Title of the PhD project:

PHYTOCHROME INTERACTING FACTOR Condensates - Shaping Plant Response to Ambient Temperature Changes

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Keywords: Thermosensing, liquid-liquid phase separation, PHYTOCHROME INTERACTING FACTORS (PIFs), biomolecular condensates, Thermomorphogenesis

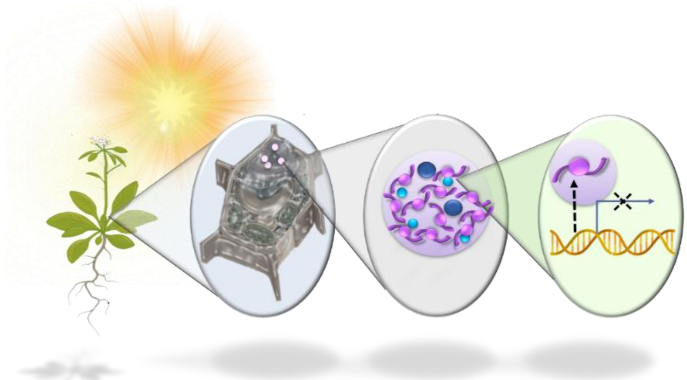

Figure 1: The PIFCAT project will identify if PIFs drive LLPS and determine their protein interactors in *A. thaliana*, investigate the *in vivo* dynamics of condensates as a function of temperature, and determine the physiological role of PIF condensates in thermosensing.

Project summary: The increasing global temperatures and extreme weather conditions caused by climate change are already affecting plant phenology in both wild and domesticated species, posing a significant threat to food security in the coming decades. A critical but not fully understood question is how plants perceive and respond to temperature changes. One rapid-response mechanism is the formation of dynamic liquid-liquid phase-separated (LLPS) states, often driven by proteins containing intrinsically disordered regions and low-complexity prion-like domains (PrLDs). This project explores the role of PrLD-containing PHYTOCHROME INTERACTING FACTORs (PIFs), key transcription factors in *Arabidopsis thaliana*, in regulating plant thermosensing through LLPS.

The objectives of the proposed thesis project are to: 1) Determine if PIF4 and PIF7 drive LLPS *in vitro* and *in vivo* 2) Investigate the temperature-dependent dynamics of PIF condensates *in vitro* and *in vivo*, 3) identify their *in vivo* protein interaction partners, and 4) uncover the physiological role of PIF condensates in thermosensing and plant development. Using techniques in biochemistry, genetics, and microscopy, this project will provide fundamental insights into how PIF condensates affect transcriptional responses at different temperatures and will provide a foundation for innovative strategies for enhancing plant adaptability in a warming climate.

Student role: The PhD candidate will investigate the LLPS properties of PIF4 and PIF7 and their role in plant thermosensing. This will involve recombinant protein expression, biochemical and structural analyses, and *in vivo* studies using confocal microscopy and genetic transformation of *Arabidopsis thaliana*. The candidate will design and conduct experiments, analyze data, collaborate with interdisciplinary experts, and present findings at conferences. Through this work, they will gain expertise in molecular biology, biochemistry, biophysics, and plant genetics, contributing to a deeper understanding of plant temperature adaptation mechanisms.

Skills/Qualifications: The ideal candidate holds a Master's degree in molecular biology, biochemistry, structural biology, biophysics, or plant sciences, with experience in molecular techniques, recombinant protein expression, and biochemical/biophysical characterization. Fluorescence microscopy skills and familiarity with *Arabidopsis thaliana* transformation are advantageous. Strong analytical, communication, and problem-solving abilities are essential, along with the capacity to work independently and in multidisciplinary teams. The candidate should be motivated to explore plant stress responses and willing to train in advanced techniques while managing multiple research tasks efficiently.

Relevant publications of the team: (5 max.)

Jung J-H*, Barbosa AD*, Hutin S*, *et al.* Nature, 2020.
Hutin S*, *et al*. Proceedings of the National Academy of Sciences, 2023.
Silva CS *#, Nayak A*, Lai X*, *et al.* Proceedings of the National Academy of Sciences, 2020.
Peng M, *et al.* Chen, M. (eds) Thermomorphogenesis. Methods in Molecular Biology, 2024.
Hutin S*, *et al.* 2024 in: Chen, M. (eds) Thermomorphogenesis. Methods in Molecular Biology, 2024.