



Blended Intensive Program

Plant adaptations to climate changes

2nd edition

University of Minho, School of Sciences
Braga, Portugal

15-26 June 2026

-one in-person week (22-26 June)-

University of Minho

School of Sciences | Centre of Molecular and Environmental Biology | Department of Biology
School of Engineering | Center for MicroElectroMechanics Systems

+ Info: Prof. Hernâni Gerós - geros@bio.uminho.pt



Info of the 1st edition - May 2024



Minho takes Arqus students to investigate the Douro vineyards within the BIP “Plant Adaptations to Climate Changes”

University of Granada | 09 May 2024

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The visit is part of the Blended Intensive Programme (BIP) “Plant Adaptations to Climate Changes” that is being coordinated by the University of Minho and co-organised by the members of the Arqus Cluster on Sustainable Development and Climate Change from the Universities of Granada and Wrocław, and the Université Catholique de Louvain.

- <https://www.ecum.uminho.pt/pt/Ensino/Paginas/Plant-adaptations-to-climate-changes.aspx>
- <https://arqus-alliance.eu/news/minho-arqus-students-douro-vineyards-bip-plant-adaptations/>




Blended Intensive Programme 16 ECTS

PLANT ADAPTATIONS TO CLIMATE CHANGES

<https://www.ecum.uminho.pt/pt/Ensino/Paginas/Plant-adaptations-to-climate-changes.aspx>
 Biology Department | School of Sciences | University of Minho | Braga - Portugal | 15-19 April | 6-17 May 2024

Organizers: Hermâni Gerós, Viviana Martins

Invited lectures:

- Jobo Santos - University of Trás-os-Montes e Alto Douro: Climate change impacts: adaptation in viticulture as a case study
- Ana Fortes - University of Lisbon: Interdisciplinary approaches and cutting technologies for studying neofungal and biotrophic fungal infections during fruit ripening
- Henrique Noronha - University of Minho: Physiological responses of grapevine woody steels during winter and spring
- Ana Cunha - University of Minho: Interdisciplinary approaches and cutting technologies for studying neofungal and biotrophic fungal infections during fruit ripening
- Artur Silva Conde - University of Minho: The experimental and theoretical approaches (pH/PSII) a tool to increase the agronomical value of grapevine?
- Rui Oliveira - University of Minho: Wild roses plants (rose) can be useful for us
- Arnold Excoffier - University of Tours: Functional metabolomic tools to investigate plant responses under challenging environments
- Richard Breia - University of Minho: Interactions in regulation of activation of the role of sugar transporters on plant-pathogen interaction
- Ricardo López - University of Zaragoza: The impact of herbivores: integrating the complexities of chemical composition and perception
- Margarida Fernandes - University of Minho: Advanced nano/bio-delivery systems for novel agroformulations: towards a sustainable viticulture
- François Chaumont - University of Louvain: Aquaporins: key ubiquitous channels for plant physiology under water deficit
- Natacha Fontes - Sogrape Wines: Holistic approach to future viticulture in Portugal's Douro Valley: the NOVATERRA project approach in mountain viticulture
- Luis Marcos - ADVID CoLAB Vines & Wines: Water stress management in a changing climate in the Douro Demarcated Region
- Cristiano Soares - University of Porto: Glycosylated accumulation in agroecosystems and impacts in non-target plants
- Jorge Queiroz - University of Porto: Viticulture and wine production in the Mediterranean region in the context of climate change

Learning - teaching

Week 1: Minho

- QUESTIONING: plants (climate change / pollution)
- ORGANIZING: presentation – objectives, planning – field scenarios, orienting problems
- COLLABORATION: Theoretical (H. Gerós) & invited lectures, independent work
- APRIL 15-19, 2024
- EXPLORING: list of case studies, list of guiding problems, list of projects
- PROJECT DESIGN: independent work
- PLANNING: independent work (team work): reflection, resource mapping, literature research, designing experiments
- RESOURCE ALLOCATION: independent work
- RESEARCH/LEARNING: independent work
- REFLEXION: Experimental sessions – results exploitation
- ADAPTATION: Scientific visit to vineyard, individual lectures
- MAY 6-10, 2024
- REORGANIZING: independent work
- CRITICAL THINKING: presentations – general discussion – reflection – course assessment and feedback
- COMMUNITY ENGAGEMENT: independent work
- APR 13-17, 2024
- APPLICATION: Solid and lasting knowledge based on experience, ability to transfer knowledge, experimental skills, teamwork skills, communication skills, critical thinking, autonomy and independence, creativity
- EVALUATION: independent work
- CELEBRATION: independent work

Week 2: Braga

Experimental sessions
V. Martins

- Day 1 | Elicitation of plant material
- Day 2 | Sample harvest and RNA extraction
- Day 3 | cDNA synthesis & qPCR, metabolite quantification
- Day 4 | Scientific visit to the vineyards of Douro Valley
- Day 5 | Data integration and metabolic pathways

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Scientific mission to the vineyards of Douro Valley, May 9th

9h30
 Arrival at ADVID CoLAB Vines & Wines - <https://www.advid.pt/en/Reception>

10h45
 Natacha Fontes – Sogrape Wines
 “Holistic approach to future viticulture in Portugal’s Douro Valley: the NOVATERRA project approach in mountain viticulture”

Luis Marcos – ADVID CoLAB Vines & Wines
 “Water stress management in a changing climate in the Douro Demarcated Region”

Jorge Queiroz – University of Porto
 “Viticulture and wine production in the Mediterranean region in the context of climate change”

12h30
 Lunch

13h30
 Trip to Quinta do Seixo - Sandeman - and visit to the field

16h00
 Departure to Braga

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What is a BIP?

- ✓ The BIPs aim to promote mixed mobility, create innovative approaches to teaching and learning, and implement transnational and transdisciplinary short-term courses for students and/or administrative staff.
- ✓ The virtual component is mandatory (of any duration and can take place before or after physical mobility), and physical mobility can last between 5 to 30 days.
- ✓ A BIP must involve a minimum of three Higher Education Institutions (HEIs) from three countries in the Erasmus+ Program, with 15 to 20 participants, and the combined mobility (virtual and physical) must award a minimum of 3 ECTS to participants.
- ✓ Erasmus+ Interinstitutional Agreements must be signed between the host and foreign HEIs before the (virtual and physical) mobilities take place



Code of good practices of a BIP:

- ✓ They should add value to other existing programs or courses in terms of their content or relevance;
- ✓ They should promote transdisciplinary and multinational teaching and training, benefiting from special learning and teaching conditions not available in a single institution;
- ✓ They must ensure transnational participation: individual participants or groups from at least three countries;
- ✓ They may include challenge-based learning, where transnational and transdisciplinary teams collaborate synergistically;
- ✓ They should encourage faculty to exchange views on content, new curricular approaches, and innovative teaching methods that may eventually be applied to other national or international teaching projects;
- ✓ They should provide students with new learning and skill development opportunities, particularly in information exploration;
- ✓ They should aim to reach all types of students from diverse backgrounds and any fields and study cycles;
- ✓ The student-to-faculty ratio should be adjusted to allow for active student engagement;
- ✓ A balance between transnational and national participation, as well as teaching staff, should be considered;
- ✓ They should facilitate the development of cross-cutting skills beyond discipline-specific competencies;
- ✓ It should ensure that the majority of the work carried out by students/professors at the foreign institution is of the face-to-face learning/teaching type.



Priorities addressed:

Environment and fight against climate change

Objectives and methods:

Agriculture faces significant challenges exacerbated by climate change and pollution. Our program addresses this need through a multifaceted approach. Theoretical sessions, conducted both online and in-person, in synchronous and asynchronous formats, explore the diverse facets such as plant physiology, development, and productivity in response to abiotic and biotic stresses induced by climate change and pollution. Hands-on experimental activities will enable participants to apply theoretical concepts. Furthermore, seminars by national and international specialists will enrich participants' understanding of cutting-edge research and emerging trends.

Field of Education: Biology

Level of Study: Master or Doctorate

Main Teaching/Training Language: English

Number of ECTS Credits Awarded: 6 ECTS



Blended Intensive Program

Plant adaptations to climate changes

Physical (in person) start/end date: 22 – 26 June 2026

- ✓ Country of venue: Portugal
- ✓ City of venue: Braga
- ✓ Physical component description: Conducting experimental research aimed at elucidating the interactions between plants and their environment. Theoretical-practical sessions.

Virtual component description

- ✓ 15 – 19 June 2026: kick off with presentations, group formation, seminars (online and in-person; synchronous and asynchronous) by national and international experts, and problem and project elaborations.
- ✓ 29 June – 3 July: analyzing the results, preparing and presenting oral communications, and evaluating students.

Teachers/Researchers delivering the Programme

Hernâni Gerós (UMinho, plant molecular physiology)

Experienced national and international professors and researchers, including from the partner institutions (see 1st edition info).



Learning outcomes (general)

- ✓ Explain the impact of climate change on plant diversity, growth, and productivity;
- ✓ Explain how pollution and climate change are closely intermingled;
- ✓ Identify the main air pollutants that contribute to the greenhouse effect;
- ✓ Identify the main environmental factors affecting plant development and productivity;
- ✓ Identify the main route by which air pollutants are incorporated in plants;
- ✓ Identify the main water pollutants;
- ✓ Explain how different stresses, including salinity and heavy metal stress, affect plant metabolism at the biochemical and molecular levels;
- ✓ Provide examples of diseases and pests that compromise plant productivity;
- ✓ Identify key molecular mechanisms of plant interaction with the environment, including cellular signaling and substrate transport;
- ✓ Explain the concept of biocontrol and provide examples;
- ✓ Give examples of bio-stimulants used, for instance, in viticulture;
- ✓ Explain how optimizing agricultural practices can mitigate the negative impact of environmental factors;
- ✓ Provide examples of precision agriculture and its applications;
- ✓ Give examples of successful cases of environmental stress mitigation strategies;
- ✓ Explain the importance of omics approaches, such as transcriptomics and metabolomics, in studying plant-environment interactions;
- ✓ Explain strategies for the rational design of miRNA-derived micropeptides aimed at stimulating secondary metabolite biosynthesis in plant cell cultures and fruits.
- ✓ Design and interpret in vitro and in planta assays to assess the efficacy of bioactive compounds in controlling plant diseases and improving plant health.
- ✓ Develop protocols for studying gene expression in plant response.

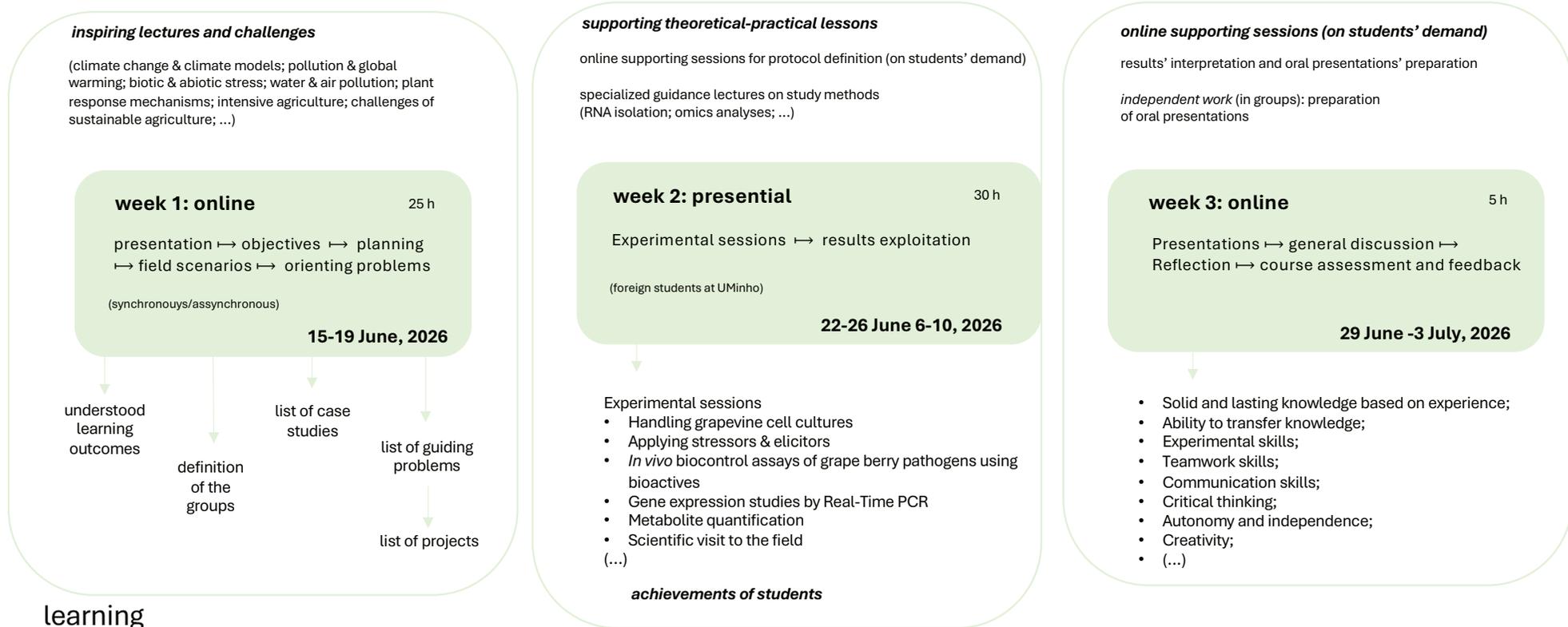


Methods and outcomes

- ✓ The challenge-based learning approach will place students at the center of the teaching/learning process;
- ✓ The adopted approach will be constructivist, requiring students to build their own knowledge through active exploration and practical application of theoretical concepts;
- ✓ The course will begin with the exploration of key learning outcomes and the definition of assessment methods and criteria aligned with these outcomes;
- ✓ Foundational scientific literature will be provided, and research and information-seeking methods will be explored, including the use of databases such as PubMed;
- ✓ The progress of the Course will be planned as much as possible, particularly regarding in-person teaching moments, such as experimental sessions, reflection and debate periods, and the final event where students will present their projects and results;
- ✓ Activities will commence with "inspirational lectures" and "challenging sessions" (e.g., on intensive agriculture and diseases and pests in a field context);
- ✓ This approach will create real-world field scenarios and the definition of guiding problems that will constitute the backbone of the entire project;
- ✓ Students are then encouraged to seek and explore relevant scientific literature and design experiments, in other words, to make decisions;
- ✓ (However, it is important to set boundaries in advance for activities and tasks, especially experimental or field visits in which students may be involved, as well as the resources available in the laboratory)
- ✓ Invited scientists from Portuguese and foreign institutions will give lectures (in-person or online) on topics that best fit each group's project, followed by brainstorming sessions;
- ✓ In the end, students should present their results, collectively, in a creative and accessible manner with a focus on proximity, aiming to develop oral and written communication skills;
- ✓ Students will also be invited to reflect on the construction process of the Course and its results, making their feedback crucial for the enhancement of the Course each year.



teaching



learning

QUESTIONING ORGANIZING EXPLORING PLANNING RESEARCH/LEARNING THINKING (RE)ORGANIZING LEARNING APPLYING



Figure 1: General structure of the Erasmus+ Blended Intensive Course (BIP) titled "Plant adaptations to climate changes" delivered in the Challenge Based Learning (CBL) format.

In summary:

- ✓ Consortium of 3 Higher Education Institutions
- ✓ Blended format: remote + in-person sessions
- ✓ Challenge-Based Learning methodology
- ✓ 15 international students
- ✓ 1 on-site week at UMinho (experimental activities) + 1 day technical visit to vineyards in the Douro Valley
- ✓ 1 remote teaching week (synchronous & asynchronous) + 1 remote week for results presentation & evaluation
- ✓ 6 ECTS

