Bilayers at the ILL

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Structural and functional characterization of a complex involved in lipid transport to mitochondria during plant adaptation to phosphate starvation

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Phosphate starvation is a frequent nutrient stress encountered by plants to which they adapt by exerting different mechanisms. The partial degradation of phospholipids, a common constituent of cellular membranes, is a widespread response observed in plants to increase the intracellular phosphate availability. To maintain membrane integrity, the degraded phospholipids have to be replaced by a non-phosphorous plastid-synthetized lipid, the galactoglycerolipid digalactosyldiacylglycerol (DGDG). This replacement implies a lipid transport by an unknown mechanism from the plastid to other organelles. A large set of studies has revealed that lipid transport between intracellular membranes can effectively take place at membrane contact sites (MCS) where it is enabled by specific proteins. Recently, the mitochondrial transmembrane lipoprotein (MTL) complex, a huge complex enriched in lipids, has been identified and one of its components, AtMic60, was shown to play a role in DGDG trafficking to mitochondria. We hypothesize that this complex plays a major role in lipid transport between the chloroplast and the mitochondria at specific MCSs in response to phosphate starvation. However, the transport mechanism used by the MTL complex as well as its structure and its functions remain unknown. To dissect the role of the MTL complex in lipid transport and plant adaptation to phosphate starvation, its composition and structure will be characterized by a combination of innovative multi-disciplinary approaches including co-immunoprecipitations, proximity dependent biotin identification and single particle cryo-electron microscopy. Further investigation by reverse genetics and lipidomic analyses in phosphate deplete and replete conditions will enable to dissect the cellular function of the MTL complex and its role in plant adaptation to phosphate starvation. The results obtained will not only shed light on a huge gap of fundamental knowledge in the field of membrane biogenesis and lipid transport between organelles but will also pave the way for agricultural improvement in plant phosphate usage.

Primary author: LETERME, Sébastien (Laboratoire Physiologie Cellulaire & Végétale)

Co-authors: ALBRIEUX, Catherine (Laboratoire Physiologie Cellulaire & Végétale); JOUHET, Juliette (Laboratoire de Physiologie Cellulaire et Végétale); MICHAUD, Morgane (Laboratoire Physiologie Cellulaire & Végétale)

Presenter: LETERME, Sébastien (Laboratoire Physiologie Cellulaire & Végétale)

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