Preface

Life must be constantly fuelled with energy to keep the numerous chemical reactions in the cell from thermodynamic equilibrium, which constitutes the energetic driving force for metabolism. The chloroplast organelles in plant leaves have been tuned by more than a billion years of evolution to function as the most efficient and robust powerhouses for life on earth by using energy from the sun. Besides fuelling cell metabolism, the chloroplast also represents a sophisticated anabolic factory for producing a variety of primary and secondary metabolites. This gives the organelle a central role in maintaining life on our planet. Furthermore, in recent decades, multiple endeavours have been initiated to make use of the unique bioenergetic and anabolic potential of chloroplasts to help solve some of the most urgent problems of mankind in the areas of sustainable energy supply, paving the way for a second green revolution, and in the production of valuable chemicals, for example for medical applications.

This book surveys hot topics in chloroplast biology showing that this is a highly active and dynamic area in plant sciences. The chapters in this book document one of the main aspects of chloroplast biology, that is, the plasticity of chloroplast functions in context of a dynamic environment and of different metabolic needs. In recent years, the research community has appreciated that we have to understand how plants in general, and the chloroplast in particular, respond to often unpredictable changes in natural parameters (i.e. light intensity, temperature, etc.). We now have a better understanding of the fact that many gene products have evolved to deal with the environmental and metabolic fluctuations required to ensure plant fitness and survival.

The book gives a state-of-the-art view on eminent areas in chloroplast research. In detail, it starts with the building blocks of the energy-converting thylakoid membranes (lipids, pigments, proteins and membranes); this is complemented by a chapter on plastoglobuli, which are attached to thylakoid membranes. The book continues by presenting current knowledge on electron and proton fluxes and the regulation and repair of the energy-converting machinery. The regulatory aspect is widened to redox regulation, which is followed by a chapter addressing how ions and metabolites are transported across chloroplast membranes. The book closes by presenting system-based approaches for identification and characterization of unique chloroplast-hosted proteins.

The chapters were prepared by internationally, highly acknowledged colleagues who work at the forefront of their research area and, therefore, provide expert insight in their scientific field. I'm deeply thankful for my colleagues' hard work and the fact that they have shared their expert knowledge in excellently written chapters. Last but not least, the realization of this book would not have been possible without the volunteering reviewers. Their thorough job significantly increased the quality of the individual chapters. Their fresh eyes and constructive critique provided valuable input to the contributors. For this essential contribution, I'm highly indebted to the reviewers (alphabetical order): Drs Claire Brehelin, Rikard Fristedt, Jingpeng Gao, Mark Heinnickel, Toru Hisabori, Zhirong Li, Sujith Puthiyaveetil, Mark Aurel Schoettler and Ildiko Szabo.

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