Master 2 research internship in Integrated Structural & Cell Biology in Grenoble

Supervisor(s):
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Host laboratory:
LPCV, https://www.lpcv.fr/en

Host group/team:
Lipid: Biogenesis, dynamics and homeostasis of membrane lipids

Title of the M2 research internship:

Role of OMP24 in the regulation of plastids-mitochondria contact sites in response to phosphate starvation in plants

Project summary:
These last decades, direct contacts between organelles appeared as cellular hubs where many fundamental processes occur, including lipids and ion exchanges or programmed cell death. Membrane contact sites (MCSs) are formed when two membranes are closely apposed (10-30 nm) without fusing. In plants, MCSs are highly regulated in response to stress, in particular during phosphate (Pi) starvation, a frequent nutrient stress triggering important decreases of crop yields. Low Pi in soil leads to a significant increase of plastids-mitochondria MCSs and promotes lipid transfer between those two organelles, a process required for the remobilization of intracellular Pi reserves. Previously, we identified OMP24, an uncharacterized protein of the plastid envelope as a putative candidate involved in lipid remodeling during Pi starvation. We showed that the overexpression of OMP24 led to a perturbation of mitochondrial lipid homeostasis in particular during Pi starvation. Mitochondrial morphology was affected in this line, suggesting an important role of OMP24 in the regulation of mitochondria biogenesis. The goal of the project is to decipher how OMP24 interferes with mitochondria biogenesis, in particular with the formation of MCSs between plastids and mitochondria. To this aim, the precise sub-cellular localization of OMP24 will be investigated by fluorescent microscopy and by electron microscopy immuno-labeling in plants grown in presence and absence of Pi. Then, a live imaging approach will be used to analyze plastid-mitochondria MCSs in our overexpressor line and in a KO CRISPR/Cas9 line. In vitro approaches based on protein expression in liposomes will be optimized to analyze the ability of OMP24 to tether membranes. Finally, plant phenotype analyses will be performed on our KO and overexpressor lines to reveal the role of OMP24 in plant development and Pi starvation adaptation. Overall, this project will open important perspectives to understand the intracellular adaptations occurring in plants in response to nutrient stress.

Keywords:
plastid-mitochondria interaction, lipid transport, phosphate starvation

Relevant publications of the team:

Leterme, S., and Michaud, M. 2022. Non-vesicular glycerolipids transport in plant cells. Lipids Plants Algae Fundam. Sci. Ind. Appl. 101:121–189. doi:10.1016/bs.abr.2021.07.001.

Michaud, M., V. Gros, M. Tardif, S. Brugière, M. Ferro, W.A. Prinz, A. Toulmay, J. Mathur, M. Wozny, D. Falconet, E. Maréchal, M.A. Block, and J. Jouhet. 2016. AtMic60 Is Involved in Plant Mitochondria Lipid Trafficking and Is Part of a Large Complex. Curr. Biol. CB. 26:627–639. doi:10.1016/j.cub.2016.01.011.

Michaud, M., and J. Jouhet. 2019. Lipid Trafficking at Membrane Contact Sites During Plant Development and Stress Response. Front. Plant Sci. 10:2. doi:10.3389/fpls.2019.00002.

Michaud, M., W.A. Prinz, and J. Jouhet. 2017. Glycerolipid synthesis and lipid trafficking in plant mitochondria. FEBS J. 284:376–390. doi:10.1111/febs.13812.

Mueller-Schuessele, S.J., and M. Michaud. 2018. Plastid Transient and Stable Interactions with Other Cell Compartments. Methods Mol. Biol. Clifton NJ. 1829:87–109. doi:10.1007/978-1-4939-8654-5_6.