Abstract of Doctoral Dissertation

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A novel abscisic acid-dependent chloroplast division pathway
is present in the moss, *Physcomitrella patens*
（ヒメツリガネゴケに見出したアブシジン酸経路依存的な葉緑体分裂制御に関する研究）

Chloroplast division is an essential process for the maintenance of appropriate chloroplast populations in the plant cells. Environmental stresses affect chloroplast division and morphology of chloroplasts, but significance and mechanism of regulation of chloroplast number and size are still largely unknown.

Here, I uncovered a novel ABA-dependent chloroplast division pathway without using the peptidoglycan (PG) synthesis. Division and morphology of chloroplasts in the moss, *Physcomitrella patens* were examined under normal and abiotic stress conditions by using live-cell imaging analysis and genetic analysis. I found that exogenous ABA induced division of giant chloroplasts by symmetric and asymmetric modes in ampicillin-treated cells and in PG knockout mutants. Then, I proved that overexpression of ABA signaling gene, *SnRK2A* or *ABI3A* in ampicillin-treated cells induced division of giant chloroplasts. Overexpression of *ABI3A* gene in *Pbp*, one of the PG biosynthesis gene, knockout mutants (*PpABI3Aiox*-Δ*Pp*-*Pbp*) was able to rescue giant chloroplasts to the normal chloroplast phenotypes. ABA had no effect on chloroplast numbers in ampicillin-treated cells of *Ppsnrk2* quadruple KO and *Ppabi3* triple KO mutants, respectively. Thus, the results suggest that ABA positively regulates chloroplast division through the expression of *SnRK2* and *ABI3* genes. I also found that ABA-dependent chloroplast division required dynamin-related proteins, which are essential for constriction during the chloroplast division. Furthermore, my research partner and I newly demonstrated that AP2/ERF transcription factors regulate salt-induced chloroplast division in *P. patens*.

Thus, the novel finding indicates that *P. patens* exploits ABA-dependent chloroplast division pathway and holds the robustness of chloroplast division, including the other potential alternative mode besides PG-dependent mechanism, according to changing environmental conditions.