

Preface

This book is being published more than three decades after the publication of the first formal report on flow cytometric analysis of plant material by F. O. Heller in 1973. This pioneering work did not find immediate favor with researchers and it was only after a considerable period of time that the usefulness of the technique was recognized with numerous applications of flow cytometry being developed and applied in plant science and industry. The reason for the growing popularity of flow cytometry is not hard to guess, as the method provides a unique means with which to analyze and manipulate plant cells and subcellular particles. Several optical parameters of particles can be analyzed simultaneously, quantitatively and at high speed. Statistically relevant data are quickly provided and the detection of subpopulations is possible. The ability to purify specific subpopulations of particles by flow sorting then provides a tool for their manipulation and analysis using other methods. As a result, current flow cytometry is now able to provide answers to the once utopian suite of challenging questions on plant growth, development, function and evolution at subcellular, cellular, organismal, and population levels.

Despite significant progress in the development of instrumentation, and the growing number of reported applications, researchers continue to be frustrated when searching for first-hand information on plant flow cytometry. Such information is currently scattered in a number of books and various journals. Due to some fundamental differences between plant, human and animal cells and tissues, and the fact that the scientific targets of those working with these different cell and tissue types only partially overlap, the plethora of biomedical publications cannot provide a substitute. One of the gurus of flow cytometry, Howard Shapiro, pertinently characterized the state of affairs in his fourth edition of *Practical Flow Cytometry* (2003, p. 512): "There are now enough references to justify a book on applications of flow cytometry to plants, but, as far as I know, nobody has written one."

Sharing the same opinion, and stimulated by our long-term experience with plant flow cytometry, we arrived at the conclusion in late 2003 that the time was ripe for the publication of such a treatise. Our intention was to prepare a comprehensive, instructive and stimulating title which would cover virtually all fields of current plant flow cytometric research and offer an easily accessible source of

information. We trust that we have succeeded and look forward to the comments from the readers.

So what is on the menu? We start by describing the origin and evolution of flow cytometry and explaining the principles of flow cytometry and sorting (Chapters 1 and 2). Chapter 3 provides a general overview of plant flow cytometry, setting the stage for the more specialized topics discussed in Chapters 4–17. The first three of which cover the analysis of nuclear DNA content and its applications in the determination of genome size (Chapter 4), ploidy level (Chapter 5) and mode of reproduction (Chapter 6). Chapter 7 then explains the importance of research on nuclear genome size and Chapter 8 discusses the use of flow cytometry to estimate base composition in plant genomes. Focusing on microorganisms, Chapter 9 describes the use of flow cytometry in plant pathology, while Chapter 10 brings us back to plants and explains the analysis and sorting of naked plant cells, or protoplasts. We then move on to Chapter 11, the analysis of chloroplasts. Entering more exotic worlds, non-vascular plants and their DNA content is considered in Chapter 12 and the characterization of phytoplankton provides the subject of Chapter 13. Chapter 14 deals with the analysis of the cell cycle and is logically followed by a discussion on endopolyploidy (Chapter 15). Moving on to genome analysis, Chapter 16 describes the analysis and sorting of mitotic chromosomes and Chapter 17 introduces flow cytometry as a powerful tool for analyzing gene expression. The book closes with Chapter 18, which presents the FLOWER, a plant DNA flow cytometry database, and offers interesting quantitative data retrieved from publications in this area of flow cytometry.

Although the book was written by leading authorities and includes the most recent information, every effort has been made to avoid jargon and to explain all specific terms. Thus the book should be appreciated by users at every level of experience. Indeed, we are very happy with the final outcome and we hope that we have not only filled the gap in the current literature but created a reference volume for plant flow cytometry.

This book would never have materialized without the hard work, encouragement and support of many people. We are particularly indebted to the authors of the individual chapters who joined us on our formidable journey and provided excellent contributions. It is their hard work which makes this book a valuable reference text. We extend our gratitude to them all.

We greatly appreciate the highly professional, efficient, and conscientious work of the team at Wiley-VCH, who made publication of this book possible and who guided us carefully through the whole process. All three of us are excited by the graphical design of the book and the attractive front cover featuring the flower of lotos (*Nelumbo nucifera*). We felt it appropriate to include the nuclear genome size of the cover plant, and our original estimates are 1010 Mbp/1C (Prague) and 1017 Mbp/1C (Vienna).

We thank our colleagues for their assistance with editing the manuscripts and their preparation for submission. In particular we appreciate the assistance of Eva M. Temsch and Hermann Voglmayr with the revision of some of the figures.

We hope that the investment of our time, which was to a significant extent at the expense of our private lives, was justified and that it will promote the use of flow cytometry in plant science and production. We sincerely hope that the readers will enjoy exploring the fascinating world of plant flow cytometry as much as we enjoyed writing and editing this book.

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