Photosynthesis and the Environment

Advances in Photosynthesis

VOLUME 5

Advances in Photosynthesis is an ambitious new book series seeking to provide a comprehensive and state-of-the-art account of photosynthesis research. Photosynthesis is the process by which higher plants, algae and certain species of bacteria transform and store solar energy in the form of energy-rich organic molecules. These compounds are in turn used as the energy source for all growth and reproduction in these organisms. As such, virtually all life on the planet ultimately depends on photosynthetic energy conversion. This series of multiauthored books spans topics from physics to agronomy, from femtosecond reactions to season long production, from the photophysics of reaction centers to the physiology of whole organisms, and from X-ray crystallography of proteins to the morphology of intact plants. The intent of this new series of publications is to offer beginning researchers, graduate students, and even research specialists a comprehensive current picture of the remarkable advances across the full scope of photosynthesis research.

Photosynthesis and the Environment

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Preface

Over the past decade there has been increasing concern about the potential future impact of global climate changes on crop production and the ability to feed an increasing world population. Accurate prediction of the effects of changing climatic variables on plant productivity will almost certainly be dependent upon the development of robust dynamic mechanistic models, which are built upon a sound understanding of the mechanisms by which environmental factors can influence photosynthetic processes. Although a detailed understanding of the molecular mechanisms and systems involved in photosynthesis has been achieved over the past decade, our knowledge of the intrinsic biological factors determining photosynthetic capacity and efficiency and how these factors can be modified by edaphic and climatic variables is not as well advanced. This is primarily due to the complexities of the dynamic interactions between components of the photosynthetic apparatus and the modifications of these interactions by extrinsic factors. Such complexities are only likely to be properly understood from integrated multidisciplinary studies involving analyses of structural, functional and developmental aspects of the photosynthetic systems. This volume was conceived with a view to providing an up to date reference text for advanced students and scientists who want to understand how photosynthetic performance may be influenced by environmental change. Consequently, the book contains contributions from authors drawn from a wide range of disciplines, all of whom have interests in the responses of the photosynthetic system to environmental challenges.

The first part of the book examines structural and functional aspects of the photosynthetic apparatus in the context of responses to environmental stimuli and deals specifically with the processing of light energy by thylakoids, metabolic regulation, gas exchange and source-sink relations. Consideration is then given to development and genetic responses to environmental change. This is followed by a number of chapters which examine the effects of specific environmental variables (light, temperature, water, CO_2 concentration, ozone and UV-B) on photosynthetic performance and illustrate the complexities of the responses and need for multidisciplinary approaches. Recent developments in the methodology for studying photosynthetic performance of leaves have been important in advancing knowledge of the regulation of photosynthetic processes and the effects of the environment on photosynthesis. Details of new methods and their applications are presented at appropriate places throughout the book.

It was with great sadness that I recently learnt of the death of Harold W. Woolhouse. Harold was a polymath with interests in a wide range of biological issues and who made many important contributions to plant biology, particularly in the area of environmental physiology. For many years prior to environmental biology becoming a fashionable subject Harold had held the view that an understanding of the responses of the photosynthetic apparatus to environmental factors would require an integration of knowledge across the biological disciplines. For as long as I can remember he had also always advocated vigorously the application of new and advanced biophysical and biochemical techniques to resolve problems in whole plant physiology. Many may consider that his major contribution to plant biology occurred towards the end of his illustrious career when he played a major role in encouraging and facilitating the use of molecular biological and molecular genetic approaches. There is no doubt that Harold had a great influence on the development of many plant biologists, not least myself. I would like to think that Harold would have supported strongly the philosophy underlying the production of this volume. I dedicate this volume to the memory of Harold, a very good friend and excellent colleague of many.

The production of this volume has involved the efforts of a number of people who I would like to thank. Firstly, I thank the authors for their contributions and patience in dealing with editorial changes. Secondly, Larry Orr deserves special thanks for the production of the page layout of the book, which at times was less than straightforward; it was

a pleasure to work with Larry and experience his friendly and efficient manner in dealing with problems. Finally, I must thank my wife, Maxine Baker, for her patience during the preparation of the volume and her help with checking references and construction of the index.

–Neil R. Baker