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 3.2 Biotic interactions**	ECTS **4**	Catalogue number **HORT 3.2**
Name in Polish **Moduł: HORT 3 Odpowiedzi roślin na niekorzystne czynniki środowiska** **Kurs: HORT 3.2 Biotyczne oddziaływania**		
Head of course/module **Prof. dr hab. Iwona Morkunas**		
Unit(-s) providing the course/module (Institute/Department) **Department of Plant Physiology**		

Field of study	Level	Profile	Semester
Biology and Horticulture		**Academic-general**	**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	**13**	- lectures	
- practical total		- classes	
- laboratory practical	**20**	-	
- project based practical		-	
- Other – tutored	**2**	-	
- 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 biotic stress factors on plants. Understanding the physiological-molecular basis of plant responses to environmental stresses. The relationships between plant and biotic stress factors. 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 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 biotic stressors E3 Student understands convergence points between biotic and abiotic stress E4. Student has knowledge concerning the plant-microbe interactions at the physiological, biochemical and molecular level E.5. The student has knowledge on a variety of plant responses to 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 biotic and abiotic 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 biotic interactions

Introduction to plant stress physiology
Stress responses of plants at the cellular and molecular level
The effect of plant pathogens on the host physiology
The role of phytoalexins in plant defence
Mechanisms of plant defence against insect herbivores
The role of sugars in plant defence strategy against biotic stressors
Summary of plant responses to stress factors. The improvement of crop plant resistance to environmental stresses

Content of laboratory practical:

The cross-talk of the abiotic factor (heavy metal) and biotic factor (aphid) on the level of oxidative stress in plant
Determination of oxidative stress indicators and the activity of antioxidant enzymes in plant infected with fungal pathogen
Determination of phenolic compounds in plant defence response to pathogenic fungi
Allelopathic interactions between plants - effect of plant extracts and post-harvest residues on seed germination and seedling growth

Forms and criteria for passing of course/module **Written test – passed above 60%**	Percentage of final mark **100%**

LIST OF LITERATURE

1. Plant environment interactions. 2009. Ed. Baluška F., Springer, ISBN 978-3-540-89229-8
2. Signal crosstalk in plant stress responses. 2009. Ed. Yoshioka K., Shinozaki K. Wiley-Blackwell
3. Physiological mechanisms and adaptation strategies in plants under changing environment. 2014. Eds. Paravaiz A., Mohd Rafiq W. Springer. ISBN 978-1-4614-8599-5
4. Plant-fungal pathogen interaction. A classical and molecular view. 2001. H.H. Prell, Day P.R.. Springer, ISBN 3-540-66727-X
5. Buchanan B.B, Gruissem W. and Russell L.J. Biochemistry & Molecular Biology of Plants. Chapter: Responses to abitoic stresses. Wiley Blackwell, 2015.
6. Buchanan B.B, Gruissem W., Russell L.J. Biochemistry & Molecular Biology of Plants. Chapter: Responses to plant pathogens. Wiley Blackwell, 2015.
7. Jones, J. D., & Dangl, J. L. 2006. The plant immune system. Nature, 444(7117), 323-329.
8. Plant Physiology, Fifth Edition. 2017. Eds. Taiz L., Zeiger E. Publisher: Sinauer Associates, Inc. ISBN-13: 978-0878938667
9. Pieterse C. M., Van der Does D., Zamioudis C., Leon-Reyes A., Van Wees S.C. 2012. Hormonal modulation of plant immunity. Annu. Rev. Cell Dev. Biol. 28:489-521.
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16. Morkunas I., Ł. Marczak, J. Stachowiak, M. Stobiecki. 2005. Sucrose-induced lupine defense against Fusarium oxysporum: Sucrose-stimulated accumulation of isoflavonoids as a defense response of lupine to *Fusarium oxysporum*, Plant Physiol. Biochem. 43: 363-373.
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18. Mai V.C., Drzewiecka K., Jeleń H., Narożna D., Rucińska-Sobkowiak R., Kęsy J., Floryszak-Wieczorek J., Gabryś B., Morkunas I. 2014. Differential induction of *Pisum sativum* defense signaling molecules in response to pea aphid infestation. Plant Science 221–222:1–12