PREFACE

Membrane transport in plants contributes to key aspects of their growth and development, and to their adaptation to multiple and ever changing environments. From the 1950s, membrane transport has emerged as a main topic in plant physiology based on robust biophysical and theoretical grounds. From the 1990s, this field of research has experienced an amazing explosion of molecular data through the identification and functional characterization of numerous families of membrane transport proteins. Current research aims at combining this molecular and physiological knowledge to draw an integrative view of transport functions in plants.

Because of the multiplicity of transport systems and physiological contexts, assembling of volume on this topic is a challenge, for sure! As we clearly cannot be comprehensive, we decided to look at this topic through three different angles. The resulting views obviously overlap, and the reader will hopefully take these overlaps as signs that we are approaching a multidimensional understanding of plant membrane transport complexity.

The first chapters take the classical approach of focusing on a given family of membrane transporters. The main message is that a same class of proteins can fulfil multiple transport functions; much more than initially foreseen. For instance, the study of ABC transporters (Chapter 1) has revealed an unsuspected range of metabolites that can be transported in plants, from cuticle precursors to glutathione conjugates and chlorophyll metabolites. Many more are to be discovered. The aquaporins (Chapter 2) which were initially seen as water channels can actually transport important gases (carbon dioxide) or signalling molecules (hydrogen peroxide). P-type ATPase pumps are essential for energization of membrane transport in plants. In Chapter 3, Østerberg and Palmgren focus on the P1B ATPases which are present in different subcellular membranes of plants and control heavy metal homeostasis in plants. Phylogenetic analyses provide interesting insights into how plant membrane functions can be used to track the paths of plant evolution.

The converse approach was to consider a class of transported molecules, not transporters. Eroglu (Chapter 4) follows up on metal transport and discusses the specific context of seeds, showing how an impressive series arrangement of transport systems permits translocation of metals from phloem to embryo. While auxin transport was long identified as crucial

for tropic responses of plants, Abualia et al. show in Chapter 5 that all major groups of plant hormones do have specific transport systems for controlling their distribution. The role of membrane transport in plant mineral nutrition is addressed by Lejay and Gojon (Chapter 6) through the emblematic example of nitrate uptake by roots. Here, the identification of transceptors, membrane proteins that serve both as transporters and receptors, identifies another interesting connection between transport and signalling.

Ultimately, we need to embrace the contribution of various types of membrane transport in a whole process. This is the third approach taken by several contributors of this volume. How to talk about membrane transport in plants without touching on guard cells? As discussed by Roux and Leonhardt in Chapter 7, this cell type continues to bring new knowledge on ion transport regulation in the plasma and vacuolar membranes, to integrate multiple endogenous signals and environmental stimuli. Pollen vegetative cells and pollen tubes represent another spectacular cell type of plants. Pertl-Obermeyer et al. present in Chapter 8 an overview of the transportome of pollen tubes and propose a speculative model to explain how heterogeneous distribution of transporters in the plasma membrane could explain the electrical current pattern observed in these cells. Understanding transport processes occurring in less accessible organs or cell type remains a great challenge. In these respects, Ishikawa et al. present in Chapter 9 a prospective view of mechanisms at work during xylem loading in plants under stress. Finally, it should be realized that plants in natural environments interact with a myriad of microbes and fungi, which balance between pathogenic and beneficial effects. Guerrero-Galán et al. (Chapter 10) explain how plant mineral nutrition a traditional topic in membrane transport most often occurs in symbiotic interaction with fungi.

This first overview spans over many fascinating facets of plant biology. I invite the reader to discover many more in this volume.

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