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

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Title of the M2 research internship:
Role of OMP24 in the regulation of plastids-mitochondria contact sites in response to phosphate starvation in Arabidopsis thaliana.

Project summary:
These last decades, direct contact sites between organelles appear 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 a complex located in mitochondria involved in mitochondrial lipid transport during Pi starvation in Arabidopsis thaliana. Interestingly, one of the major proteins of this complex, OMP24, is an uncharacterized protein located in the plastid envelope, suggesting its presence at plastids-mitochondria MCSs. In addition, preliminary results suggest that plastid-mitochondria lipid transfer is reduced in omp24 knock out (KO) lines during Pi starvation. The goal of the project is to investigate the role of OMP24 in the regulation of plastids-mitochondria MCSs formation during Pi starvation. To this aim, the partners of OMP24 will be determined by co-immunoprecipitation and proteomic analyses from A. thaliana cell cultures grown in presence or absence of Pi to highlight specific interactions induced by this stress. In parallel, an analysis of the subcellular localization of OMP24 will be performed by immuno-labeling to confirm the presence of OMP24 at plastids-mitochondria MCSs. Finally, the number and extent of plastids-mitochondria MCSs will be analyzed in KO and overexpression lines by electron microscopy to decipher the role of OMP24 in the formation of such structure in response to stress. Overall, this project will open important perspectives to understand the intracellular adaptations occurring in plants in response to nutrient stress.

Keywords:
plastids-mitochondria interaction, membrane contact site remodeling, phosphate starvation

Relevant publications of the team:
Sébastien Leterme, Michaud, M. and Jouhet J. (2020). Purification of mitochondria for lipid analysis. Methods in Molecular Biology. In press

Jouhet J., Gros V. and Michaud, M. (2019). Measurement of lipid transport in mitochondria by the MTL complex. Methods in Molecular Biology. Lipid transport: Methods and Protocols. 1949, 69-93.

Michaud, M.* and Jouhet, J. (2019) Lipid trafficking at membrane contact sites during plant development and stress response. Frontiers in Plant Science. 10, 1-10 (*Corresponding author)

Michaud, M.*, Prinz, W. A. and Jouhet, J. (2017) Glycerolipid synthesis and lipid trafficking in plant mitochondria. Febs Journal. 284, 376-390 (*Corresponding author)

Michaud, M.*, Gros, V., Tardif, M., Brugière, S., Ferro, M., Prinz, W. A., Toulmay, A., Mathur, J., Wozny, M., Falconet, D., Maréchal, E., Block, M. A. and Jouhet, J.* (2016) AtMic60 is involved in plant mitochondria lipid trafficking and is part of a large complex. Current Biology 26, 627-639. (*Co-corresponding authors)