LIPID METABOLISM

Interconnecting plastid lipases

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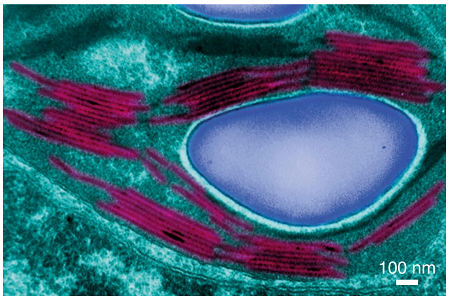

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Chloroplast thylakoid membranes are the main sites for plant photosynthetic reactions. They are primarily composed of polar glycerolipids, such as monogalactosyldiacylglycerol (MGDG), digalactosyldiacylglycerol (DGDG), phosphatidylglycerol (PG) and sulfoquinovosyldiacylglycerol (SQDG). Metabolism of photosynthetic membranes is predicted to play a role in interconnecting plant growth and development with different environmental conditions. Recently, Christoph Benning's group at Michigan State University looked into this hypothesis and published two papers about the possible functions of three chloroplast lipases in *Arabidopsis*.

In their 2017 paper, Kun Wang et al. reported the function of *PLASTID LIPASE1* (*PLIP1*) in lipid metabolism and seed development. This chloroplast thylakoid-membrane-associated lipase displayed phospholipase activity in vitro, preferentially hydrolysing unsaturated acyl groups, of which the native substrate is likely to be PG. Two knock-down mutants of *plip1* are physiologically similar to the wild-type (WT) plants, but their seeds contain about 10% less oil. The overexpression lines showed dwarf phenotype and accumulated 40–50% increased seed oil compared to the WT.

As a follow-up project, Kun Wang et al. continued to investigate the two paralogues of *PLIP1* in *Arabidopsis*. They encode PLIP2 and PLIP3, both of which can catalyse lipid turnover in chloroplast but are not involved in the regulation of seed oil biosynthesis. The preferred substrate of PLIP2 is most likely MGDG, while PLIP3 prefers PG similarly to PLIP1. *plip2* and *plip3* single mutants showed no detectable defects but the overexpression lines of either PLIP2 or PLIP3 are severely dwarf. Interestingly, activated jasmonic acid (JA) responses were detected in these overexpression lines and disrupting JA signalling restored their growth to the WT level. Moreover, both *PLIP2* and *PLIP3* are transcriptionally regulated by abscisic acid (ABA). The triple mutant of *plip1/2/3* is hypersensitive to ABA treatment.

There are hundreds of lipases that are presumed to exist in *Arabidopsis* and many other plant species. Here, the valuable attempts to explore the metabolic and physiological functions of these lipid-degrading enzymes provide new routes for us to think about the regulatory networks of plant growth and development.

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