論文の内容の要旨

Comparative analysis of cell division pattern and key gene expression patterns in unifacial leaves (単面葉における形態形成鍵遺伝子の発現パターンと細胞分裂パターンとの比較解析)

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Unifacial leaves are unique among angiosperm leaves in that the adaxial/abaxial (ad/abaxial) polarity along the longitudinal axis of leaves is different. The proximal leaf sheath is bifacial, including both the adaxial and the abaxial polarities. The distal leaf blade, however, is unifacial, including only the abaxial polarity. The evolutionary origin and developmental processes of unifacial leaves, and the degree of abaxilization in the distal leaf blade, were much debated in the history. The “adaxial meristem hypothesis” states that unifacial leaves are formed postgenitally by the activity of the adaxial meristem in certain part of the leaf blade. The “sympodial hypothesis” states that unifacial leaves are formed by the leaf meristem succession from the bifacial leaf apex to the unifacial leaf apex. The “subunifacial hypothesis” states that unifacial leaves are formed postgenitally by marginal fusion and a small adaxial sector is retained in the distal blade. These hypotheses were formed more than 40 years ago, based on comparative morphological, anatomical, developmental, and histogenetic evidences. These approaches are quite outdated and modern ones such as examining DNA synthesis activity and gene expression should be applied instead. In addition, in the past there is no efficient method to analyze the direction of cell division, making it hard to evaluate these hypotheses. Therefore, in my dissertation, I aim to development an efficient method to quantify the direction of cell division, and use this method and another modern approach (*in situ* hybridization) to check these hypotheses regarding unifacial leaves. In Chapter I, I reviewed historical and recent

molecular studies regarding unifacial leaves and leaf ad/abaxial polarity. In Chapter II, I developed a pulse-chase 5-ethynyl-2'-deoxyuridine (EdU) method and demonstrated its efficiency and usefulness in the model plant Arabidopsis (*Arabidopsis thaliana*). In Chapter III, I applied this method to an ensiform unifacial leaf species *Juncus prismatocarpus* (Juncaceae) and analyzed the location and direction of cell division to evaluate the "adaxial meristem hypothesis" and the "sympodial hypothesis". I also compared cell division pattern with expression patterns of various genes known to be important in its leaf development. In Chapter IV, I cloned and checked the expression pattern of *KNOTTED1* (*KN1*) ortholog in *J. torreyi*, to examine the "subunifacial hypothesis" and its likely cause. I found that while the "sympodial hypothesis" should be rejected, the "adaxial meristem hypothesis" and the "subunifacial hypothesis" should be modified substantially.