ANEXO I (Referencia Proyecto PID2023-148311OB-I00)

1. Training program

The PhD student with a degree in Life Sciences (Biology, Chemistry, Biotechnology, Environmental Sciences or Pharmacy) will receive practical and theoretical formation on Plant Physiology, Biochemistry and Molecular Biology at IRNASA. As the PhD student acquires a step-by-step understanding of the project and its societal significance, he or she will also receive training in the laboratory methods essential for the project's goals. Additionally, the PhD student will take advantage of the annual CSIC transversal formation courses on bioinformatic, statistics and -omics technologies. The PhD student will be acquainted with the bibliography needed for a better understanding of the main goals of the project and will learn how to use bibliographic databases (Scopus, WoS, etc.) for the search of scientific data. Moreover, he or she will actively participate in outreach activities organized by the Photosynthesis group or/and IRNASA. The PhD student has to be preferentially matriculated in the PhD Program in Agrobiotechnology of the University of Salamanca (USAL) (https://doctorado.usal.es/en/doctorate/agrobiotechnology). Both Rosa Morcuende (Quality Assurance Commission) and Juan B. Arellano (Academic Commission) are active members of the Directive Organs of the PhD Program in Agrobiotechnology. As a part of the PhD training, the predoctoral fellow will enjoy short term stays at Dr. Borrill's laboratory of the John Innes Centre and at Drs. Vicente and Vergara's laboratory of the ITQB NOVA, Universidade Nova de Lisboa. The PhD student would receive training in wheat genomics and analyse the RNA-seq data produced in this project using state-of-the-art pipelines developed in Dr. Borrill's lab. The student would learn to use a High-Performance Computing cluster to apply RNA-seq analysis pipelines relevant to complex polyploid wheat. The PhD student would carry out differential gene expression analysis and visualize their results using R. He or she would learn how to interpret their data using gene functional annotation. At the Universidade Nova de Lisboa, the PhD student will be introduced to advance technologies of plant phenotyping within the EU networking AgroServ (Grant agreement ID: 101058020).

2. Supervisors' CVA

A summary of the PhD supervisors' background with a list of research and outreach activities, projects and publications is given in the following links:

Rosa Morcuende Morcuende

https://www.irnasa.csic.es/uic044_morcuende

Juan B. Arellano

https://www.irnasa.csic.es/uic044_arellano

3. Publications in 2024

Vicente R, Vergara-Díaz O, Uberegui E, Martínez-Peña R, Morcuende R, Kefauver SC, López-Cristoffanini C, Aparicio N, Serret MD, Araus JL. (2024) Non-foliar photosynthesis and nitrogen assimilation influence grain yield in durum wheat regardless of water conditions. J Exp Bot. 75(11):3412-3430. doi: 10.1093/jxb/erae064.

Bendou O, Bueno-Ramos N, Marcos-Barbero EL, Morcuende R, Arellano JB. (2024) Singlet Oxygen and Superoxide Anion Radical Detection by EPR Spin Trapping in Thylakoid Preparations. Methods Mol Biol. 2798:11-26. doi: 10.1007/978-1-0716-3826-2_2.

Hananya N, Green O, Gutiérrez-Fernández I, Shabat D, Arellano JB. (2024) Singlet Oxygen Detection by Chemiluminescence Probes in Living Cells. Methods Mol Biol. 2798:27-43. doi: 10.1007/978-1-0716-3826-2_3.

Zabalgogeazcoa I, Arellano JB, Mellado-Ortega E, Barro F, Martínez-Castilla A, González-Blanco V, Vázquez de Aldana BR. (2024) Symbiotic fungi from a wild grass (Celtica gigantea) increase the growth, grain yield and quality of tritordeum under field conditions. AoB Plants. 16(2):plae013. doi: 10.1093/aobpla/plae013. eCollection 2024 Feb.

4. Group background

The research group of Photosynthesis is currently integrated by two research scientists (Rosa María Morcuende Morcuende, RMM, and Juan B. Arellano Martínez, JBA), one postdoctoral researcher (Emilio Luis Marcos Barbero), three PhD students (Nara Bueno Ramos, Ouardia Bendou and Ismael Gutiérrez Fernández) and two laboratory technicians (Ángel Luis Verdejo Centeno and María Ángeles Boyero San Blas). The Photosynthesis group (hereafter group) has been recognized as a research group by CSIC since 2004 and develops its research activity at the Department of Abiotic Stress of the Institute of Natural Resources and Agrobiology of Salamanca (IRNASA-CSIC). Moreover, the scientific production and the capacity to receive public funding were evaluated by the Agency for the Quality of the University System of Castilla y León and nowadays the group has also been recognized as a Consolidated Research Unit of Castilla y León (UIC044) since 2015. The research leader of UIC044 (JCyL) is RMM and the coordinator of the group of Photosynthesis is JBA. RMM is also a guarantor member of the recognition that IRNASA-CSIC received in 2020 as a Structure of Excellence (Ref. CLU-2019-05) by Junta de Castilla y León for the year period between 2021 and 2024 and the coordinator of the CSIC network Trigo (https://conexion-trigo.csic.es/), of which JBA is also member. The two research scientists, RMM and JBA, are members of the scientific network CERES (Cereales Resilientes, https://redceres.weebly.com/) and are involved in the CSIC Interdisciplinary Thematic Platform AGROFOR (PTI27). After several years of research, the group has gained experience in the analysis of foliar chlorophyll, CO_2 assimilation rate and water use efficiency and holds a solid background in the analysis of a large battery of enzymatic activities belonging to (i) the carbon and nitrogen primary metabolism and how they are interconnected among them and (ii) the antioxidant metabolism responsible for the maintenance of the homeostatic redox status and the scavenging of reactive oxygen species produced under environmental stresses. The group also performs multiple analyses to measure the content of metabolites such as amino acids, sugars, mineral nutrients, total polyphenols and small antioxidants (ascorbate and glutathione) in different organs of the plants to know how the adverse conditions affect physiological processes such as the mobilization and distribution of nutrients among organs, and the grain yield and nutritional quality with special attention to its content in starch, proteins, minerals and secondary metabolites. In the most recent years, the group has made further progress on the selection of wheat genotypes with improved grain yield and biomass using statistical approaches that include multifactorial analyses, correlation networks and hierarchical clustering.

5. Research line

The group of photosynthesis addresses studies on the physiology, biochemistry and molecular biology of cereal crops, especially wheat. The objective is the characterization of the adaptive response to adverse environments, investigating the photosynthetic assimilation of carbon and nitrogen, and the cellular antioxidant status, in addition to the selection of more resilient varieties with better nutritional quality and productivity in a context of climate change, sustainability agriculture and population growth.