Univerza v Mariboru

Fakulteta za naravoslovje in matematiko

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	**Izbor iz fiziološke ekologije rastlin**
Course title:	**Selection in PhysiologicalPlantEcology**

Študijski program in stopnja Studyprogrammeandlevel	Študijska smer Studyfield	Letnik Academicyear	Semester Semester
Doktorski študij Ekološke znanosti, 3. stopnja		**1. ali 2.; 1stor 2nd**	**1.- 4.; 1st-4th**
DoctoralStudyEcologicalSciences, 3rd degree			

Vrsta predmeta / Coursetype Izbirni/Elective

Univerzitetna koda predmeta / Universitycoursecode:

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

Nosilec predmeta / Lecturer: Andreja URBANEK KRAJNC

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisits:
Poznavanje fiziologije rastlin na ravni dodiplomskega študija	Knowledgeofphysiologicalplantecology at graduatelevel

Vsebina:	Content (Syllabusoutline):
V predmetu so podrobno obravnavana izbrana poglavja iz vpliva naravnih (abiotskih in biotskih) 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	The lecture focuses on selected chapters on the impact of natural (abiotic and biotic) and anthropogenic stress factors on physiological processes in plantswiththespecialemphasis 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

Negativen učinek reaktivnih kisikovih vrst (ROS) na subcelularnm nivoju, motnje v metabolizmu ogljika, motnje v mineralni prehrani B) Odzivi rastlin na stresne dejavnike Obrambni in reparaturni mehanizmi, detoksifikacija ROS z antioksidanti in encimi; sinteza, kompartimentacija 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 (thermaldissipation probe, tipalo termičnega odvoda) in HPV (Heatpulsevelocity) 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 abiotski/biotski stres v kmetijskih ekosistemih 3. Biokemične in strukturne spremembe rastlinskih tkiv kot posledica fizioloških motenj na hortikulturnih rastlinah Vloga antocianskihvakuolarnih vključkov (AVI, anthocyanicvacuolarinclusions) na barvo cvetov in plodov v povezavi s pomanjkanjem kalcija Programiranaceličnasmrt v povezavi s fiziološkimi motnami 4. Bioindikacija onesnaževanja okolja	Negative effects of reactive oxygen species (ROS) on subcellular level, disturbances 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 ROS with antioxidants and enzymes; synthesis, compartimentation and function of antioxidants; recent advances in the role of glutathione, ascorbate, tocoferol and carotinoides in defense against oxidative stress. Particular emphasis is placed on the presentation of the lecture's own research in the following learning packages: 1. Long distance transport of water in trees (physiological background of xylem flux, relationship between xylem flux, evapotranspiration and photosynthesis, principles of techniques to measure water flux with TDP (thermal dissipation probe) and HPV (heat pulse velocity) sensors. Presentation of own results of sap flow measurements on spruce affected by the bark beetle and *Ceratocystis polonica* infection). 2.The effects of sulphur metabolism in plants and adaptation to biotic/abiotic stress in agricultural ecosystems. 3. Biochemical and structural changes in plant tissues as a result of physiological disturbances in horticultural crops. The effects of anthocyanic vacuolar inclusions (AVI) on flower and fruit colour in respect to calcium deficiency. Programmed cell death associated with physiological disorders.

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 aspekttermogeneze, 4 tipi termogeneze (morfološke in fiziološke posebnosti, časovni potek gretja posameznih tipov termogeneze), predstavitev znanstvenih objavin raziskovalnega delana rodovih *Alocasia*, *Colocasia* in *Arum*, predstavitev rezultatov raziskav v okviru mednarodnega projekta INEA (InternationalNetworkforEdibleAroids). - Inventarizacija, morfološke in biokemijske raziskave bele murve, reintegracija morikulture. Pomen fitolitov v listih murv v odzivu na stres. Fitoremediacijski učinek murv.	4. Bioindication of pollution effects Reaction and accumulation indicators, indicators and test organisms, biomonitoring methods, the role of glutathione in the detoxification of heavy metals. 5.Termogenesis of the aroid species: physiological background of thermogenesis (regulation, the role of alternative oxidase, the role of salicylic acid and ethylene, volatile secondary metabolites); ultrastructural features of the spadix and the surface of the spatha, ecological aspect of thermogenesis, 4 types of thermogenesis (morphological and physiological features, time course of the heating process in the different types of thermogenesis), presentation of scientific publications and research on the genera *Alocasia*, *Colocasia* and *Arum*, presentation of research results in the framework of the international project INEA (international Network for Edible Aroids). -Inventory, morphological and biochemical analyses of the white mulberry, reintegration of moriculture. The role of phytoliths in mulberry leaves in relation to stress. Phytoremediation effect of mulberries.

Temeljni literatura in viri / Readings:

- Schopfer P., Brennicke A. 2016. Pflanzenphysiologie. Springer Spektrum, Berlin-Heidelberg.
- Taiz, L., E. Zeiger, I. M. Moller, A. Murphy 2020: Plant Physiology. 6th Edition. Sinauer Associatites, Inc., Publishers, Sunderland, Massachusetts.
- Hamlyn G. Jones 2013. Plants and Microclimate, A Quantitative Approach to Environmental Plant Physiology, 2013, Cambridge UniversityPress.
- Sadras V. O., Calderini D. F., CropPhysiology, 2009, AcademicPress.
- Sadras V.O. &Calderini D.F. 2009. CropPhysiology, AcademicPress, Elsevier.
- Larcher W., 2003. PhysiologicalPlantEcology. 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 efektov kisika
- Poznavanje funkcijskih motenj celičnega metabolizma
- Vpogled v simptome poškodb na nivoju celic in celega organizma
- Obravnava v izbrane obrambne in reparaturne 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 thedefense 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:

- Študentje bodo pridobili z nanje in razumevanje odziva rastlin na izbrane okoljske dejavnike
- Povezali bodo razumevanje toksičnih efektov kisika
- Pridobili bodo poznavanje stresnih faktorjev, prepoznavanje simptomov

Intendedlearningoutcomes:

Knowledge and Understanding:
Students will gain knowledge and understanding of plant response to selected environmental factors
- They will make a connection understanding of the toxic effects of oxygen
- They will acquire knowledge of stress factors, recognition of symptoms of injury and basic defence and repair mechanisms

poškodb in osnovnih obrambnih in reparaturnih mehanizmov • Uporabljali bodo izbran 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	- They will apply selected methods of ecophysiology 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:	**Learningandteachingmethods:**
• 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

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
• Seminarska naloga in njena predstavitev • Laboratorijski dnevnik • Pisni izpit	 25% 25% 50%	• Seminar essayanditsdefense • Diaryoflaboratoryresults • Writtenexam

Reference nosilca / Lecturer'sreferences:

. AMBROŽIČ-DOLINŠEK, Jana, PODGRAJŠEK, Anja, ŠABEDER, Nik, MAZEJ, Zdenka, URBANEK KRAJNC, Andreja, TODOROVIĆ, Biljana, CIRINGER, Terezija. The potential of berula erecta in vitro for As bioaccumulation and phytoremediation of water environments. *Environmental pollutants & bioavailability*. 2023, vol. 35, no. 1, [article no.] 2205010, 12 str. ISSN 2639-5940. DOI: 10.1080/26395940.2023.2205010. [COBISS.SI-ID 151163139], [JCR, SNIP]

URBANEK KRAJNC, Andreja, BAKONYI, Tamás, ANDO, Istvan, KURUCZ, Eva, SOLYMOSI, Norbert, PONGRAC, Paula, BERČIČ, Rebeka Lucijana. The effect of feeding with Central European local mulberry genotypes on the development and health status of silkworms and quality parameters of raw silk. *Insects*. 2022, vol. 13, iss. 9, [article no.] 836, str. 1-29, graf. prikazi. ISSN 2075-4450. https://www.mdpi.com/2075-4450/13/9/836, DOI: 10.3390/insects13090836. financer: Hungarian Scientific Research Fund ARRS, OTKA SNN 116993, N1-0041, P-0164, P1-0212, J4-309

BERK, Peter, SEČNIK, Matej, URBANEK KRAJNC, Andreja, STAJNKO, Denis. Digital evaluation of the leaf wall area of the grapevine (Vitis vinifera cv. Sauvignon) by using LIDAR measuring technology. *Glasnik zaštite bilja : glasilo Sekcije za biljnu zaštitu Hrvatskog agronomskog društva*. 2021, god. 44, št. 4, str. 74-81, ilustr. ISSN

0350-9664. https://hrcak.srce.hr/index.php?show=clanak&id_clanak_jezik=380177. [COBISS.SI-ID 71934211]

ŽEBELJAN, Aleksandra, VICO, Ivana, DUDUK, Nataša, ŽIBERNA, Bojana, URBANEK KRAJNC, Andreja. Profiling changes in primary metabolites and antioxidants during apple fruit decay caused by Penicillium crustosum. *Physiological and molecular plant pathology*. January 2021, vol. 113, 101586, str. 1-10, ilustr. ISSN 0885-5765. DOI: 10.1016/j.pmpp.2020.101586.

TODOROVIĆ, Biljana, GRUJIĆ, Jaša Veno, URBANEK KRAJNC, Andreja, KRANVOGL, Roman, AMBROŽIČ-DOLINŠEK, Jana. Identification and content of astaxanthin and its esters from microalgae Haematococcus pluvialis by HPLC-DAD and LC-QTOF-MS after extraction with various solvents. *Plants*. 2021, vol. 10, iss. 11, str. 1-14. ISSN 2223-7747. DOI: 10.3390/plants10112413.

MECHORA, Špela, RIŽNIK, Tadeja, URBANEK KRAJNC, Andreja, AMBROŽIČ-DOLINŠEK, Jana. Response of Berula erecta to lead in combination with selenium. *Bulletin of environmental contamination and toxicology*. 2020, vol. 105, no. 1, str. 51-61, graf. prikazi. ISSN 0007-4861. DOI: 10.1007/s00128-020-02910-0. [COBISS.SI-ID 22564355].

URBANEK KRAJNC, Andreja, IVANUŠ, Anja, LUTHAR, Zlata, LIPOVŠEK, Matej. Raznolikost morfoloških lastnosti in taksonomski koncepti oblikovnega kroga širokolistne močvirnice Epipactis helleborine (L.) Crantz = Morphological variability and taxonomic concepts of broad-leaved helleborine ingroup Epipactis helleborine (L.) Crantz. *Folia biologica et geologica*. [Tiskana izd.]. 2020, letn. 61, št. 2, str. 97-125, ilustr. ISSN 1855-7996. http://www.dlib.si/details/URN:NBN:SI:doc-EUK7BU2F, DOI: 10.3986/fbg0071.

ŠELIH, Mateja, MIKULIČ PETKOVŠEK, Maja, KRAJNC, Damjan, BERČIČ, Rebeka Lucijana, URBANEK KRAJNC, Andreja. Screening of leaf metabolites in historical mulberry trees (Morus alba L.) from different eco-geographical regions of Slovenia. *Trees*. 2020, vol. 34, iss. 4, str. 971-986. ISSN 0931-1890. https://link-springer-com.ezproxy.lib.ukm.si/content/pdf/10.1007%2Fs00468-020-01974-z.pdf, DOI: 10.1007/s00468-020-01974-z. [COBISS.SI-ID 4678188].

URBANEK KRAJNC, Andreja, UGULIN, Tina, PAUŠIČ, Andrej, RABENSTEINER, Johannes, MEDEN, Vesna Mila, MIKULIČ PETKOVŠEK, Maja, JANŽEKOVIČ, Franc, BAKONYI, Tamás, BERČIČ, Rebeka Lucijana, ŠELIH, Mateja. Morphometric and biochemical screening of old mulberry trees (Morus alba L.) in the former sericulture region of Slovenia. *Acta Societatis Botanicorum Poloniae*. 2019, vol. 88, no. 1, str. 1-22. ISSN 2083-9480. https://pbsociety.org.pl/journals/index.php/asbp/article/view/asbp.3614, DOI: 10.5586/asbp.3614. [COBISS.SI-ID 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*. 2019, vol. 106, no. april, str. 166-174, ilustr. ISSN 0885-5765. DOI: 10.1016/j.pmpp.2019.02.001.