

Photosynthesis and the Environment

Advances in Photosynthesis

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*Department of Plant Biology
University of Illinois, Urbana, Illinois, U.S.A.*

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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

Edited by

Neil R. Baker

*Department of Biological and Chemical Sciences,
University of Essex,
Colchester, United Kingdom*

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Contents

Preface	xi
1 Processing of Excitation Energy by Antenna Pigments	1–23
<i>Thomas G. Owens</i>	
Summary	1
I. Introduction	2
II. Structure and Composition of Photosynthetic Antennae	4
III. Role of the Antenna in Photosynthesis	5
IV. Light-Harvesting Function of Antenna Pigments	9
V. Non-Photochemical Quenching and Regulation of Light Energy Utilization	12
VI. Concluding Remarks	21
Acknowledgments	21
References	21
2 Control and Measurement of Photosynthetic Electron Transport in Vivo	25–66
<i>David Mark Kramer and Antony Richard Crofts</i>	
Summary	26
I. Introduction	27
II. Control of the Photosynthetic Electron Transfer Chain	28
III. What Reactions Can We Measure?	31
IV. Instrumentation and Measurement	32
V. The Future of Instrumentation for Intact Plants	58
Acknowledgments	59
References	60
3 Regulation of Light Utilization for Photosynthetic Electron Transport	67–99
<i>B. Genty and J. Harbinson</i>	
Summary	68
I. Introduction	68
II. Operation of Light-driven Energy Transduction in Leaves	69
III. Significance of Structural Acclimation on the Operation of Light-driven Energy Transduction. A Case Study: Acclimation to Growth Irradiance	86
IV. Conclusions	90
V. Appendix: The Use of Light-Induced Absorbance Changes Around 820 nm to Measure P700 Oxidation	91
Acknowledgments	92
References	92
4 Mechanisms of Photodamage and Protein Degradation During Photoinhibition of Photosystem II	101–121
<i>B. Andersson and J. Barber</i>	
Summary	101
I. Introduction	102
II. Photosystem II: Structure and Function	104
III. Photochemical Processes Giving Rise to Damage	106

IV. Does Triggering for D1 Protein Degradation Require a Conformational Change?	110
V. Degradation of Reaction Center Subunits in Photosystem II	111
VI. Repair of Photodamaged Photosystem II Requires Co-ordination Between Degradation and Biosynthesis	116
Acknowledgments	117
References	117

5 Radical Production and Scavenging in the Chloroplasts **123–150**

Kozi Asado

Summary	124
I. Introduction	124
II. Radicals and Dioxygen	125
III. The Primary Target Molecules and Sites	127
IV. Production of Reactive Oxygens and Radicals and their Scavenging Enzymes	130
V. Microcompartmentation of the Scavenging Systems of Superoxide and Hydrogen Peroxide in Chloroplasts	141
VI. Dioxygen Protects from Photoinhibition	142
VII. Concluding Remarks	144
Acknowledgments	145
References	145

6 Metabolic Regulation of Photosynthesis **151–190**

Mark Stitt

Summary	152
I. Introduction	153
II. Pathways and Metabolite Measurements: Evidence for Highly Coordinated Regulation of Many Reactions	154
III. Regulatory Properties of Calvin Cycle Enzymes	155
IV. Coarse Regulatability	166
V. How can the Regulatory Capacity of a Protein be Evaluated?	167
VI. Distribution of Control in Photosynthetic Carbon Metabolism	173
Acknowledgments	183
References	183

7 Carbon Metabolism and Photorespiration: Temperature Dependence in Relation to Other Environmental Factors **191–221**

Richard C. Leegood and Gerald E. Edwards

Summary	192
I. General Philosophy	192
II. Stomatal Versus Biochemical/Photochemical Limitations	193
III. Changes in Biochemical Versus Photochemical Efficiency	193
IV. Effects of Temperature on Metabolism	193
V. Effects of Temperature on Photosynthesis in C ₃ Plants	194
VI. Effects of Temperature on C ₄ Photosynthesis	200
VII. Effects of Temperature on Crassulacean Acid Metabolism	205
VIII. Temperature Compensation in Photosynthetic Metabolism	206
IX. Effects of Temperature on Carbon Partitioning to Starch and Sucrose	207
X. Acclimation of Photosynthesis to Temperature Shifts	211
References	215

8	Gas Exchange: Models and Measurements	223–240
	<i>John M. Cheeseman and Matej Lexa</i>	
	Summary	223
	I. Introduction	224
	II. The Biochemical Model	226
	III. Beyond the Biochemical Model	228
	IV. The Feedback Loop: Consequences for Field Studies	235
	V. Conclusion	237
	Acknowledgments	237
	References	237
9	Stomata: Biophysical and Biochemical Aspects	241–259
	<i>William H. Outlaw Jr., Shuqiu Zhang, Daniel R. C. Hite and Anne B. Thistle</i>	
	Summary	241
	I. Introduction	242
	II. Plasmalemma Guard Cell Proton Pump	242
	III. Plasmalemma Potassium Channels	244
	IV. Plasmalemma Anion Channels	245
	V. Tonoplast Transport Processes	246
	VI. Abscisic Acid, Calcium, and the Phosphoinositide Messenger Systems	247
	VII. Integrating Role of Abscisic Acid in the Plant's Physiology	249
	VIII. Carbon Metabolism	249
	IX. Concluding Remarks	253
	References	253
10	Source-Sink Relations: The Role of Sucrose	261–279
	<i>C. J. Pollock and J. F. Farrar</i>	
	Summary	262
	I. Introduction	262
	II. Sucrose As a Regulator	263
	III. Changes in Source Leaf Metabolism	266
	IV. Sinks	271
	V. Potential Mechanisms of Gene Regulation by Sugars	274
	VI. Conclusion	275
	References	276
11	Developmental Constraints on Photosynthesis: Effects of Light and Nutrition	281–304
	<i>John Richard Evans</i>	
	Summary	281
	I. Introduction	282
	II. Effects of Light	283
	III. Effects of Nutrition	295
	IV. Conclusions	299
	Acknowledgments	300
	References	300

12	Molecular Biological Approaches to Environmental Effects on Photosynthesis	305–319
	<i>Christine A. Raines and Julie C. Lloyd</i>	
	Summary	305
	I. Introduction	306
	II. Genetics and Biogenesis of the Photosynthetic Apparatus	307
	III. Molecular Approaches to Environmental Stress	308
	IV. Environmental Stress in Photosynthetic Systems	315
	V. Conclusions	317
	References	317
13	Photosynthesis in Fluctuating Light Environments	321–346
	<i>Robert W. Percy, John P. Krall and Gretchen F. Sassenrath-Cole</i>	
	Summary	321
	I. Introduction	322
	II. The Nature of Sunfleck Light Regimes	323
	III. Factors Regulating the Photosynthetic Utilization of Sunflecks	324
	IV. Regulation of the Transient Responses to Individual Lightflecks	334
	V. Are There Specific Adaptations in Shade Leaves for the Utilization of Sunflecks?	340
	VI. Sunfleck Utilization in Natural Light Regimes	341
	Acknowledgments	343
	References	343
14	Leaf Photosynthesis Under Drought Stress	347–366
	<i>Gabriel Cornic and Angelo Massacci</i>	
	Summary	347
	I. Introduction	348
	II. The Resistance of Photosynthetic Mechanisms to Drought	351
	III. CO ₂ Concentration Inside the Chloroplast During Drought is Low	354
	IV. Changes in Metabolic and Whole Leaf Photosynthetic Responses Induced by Water Deficits	356
	V. Maintenance of Plant Water Content During Soil Drying	358
	VI. Light Utilization by Plants Under Drought	359
	VII. Conclusions	362
	Acknowledgments	363
	References	363
15	Photosynthetic Adjustment to Temperature	367–385
	<i>Stefan Falk, Denis P. Maxwell, David E. Laudenbach and Norman P. A. Huner</i>	
	Summary	367
	I. Introduction	368
	II. Short-Term Temperature Response of Photosynthesis	369
	III. Long-Term Temperature Response of Photosynthesis	372
	IV. Thylakoid Membrane Lipids	375
	V. Temperature and Chloroplast Development	377
	VI. Interaction of Light and Temperature	378
	VII. Photosynthetic Adaptation, Acclimation and Stress	380
	Acknowledgments	380
	References	380

16	Photosynthetic Responses to Changing Atmospheric Carbon Dioxide Concentration	387–407
	<i>George Bowes</i>	
	Summary	387
	I. Rising CO ₂ in Perspective	388
	II. Sites of Action of CO ₂ in Plants	389
	III. Adaptation to Changes in Atmospheric CO ₂	390
	IV. Diversity in Photosynthetic Responses to CO ₂ Enrichment	393
	V. Concluding Comments	402
	Acknowledgments	402
	References	402
17	The Modification of Photosynthetic Capacity Induced by Ozone Exposure	409–433
	<i>Robert L. Heath</i>	
	Summary	409
	I. Introduction and Background	410
	II. Model Studies	414
	III. Whole Plant Studies	418
	IV. Photosynthesis or Stomates?	420
	V. Conclusions	429
	References	429
18	Ultraviolet-B Radiation and Photosynthesis	435–450
	<i>Alan H. Teramura and Lewis H. Ziska</i>	
	Summary	435
	I. Introduction	436
	II. Penetration of UV-B Radiation	437
	III. Direct Effects of UV-B Radiation on the Light Reaction of Photosynthesis	437
	IV. Direct Effects of UV-B Radiation on Carbon Reduction	440
	V. Direct Effects of UV-B Radiation on Carbon Oxidation	441
	VI. UV-B Induced Changes in Leaf Development	442
	VII. Changes in Plant Growth and Development with UV-B Radiation	443
	VIII. Protection and Repair of Photosynthesis	444
	IX. Future Research Priorities	446
	Acknowledgments	446
	References	446
19	Evaluation and Integration of Environmental Stress Using Stable Isotopes	451–468
	<i>H. Griffiths</i>	
	Summary	451
	I. Introduction	452
	II. Background to Stable Isotope Studies	453
	III. Applications of Stable Isotope Techniques	459
	IV. Future Potential	464
	Acknowledgments	465
	References	465
	Summary	469

20	Environmental Constraints on Photosynthesis: An Overview of Some Future Prospects	469–476
	<i>Neil R. Baker</i>	
	I. Introduction	469
	II. Light Energy Transduction by Thylakoids	470
	III. Carbon Metabolism	472
	IV. Leaf Gas Exchange	472
	V. Scaling from the Chloroplast and Leaf to the Canopy	475
	Acknowledgments	475
	References	475
Index		477

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,

CO₂ 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