

Preface

Hundreds of thousands of species of plants have evolved to thrive on Earth. One of the reasons for their prosperity must be the acquisition and clever use of cell walls. Plant cell walls dictate the plant life form by preventing cell migration, resulting in immobility of plants. On the other hand, cell walls produce the strength that allows plants to grow as huge trees and enable a unique strategy for the plant body plan by using cells hardened with cell walls as building blocks. Moreover, cell walls define cell shape, cell function, and sometimes cell fate through mechanisms such as asymmetric cell division and intercellular communication. An understanding of plant cell walls is therefore essential for an understanding of plant life.

A number of books about plant cell walls have already been published. Most books focus on the structure and biosynthesis of plant cell walls, providing invaluable knowledge of the biochemical and structural nature of plant cell walls. However, there are few books that provide detailed information about cell wall functions and their underlying mechanisms, despite recent conspicuous progress in these areas. I therefore planned a book entitled *Plant Cell Wall Patterning and Cell Shape*, describing current knowledge of the spatiotemporal regulation of plant cell organization in view of cell walls.

This book is grouped into three sections: (1) *Factors Controlling Plant Cell Wall Patterning*; (2) *Cellular Mechanisms Underlying Various Cell Shapes*; and (3) *Developmental Regulations of Cell Shape*.

Spatiotemporal regulation of cell wall formation appears as cell wall patterns. Section 1 therefore deals with crucial components for cell wall patterning. In Chapters 1 and 2, current knowledge of the biosynthesis of cell wall components, including cellulose microfibrils, is described as a basis for cell wall patterning. Membrane traffic, which is another key component for cell wall patterning, is described in Chapter 3. Mechanisms underlying cell wall patterning involve microtubule and actin filament dynamics beneath the plasma membrane. Chapters 4 and 5 therefore highlight regulation of microtubule and actin filament arrangement, respectively, in cell wall pattern formation.

A conspicuous function of cell walls is the formation of diverse cell shapes. Section 2 therefore describes new insights into cellular mechanisms leading to distinctive cell shapes. In plants, polarization of the plasma membrane leads

to the formation of a locally specialized architecture of cell walls, resulting in various shapes of plant cells with specific functions. Recent progress in this field has revealed that Rho-like GTPases from plants (ROPs) play a crucial role in polarization of the plasma membrane to form distinct plant cell shapes. Chapters 6–8 therefore deal with the role of ROPs in the shape of three different cells such as pavement cells, xylem vessel cells, and pollen tubes. Chapters 9–11 describe current knowledge of the cell shape formation in root hair, trichome, and transfer cells, in which different cellular mechanisms such as lipid signaling and cytoskeleton are discussed.

Section 3 deals with the developmental regulation of specific types of plant cells such as guard cells, xylem cells, and phloem cells. Cell wall pattern and cell shape are both under developmental control. Cell-non-autonomous extra-cellular signals derived from neighboring cells or environmental cues regulate cell fate. Within the cell, transcriptional cascades finally determine a cell fate and then execute distinct cell-specific wall formation to lead to distinct cell shape. Signaling and transcriptional cascades leading to cell differentiation are discussed in Chapters 12 and 13, respectively. Finally, Chapter 14 describes our current knowledge of inter- and intra-cellular signaling that determines phloem cell differentiation.

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