.1016/j.pmpp.2019.02.001](https://doi.org/10.1016/j.pmpp.2019.02.001). [COBISS.SI-ID [4545324](https://www.cobiss.si/record/4545324)]

URBANEK KRAJNC, Andreja, RAKUN, Jurij, BERK, Peter, IVANČIČ, Anton. The impact of fruit temperature dynamics on heat stress tolerance of selected oil pumpkin genotypes. *Advances in horticultural science*, ISSN 0394-6169, 2017, vol. 31, no. 1, str. 61-73, doi: [10.13128/ahs-20727](https://doi.org/10.13128/ahs-20727). [COBISS.SI-ID [4307500](https://www.cobiss.si/record/4307500)]

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. [Printed.], 2017, vol. 138, str. 16-23, doi: [10.1016/j.aquabot.2016.12.002](https://doi.org/10.1016/j.aquabot.2016.12.002). [COBISS.SI-ID [22874888](https://www.cobiss.si/record/22874888)]



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TURINEK, Maja, BAVEC, Martina, REPIČ, Milan, TURINEK, Matjaž, URBANEK KRAJNC, Andreja, MOELLERS, Christian, TRES, Alba, BAVEC, Franc. Effectsofintensiveand alternative productionsystems on thetechnologicalandqualityparametersofrapeseedseed (Brassicainapus L. 'Siska'). *Journalofthe science offoodandagriculture*, ISSN 0022-5142. [Printed.], June 2017, vol. 97, iss. 8, str. 2647-2656, doi: [10.1002/jsfa.8088](https://doi.org/10.1002/jsfa.8088). [COBISS.SI-ID [4240684](#)]