論文内容の要旨

論文題目

Leaf-size regulation through the coordination of cell proliferation and post-mitotic cell expansion

（細胞増殖と細胞肥大の統合による葉のサイズ決定）

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A fundamental question in developmental biology is how organ size is regulated. Organ size largely depends on the number and size of the constituent cells. Thus, cell proliferation and post-mitotic cell expansion must be tightly regulated during organogenesis. In this process, cell-size regulation should involve in the quantitative control of cellular components for proper function of each cell. Accordingly, to answer the question, we must understand the developmental processes at intercellular, cellular, and subcellular levels.

'Compensation' is a phenomenon of unsolved mechanism whereby a defect in cell proliferation over some threshold triggers enhanced post-mitotic cell expansion in leaf primordia. It suggests an interaction of these cellular processes during organogenesis, and provides clues relevant to the understanding of organ-size regulation. Although much attention has been given to compensation, it remains unclear how the cellular processes are coordinated and how the amount of cellular components are affected in association with this phenomenon.

In the chapter one, I used the loss-of-function mutation in the transcriptional coactivator gene *ANGUSTIFOLIA3* (*AN3*), which causes typical compensation in *Arabidopsis thaliana*. I established Cre/*lox* systems to generate chimeric leaves for AN3 expression and investigated whether compensation occurs in a cell-autonomous or non-cell-autonomous manner. I found that *an3*-dependent compensation is a non-cell-autonomous process, and that *an3* cells seem to generate and transmit an intercellular signal that enhances post-mitotic cell expansion. The range of this effect was found to be restricted within one-half of a leaf partitioned by the midrib. Additionally, cell-autonomous action of compensation induced by overexpression of a

cyclin-dependent kinase inhibitor gene *KIP-RELATED PROTEIN2* was also demonstrated.

In the chapter two, to characterize the compensation at subcellular level, I investigated the number of chloroplasts in palisade cells of compensation-exhibiting *A. thaliana* lines using convenient method established here. As a result, I found that the chloroplast number per cell had a positive linear correlation with the increase in cell size.

Altogether, my findings revealed coordination mechanisms involved in the organ-size regulation at intercellular, cellular and subcellular levels: cell proliferation and post-mitotic cell expansion are non-cell- and cell-autonomously coordinated by two as-yet-unknown mechanisms for leaf-size regulation; chloroplast number is regulated in response to the enhanced cell expansion. These results help us to understand the leaf-size regulation that is established by the orchestration of intercellular, cellular and subcellular processes.