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# Plant Physiology, Development and Metabolism

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Satish C Bhatla • Manju A. Lal

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## Preface

Plants serve as a source for sustainable food and biofuel and also play crucial roles in maintaining human health and ecosystem. Thus, it becomes imperative to understand the mechanisms of plant growth and development. Plant physiology is that significant branch of plant science which deals with understanding the process of functioning of plants at cell, molecular, and whole plant levels and their interaction with the surrounding environment. In spite of being static in nature, plants can withstand adverse growth conditions due to a variety of adaptive mechanisms. Intracellular compartmentalization of biochemical pathways, expression of membrane-associated transporter proteins specific for various ions and metabolites, production of secondary metabolites with multiplicity of protective functions, and a wide variety of photoreceptors biochemically synchronized with various environmental and developmental conditions are some of the noteworthy adaptive features of plants enabling them to survive in almost all possible situations. The plethora of information available today has been made possible through interaction of cell and molecular biology, biochemistry, and genetics to understand plant processes.

Plant physiology is an experimental science. Plant water relation is the first area of research in plant physiology which caught attention of scientists. Stephen Hales, also called as the Father of Plant Physiology, published the book *Vegetable Staticks* in 1727, highlighting various experimental studies on transpiration and root pressure. In the beginning of twentieth century, the development of physicochemical and biochemical techniques further facilitated the understanding of the plant processes. These techniques include spectral analysis, mass spectrometry, differential centrifugation, chromatography, electrophoresis, and the use of radioisotopes, besides many others. In the last two decades, plant physiologists made an extensive use of the molecular tools and *Arabidopsis* as a model organism to facilitate learning about the role of genes and the crosstalk among various biomolecules affecting plant functions and development. Lately, chemical biology has also contributed significantly through the use of small molecules to identify intracellular targets, thereby facilitating development of new herbicides and plant growth regulators. They are also used to identify novel signaling pathways. Small molecules are used to alter protein structure and explore the biological roles of target proteins (an area termed as chemical genetics). Low-molecular mass molecules are used as probes to modify biological processes. Major areas in plant physiology which have gained a lot of new

information include growth and development (both vegetative and reproductive), physiology of nutrition, metabolism, and plant responses to the environment.

Compilation of this volume was very enlightening as it demonstrated the extent to which information and concepts in plant physiology have changed over the years. The writing of this book began in July 2015 and took almost 3 years of persistent reading, assimilating, and consolidating of relevant information from various sources into 34 chapters. While presenting the current concepts in an understandable manner, due emphasis has also been laid on historical aspects, highlighting how the concepts evolved. All contributors are associated with Delhi University and have firsthand experience of the problems being faced by undergraduate students of plant science discipline in assimilating meaningful information from the vast literature available in plant physiology. So, the need for an easy-to-understand, systematic, and up-to-date account of plant physiology has led to writing this book. The book is well illustrated, and all illustrations have been either drawn in original by an expert or designed from experiments in the laboratory or field. The volume has been brought into its present form through strong technical support from the very supportive bright members of the research group of Professor Bhatla.

Dr. Manju A. Lal would like to thank her father, late Shri V. P. Gupta, who was instrumental in her taking up teaching science as a career choice. Dr. G. S. Sirohi, former head of the Division of Plant Physiology, Indian Agricultural Research Institute, initiated her into research and guided her Ph.D. work. Thanks are due to him. Last but not the least, Dr. Manju A. Lal would like to acknowledge the unstinted support of her husband, Dr. Anandi Lal, and son- Nitin A. Lal, during the long and arduous task of writing this book.

Professor Bhatla takes this opportunity to dedicate this work to his teachers, Professor R. C. Pant (former Head and Dean, College of Basic Sciences at G. B. Pant University of Agriculture and Technology, Pantnagar, India) and Professor Martin Bopp (former Director, Botanical Institute, University of Heidelberg, Germany). Professor Bhatla remains highly appreciative of the strong support and encouragement from his wife, Dr. Rita Bhatla, and children- Rajat, Vrinda, and Sahil. They were fully aware of the intensity with which this work was being pursued and also exhibited lot of patience with a smile. Thank you all for your understanding.

New Delhi, India

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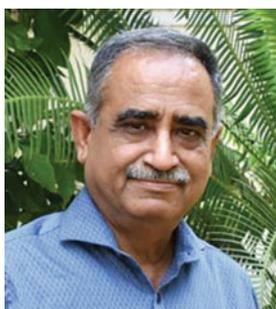
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