CITÉ DES ÉNERGIES by cea

BIAM-UMR 7265
INSTITUT DE BIOSCIENCES & BIOTECHNOLOGIES D'AIX-MARSEILLE

PhD position in Aix-Marseille University (France)

The role of a chloroplast signal molecule in plant resilience to climate change

With the escalating threats of climate change, crops are under increased risk from rising temperatures and prolonged periods of drought. Two predominant challenges arise from this scenario: (i) a decrease in photosynthetic efficiency with increasing temperatures, which limits crop yield, and (ii) the need for plants to cope with intense episodes of excessive heat and drought. As such, the ability to regulate photosynthesis rapidly under these stresses becomes paramount, both to avoid the damaging overproduction of reactive oxygen species (ROS) and to maintain or even increase yield under these challenging conditions.

A chloroplastic signalling pathway mediated by the nucleotide guanosine tetraphosphate (ppGpp), has recently emerged as a major regulator of plastid function and photosynthesis (*1*). ppGpp signalling is best known in bacteria where ppGpp functions as an allosteric and GTP-competitive regulator of many enzymes including RNA polymerase to promote energy economy and stress acclimation. Over recent years we have pioneered the study of ppGpp signalling in plants, showing that **ppGpp accumulation downregulates plastid gene expression, nucleotide metabolism, and photosynthesis** (*2*, *3*).

The photosynthetic machinery is well known to be sensitive to high temperatures. Growth at high temperatures reduces photosynthetic activity, although the diversity of plant responses suggests that there is a margin for increasing the performance of plants at higher temperatures. Heat shock can rapidly damage the photosynthetic machinery, causing energy overflow, ROS production, cellular damage and tissue death. We hypothesize that ppGpp signalling plays an important role in regulating chloroplast function and photosynthesis for growth at high temperatures, and during acclimation to episodes of heat shock.

To address this question, we offer a **PhD position starting 01/10/2024**. The successful candidate will use physiological approaches to understand the role of ppGpp signalling during episodes of heat stress, and study the regulation of the RSH enzymes responsible for ppGpp metabolism using biochemical approaches (*4*). Notably, we anticipate that the student will also develop new tools using state-of-the-art cloning approaches to follow the regulation of RSH enzymes using microscopy and biochemistry. This project will provide the opportunity to the PhD student to learn advanced analytical techniques, develop expertise quantifying key physiological parameters (photosynthesis), and become familiar with biochemical and imaging techniques for the study of RSH protein regulation.

1. M. Mehrez, *New Phytologist* **237**, 1086–1099 (2023) Link. 2. S. Romand,. *eLife* **11**, e75041 (2022) Link 3. M. Sugliani, H. *The Plant Cell* **28**, 661–679 (2016) Link. 4. S. D'Alessandro, [Preprint] (2023) Link.

PhD co-supervisors

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Location and doctoral school affiliation

Luminy Plant Genetics and Biophysics team (LGBP), Luminy Campus, Aix-Marseille Université, France
Life and Health Sciences doctoral school (ED 62), affiliated with the IM2B PhD Program.

Expected profile of the candidate

Master or equivalent in cell biology or plant biology with experience in biochemistry (SDS PAGE, detection of post-translational modifications), molecular biology (cloning), cell biology (microscopy).

Applications must be received <u>before May 2024</u>

Send a cover letter to both supervisors, CV (with English level), transcripts and ranking of Masters degree (Master 1 and first semester of Master 2) or equivalent, and contacts for at least two references.