SYLLABUS (MODULE-ERASMUS+)

Module/ course (as specified in the approved curriculum for the field of study) **Module: HORT 3 Plant responses to adverse environmental factors** **Course: HORT 3.1 Abiotic stresses**	ECTS **4**	Catalogue number **HORT 3.1**
Name in Polish **Moduł: HORT 3 Odpowiedzi roślin na niekorzystne czynniki środowiska** **Kurs: HORT 3.1 Abiotyczne stresy**		
Head of course/module **Prof. dr hab. Iwona Morkunas**		
Unit(-s) providing the course/module (Institute/Department) **Department of Plant Physiology**		

Field of study **Biology and Horticulture**	Level	Profile **Academic-general**	Semester **Winter**

TYPE OF CLASSES/LECTURES AND THE NUMBER OF HOURS
(organised classes/lectures and self-study)

Type of studies: full-time		Type of studies: extramural	
- lectures	**12**	- lectures	
- practical total		- classes	
- laboratory practical	**20**	-	
- project based practical		-	
- Other – tutored	**3**	-	
- self-study	**65**	- Self-study	
Total number of hours:	**100**	Total number of hours:	

OBJECTIVE OF COURSE/MODULE

The program includes the effect of adverse environmental factors especially abiotic stress factors on plants. Understanding the physiological-molecular basis of plant responses to environmental stresses. Presentation of crosstalk between abiotic and biotic stress responses. The knowledge of strategies of plant resistance to different types of stress factors. Current knowledge about opportunities to improve crop plant resistance to stresses

TEACHING METHODS

Lecture supported by multimedia presentation and discussion. Laboratory training consisting of performing the experimental tasks, on selected responses of plant to biotic and abiotic stresses. Microscopic observations and determination of physiological and biochemical indices. Preparation of reports (team or individual)

	LEARNING OUTCOMES	Reference to field outcomes	Reference to area outcomes
Knowledge	E1. Student acquires knowledge about the effect of adverse environmental factors on plants E2. Student has knowledge concerning physiological and molecular mechanisms of plant resistance to abiotic stressors E3 Student understands convergence points between biotic and abiotic stress E4. Student has knowledge concerning the plant-abiotic stress interactions at the physiological, biochemical and molecular level E.5. The student has knowledge on a variety of plant responses to abiotic and biotic stresses that enable them to tolerate and survive adverse condition		
Skills	E6. Student identifies main groups of environmental factors affecting plants E7. Student recognises molecular, metabolic and proteomic changes of plants in response to abiotic and biotic stressors E8. Student identifies responses of acclimatization and adaptation of plants to stresses E9. Student recognizes the influence of climate and soil on plants		

Social competences	E10. Student is able to work as a leader and/or as a partner in a group. E11. Student is able to predict the effects of different environmental stressors on food production, understanding economic significance subject in the current time		

Methods to verify learning outcomes Written test, the preparation of oral presentation	Outcome Reference Numbers

TEACHING CONTENT

Content of lectures concerning abiotic stresses

Plant stress physiology. Developmental and physiological mechanisms against environmental stresses
Molecular aspects of plan responses to various stresses
The mechanisms of plant response to drought
The influence of salt stress on plants
Soil sickness - reasons and effects
Mechanisms of plant resistance to trace metals
Summary of plant responses to stress factors. The improvement of crop plant resistance to environmental stresses

Content of laboratory practical:

Abiotic stresses

The impact of drought on nitrate reductase (NR) activity and growth of crop plants on the example of barley
The effect of different salt concentrations on growth and some physiological parameters
Determination of some physiological indicators under heavy metal stress
Determination of cell membrane damage caused by cold stress

Forms and criteria for passing of course/moduleMolecular	Percentage of final mark **100%**

LIST OF LITERATURE

1. Plant environment interactions. 2009. Ed. Baluška F., Springer, ISBN 978-3-540-89229-8
2. Physiological mechanisms and adaptation strategies in plants under changing environment. 2014. Eds. Paravaiz A., Mohd Rafiq W. Springer. ISBN 978-1-4614-8599-5
3. Buchanan B.B, Gruissem W. and Russell L.J. Biochemistry & Molecular Biology of Plants. Chapter: Responses to abiotic stresses. Wiley Blackwell, 2015.
4. Plant Physiology, Fifth Edition. 2017. Eds. Taiz L., Zeiger E. Publisher: Sinauer Associates, Inc. ISBN-13: 978-0878938667
5. Krishania S., Dwivedi P., Agarwal K. 2013. Strategies of adaptation and injury exhibited by plants under a variety of external conditions: a short review. Comunicata Scientiae 4(2): 103-110.
6. Zhu J-K. 2016. Abiotic stress signaling and responses in plants. Cell. 6; 167(2): 313–324. doi:10.1016/j.cell.2016.08.029
8. Peleg Z., Blumwald E.2011. Hormone balance and abiotic stress tolerance in crop plants. Current Opinion in Plant Biology 14(3): 290-295
9. Clemens S., 2006. Toxic metal accumulation, responses to exposure and mechanisms of tolerance in plants. Biochemie, 88: 1707-1719.
10. Gupta D. K., Corpas F. J. Palma J. M., (Eds.), 2013. Heavy metal stress in plants. Springer Heidelberg New York Dordrecht London, ISBN 978-3-642-38468-4
11. Hall L. J., 2002. Cellular mechanism for heavy metal detoxification and tolerance. J. Exp. Bot., 53: 1-11. Krämer U., 2010. Metal hyperaccumulation in plants. Annu. Rev. Plant Biol. 61: 517-534.
12. Politycka B. 2011. Soil sickness: an overview. W: Research Methods in Plant Sciences. 3. Soil Sickness. Eds. S.S. Narwal, B. Politycka, Wu Fengzhi, D.A. Sampietro (red.). Studium Press LLC (USA), Houston, pp. 2-17.
13. Breś W., Politycka B. 2016. Contaminations of soils and substrates in horticulture, In: Soil Contamination – Current Consequences and Further Solutions. Eds M.L. Larramendy and S. Soloneski, InTech, 23-41.