Tingyun Kuang
Congming Lu
Lixin Zhang

Photosynthesis Research for Food, Fuel and the Future

15th International Conference on Photosynthesis
Tingyun Kuang
Congming Lu
Lixin Zhang

Photosynthesis Research for Food, Fuel and the Future

15th International Conference on Photosynthesis

With 508 figures
Preface

Photosynthesis is a natural process that converts solar energy to chemical energy. It is widely distributed in many different organisms, ranging from plants to bacteria. It provides all the food we eat and all the fossil fuel we use. Photosynthesis has long been studied in order to understand its underlying mechanisms and then to apply this knowledge to produce energy and food for the needs of our society.

The 15th international conference on photosynthesis was successfully held on 22–27 August 2010, in Beijing, China. The conference was organized by the Institute of Botany, Chinese Academy of Sciences and International Society of Photosynthesis Research. The conference had a fantastic scientific program and featured eminent speakers and state-of-the-art symposium speakers who are at the cutting edge of discovery in their field. These speakers provided an exciting scientific program which covered the breadth and depth of photosynthesis from molecular to global.

Under the conference theme, “photosynthesis research for food, fuel and the future”, a total of 24 chapters were collected in this proceeding which contained twenty-three sections, each section representing one of the topics covered by plenary lectures and sessions at the conference. Therefore, the papers contained in this proceeding include all aspects of photosynthesis. We thank all conference participants and in particular those whose chapters are published here.

It is our belief that the Proceeding of the 15th International Conference on Photosynthesis will provide an opportunity for students, postdoctoral fellows and scientists from all over the world to enjoy the latest advanced developments on photosynthesis.

Tingyun Kuang
Chairman of Organizing Committee of
15th International Conference on
Photosynthesis, 2010, Beijing
10 January 2012
Contents

Symposium 01  Type I Reaction Centres

Symposium 01_01  Deconvolution Analysis of Photoacoustic Waves of Electron Transfer in Photosystem I of \textit{menG} Null Mutant of \textit{Synechocystis} sp. PCC 6803

\textit{Xuejing Hou, Lien-Yang Chou, Harvey JM Hou} (3)

Symposium 01_02  Towards Uncovering the Energetics of Secondary Electron Transfer Reactions in Photosystem I

\textit{Stefano Santabarbara, Fabrice Rappaport, Kevin Redding} (7)

Symposium 01_03  Supercomplex Organizations and Evolution of Photosystems I and II (\textit{Anabaena} sp. PCC 7120, \textit{Cyanophora Paradoxa} and \textit{Cyanidioschyzon Merolae})

\textit{Mai Watanabe, Hisako Kubota, Hajime Wada, Rei Narikawa, Masahiko Ikeuchi} (13)

Symposium 01_04  3D Model of PSI-LHCI Supercomplexes from Chlamydomonas Reinhardtii

\textit{Venkateswarlu Yadavalli, Chandramouli Malleda, Rajagopal Subramanyam} (17)

Symposium 01_05  Reaction of A$_1$-Menquinone in Type I Reaction Center of \textit{Heliobacterium Modesticaldum} at Cryogenic Temperature

\textit{Toru Kondo, Masahiro Matsuoka, Chiihiro Azai, Hiroyuki Mino, Hirozo Oh-oka, Shigeru Itoh} (21)

Symposium 02  Type II Reaction Centres

Symposium 02_01  Calculation of Connectivity of Photosynthetic Units in Intact Cells of \textit{Rhodobacter Sphaeroides}

\textit{Péter Maróti, Emese Asztalos} (27)

Symposium 02_02  Oxygen-Dependent Production and Arrangements of the Photosynthetic Pigments in Intact Cells of \textit{Rhodobacter Sphaeroides}

\textit{Emese Asztalos, Mariann Kis, Péter Maróti} (32)

Symposium 02_03  Electronic Structure Studies of the Spin Density Distribution of the Q$_A$ Plastosemiquinone Free Radical of Photosystem II

\textit{Tzu-Jen Lin, Patrick J O’Malley} (37)

Symposium 02_04  Spectral Properties of the \textit{Rhodobacter Sphaeroides} Mutant Photo-Reaction Center with Double Amino Acid Substitution I(L177)H+H(L173)L

\textit{Tatiana Y Fufina, Lyudmila G Vasilieva, Ravil A Khatypov, Vladimir A Shuvalov} (46)

Symposium 02_05  Spectroelectrochemical Determination of the Redox Potentials of Pheophytin \textit{a} and Primary Quinone Q$_A$ in Photosystem II from \textit{Thermosynechococcus Elongatus}

\textit{Yuki Kato, Tadao Shibamoto, Akinori Oda, Miwa Sugiura, Tadashi Watanabe} (50)

Symposium 02_06  PsbP does Not Require LHCIi to Bind the PSII Core

\textit{Cristina Pagliano, Fabiana Chimirri, Guido Saracco, James Barber} (55)

Symposium 02_07  Compositional and Structural Analyses of the Photosystem II Isolated from the Red Alga \textit{Cyanidioschyzon Merolae}

\textit{Joanna Kargul, Marko Boehm, Nina Morgner, Carol V Robinson, Peter J Nixon, James Barber} (59)
Symposium 02_08  The Position and Orientation of Active Carotenoid in Photosystem II  
Asako Kawamori, Hiroyuki Mino, Jianren Shen  (64)

Symposium 02_09  Functional Roles of the Amino- and Carboxyl-Regions of PsbP Protein in Photosystem II  
Shusuke Kakiuchi, Kentaro Ijuku, Megumi Tomita, Kunio Ido, Takumi Noguchi, Fumihiko Sato  (67)

Symposium 02_10  A New Value for the Redox Potential of Cytochrome c550 in Photosystem II from Thermosynechococcus Elongatus  
Fernando Guerrero, Arezki Sedoud, Diana Kirilovsky, A William Rutherford, Mercedes Roncel, José M Ortega  (71)

Symposium 02_11  The Polyhydroxybutyrate Pathway Promoters Can Drive Foreign Gene Expression under Circadian Rhythm in Synechocystis sp. PCC 6803  
Ryan E Hill, Julian J Eaton-Rye  (75)

Symposium 02_12  Removal of the PsbT Subunit of Photosystem II in Synechocystis sp. PCC 6803 Causes QA Oxidation to be Blocked by Dimethyl-p-Benzoquinone  
Robert D Fagerlund, Roger Young, Hao Luo, Fiona K Bentley, Julian J Eaton-Rye  (79)

Symposium 02_13  Metal and Serine Proteases in the Crude Photosystem II Particles from a Diatom, Chaetoceros Gracilis  
Ryo Nagao, Eri Noguchi, Tatsuya Tomo, Isao Enami, Masahiko Ikeuchi  (83)

Symposium 02_14  Structure-Function Studies of the Photosystem II Extrinsic Subunits PsbQ and PsbP from the Cyanobacterium Synechocystis sp. PCC 6803  
Simon A Jackson, Robert D Fagerlund, Mark G Hinds, Sigurd M Wilbanks, Julian J Eaton-Rye  (86)

Symposium 02_15  Coherent Electron Transfer in Reaction Centers of YM210L and YM210L/HL168L Mutants of Rba. sphaeroides  
Andrei G Yakovlev, Lyudmila G Vasilieva, Tatyana I Khmelnitskaya, Valentina A Shkuropatova, Anatoli Ya Shkuropatov, Vladimir A Shuvalov  (91)

Symposium 02_16  Coordination Changes of Carboxyl Ligands at the QaFeQb Triad in Photosynthetic Reaction Centers Studied by Density-Functional Theory  
Petko Chernev, Ivelina Zaharieva, Holger Dau, Michael Haumann  (95)

Symposium 03  Light Harvesting Anaerobic Systems

Symposium 03_01  Strontium Ions are Functionally Replaceable with Calcium Ions in the Light-Harvesting 1 Reaction Center Core Complex from Thermophilic Purple Sulfur Bacterium Thermochromatium Tepidum  
Yukihiro Kimura, Yuta Inada, Longjiang Yu, Takashi Ohno, Zhengyu Wang  (105)

Symposium 03_02  Cell-Free Expression of the Lhcb1 Protein of Arabidopsis Thaliana  
Anjali Pandit, Tineke de Ruijter, Riekje Brandsma, Jaap Brouwer, Huub JM de Groot and, Willem J de Grip  (110)

Symposium 03_03  Optimal Mutual Orientational Ordering of Qy Transition Dipoles of Adjacent Subantennae Pigments in the Superantenna of the Photosynthetic Green Bacterium Chloroflexus Aurantiacus. Theoretical and Experimental Studies  
Andrey yakovlev, Vladimir Novoderezhkin, Alexandra Taisova, Anastasiya Zobova, Zoya Fetisova  (113)

Symposium 03_04  CsmA Protein is Associated with BCHl a in the Baseplate Subantenna of Chlorosomes of the Green Photosynthetic Bacterium Oscillochloris Trichoides Belonging to the Family Oscillochloridaceae  
Alexandra S Taisova, Anastasiya V Zobova, Eugeney P Lukashev, Nataliya V Fedorova, Zoya G Fetisova  (117)

Symposium 03_05  Effects of Anaerobic Conditions on Photosynthetic Units of Acaryochloris Marina  
Yuankui Lin, Ben Crossett, Min Chen  (121)
Symposium 04  Light Harvesting Aerobic Systems

Symposium 04_01  Closed Reaction Centers of PS1 Still Can Perform the First Steps of Charge Separation. A Mid IR Pump Probe Study with fs Resolution

   Andreas D Stahl, Mariangela Di Donato, Ivo van Stokkum, 
   Rienk van Grondelle, Marie Louise Groot  (127)

Symposium 04_02  Modulation of Chlorophyll b Biosynthesis and Photosynthesis by Overexpression of Chlorophyllide a Oxygenase (CAO) in Tobacco

   Ajaya K Biswal, Gopal K Pattanayak, Sadhu Leelavathi, Vanga S Reddy, 
   Govindjee, Baishnab C Tripathy  (131)

Symposium 04_03  All of α–Carotene and Its Derivatives Have a Sole Chirality?

   Shinichi Takaichi, Akio Murakami, Mari Mochimaru  (135)

Symposium 04_04  Fluorescence Lifetime Imaging Microscopy of Synechocystis WT Cells — Variation in Photosynthetic Performance of Individual Cells in Various Strains of sp. PCC 6803

   Tünde Tóth, Valha V Chukhutsina, Sashka B Krumova, Zoltan Gombos, Herbert van Amerongen  (139)

Symposium 04_05  Isolation of Intact Phycobilisomes in Low Salt: a Novel Method for Purifying Phycobilisomes by Mild Cross-Linking

   Liron David, Noam Adir  (143)

Symposium 04_06  Differential Association of the Light-Harvesting Proteins (FCPs) with PSI and PSII in the Small Brown Tide Alga Aureococcus Anophagefferens

   Meriem Alami, Beverley R Green  (148)

Symposium 04_07  Non-Linear Spectroscopy of Carotenoid-Chlorophyll Interactions in Photosynthetic Light-Harvesting Complexes

   Alexander Betke, Klaus Teuchner, Bernd Voigt, Heiko Lokstein  (152)

Symposium 04_08  Three Step Dissociation and Covalent Stabilization of Phycobilisome

   Qiang Wang  (156)

Symposium 05  Bioenergetics of Photosynthetic Electron Flow

Symposium 05_01  Ferredoxin:NADP⁺ Oxidoreductase Associated with Cytochrome b₅ Complex is Highly Active in Plastoquinone Reduction

   Renata Szymańska, Jolanta Pierścińska, Ireneusz Ślesak, Jerzy Kruk  (169)

Symposium 05_02  The Mutation E242K in the Chloroplast ATP Synthase Gamma Subunit Increases the Inhibitory Binding of the Epsilon Subunit without Changing the Apparent Redox Potential of the Regulatory Dithiol

   Kim K Colvert, Fei Gao, Daxin Zheng, Shyam Mehta, Mark L Richter  (174)

Symposium 05_03  Analysis of Dark Drops, Dark-Induced Changes in Chlorophyll Fluorescence during the Recording of the OJIP Transient

   Vasilij Goltsev, Maria Gurmanova, Margarita Kouzmanova, Ivan Yordanov, Scheng Qiang, 
   Alison Pentland, Neil Wilson, Shiguo Chen, Ivelina Zaharieva, Reto Jörg Strasser  (179)

Symposium 05_04  Photosynthetic Measurements with the Idea Spec: an Integrated Diode Emitter Array Spectrophotometer/Fluorometer

   Christopher C Hall, Jeffrey Cruz, Magnus Wood, Robert Zegarac, Dustin De Mars, Joel Carpenter, Atsuko Kanazawa, David Kramer  (184)
Symposium 05_05 Crystal Structure of Ferredoxin-Nad(P)⁺ Reductase from the Green Sulfur Bacterium Chlorobaculum Tepidum

Daisuke Seo, Norifumi Muraki, Tomoo Shiba, Takeshi Sakurai, Genji Kurisu (189)

Symposium 05_06 A Potential Function for the γ2 Subunit (atpC2) of the Chloroplast ATP Synthase

Kaori Kohzuma, Cristina Dal Bosco, Atsuko Kanazawa, David M Kramer, Jörg Meurer (193)

Symposium 05_07 The Contribution of Light-Dependent Bicarbonate Uptake in Thylakoid Membrane Energization

Zolotareva EK, Polishchuk OV, Semenikhin AV, Onoiko EB (197)

Symposium 05_08 Activation of Alternative Electron Transfer in PS II by Inhibition of Proton Transfer at the Acceptor Side

Polischchuk OV, Topchiy NM, Podorvanov VV (202)

Symposium 06 Mechanisms of Water Oxidation

Symposium 06_01 Analysis of S_{2,3}-States Decay Processes: Focused on Cyanobacteria

Jiri Jablonsky, Dusan Lazar (209)

Symposium 06_02 Energetics, Kinetics and Mechanism of Oxidative Water Splitting in Photosynthesis

G Renger (213)

Symposium 06_03 Charge Equilibrium Reactions S_2 and S_3 States of Photosystem II with Cyt b_{559} and Tyrosine Y_D

Yashar Feyziyev, Stenbjörn Styring (218)

Symposium 06_04 Molecular Dynamics Simulations of a Putative H⁺ Pathway in Photosystem II

Felix M Ho (222)

Symposium 06_05 Catalytic Cooperativity of Mono-Manganese and Tri-Manganese Clusters for Water-Splitting and Oxygen-Evolving Reaction in Photosystem II: Chemical Mechanistic Insight

Masami Kusunoki (227)

Symposium 06_06 Direct Detection of Oxygen Ligands to the Mn₄Ca Complex in Photosystem II by X-ray Emission Spectroscopy

Jan Kern, Henning Schroeder, Megan Shelby, Yulia Pushkar, Benedikt Lasalle, Pieter Glatzel, Vittal K Yachandra, Uwe Bergmann, Junko Yano (231)

Symposium 06_07 Water Oxidation in Photosystem II: Energetics and Kinetics of Intermediates Formation in the S_2→S_3 and S_3→S_0 Transitions Monitored by Delayed Chlorophyll Fluorescence

Ivelina Zaharieva, Markus Grabolle, Petko Chernev, Holger Dau (234)

Symposium 06_08 An EPR and ENDOR Spectroscopic Investigation of the Ca²⁺-Depleted Oxygen-Evolving Complex of Photosystem II

Thomas Lohmiller, Nicholas Cox, Jihu Su, Johannes Messinger, Wolfgang Lubitz (239)

Symposium 06_09 Role of Protons in Photosynthetic Water Oxidation: pH Influence on the Rate Constants of the S-state Transitions and Hypotheses on the S_2→S_3 Transition

László Gerencsér, Holger Dau (244)

Symposium 06_10 Electronic Structure of the CaMn₄O₅ Cluster in the PSII System Refined to the 1.9 Å X-ray Resolution. Possible Mechanisms of Photosynthetic Water Splitting

S Yamanaka, K Kanda, H Isobe, K Nakata, Y Umema, K Kawakami, JR Shen, N Kamiya, M Okumura, T Takada, H Nakamura, K Yamaguchi (250)

Symposium 07 Mimicking Photosynthetic Catalysis

Symposium 07_01 The Structure of a Water-Oxidizing Cobalt Oxide Film and Comparison to the Photosynthetic Manganese Complex

Marcel Risch, Katharina Klingan, Anna Fischer, Holger Dau (257)
Symposium 07_02  Catalytic Mechanism of a Bioinspired Mn-oxo Olgomer/Tungston Oxide System in Water Splitting and Its Relevance to PS II Water Oxidation  
Wanshu He, Lien-Yang Chou, Ndi Geh, Robert Mulkern, Harvey JM Hou  (262)

Symposium 07_03  An Artificial Water-Oxidizing Co Electro-Catalyst: Structure and Mechanism by in Situ X-Ray Absorption Spectroscopy  
Junko Yano, Vittal K Yachandra, Matthew W Kanan, Yogesh Surendranath, Mirca Dinca, Daniel G Nocera  (266)

Symposium 08  Regulation of Electron Transfer

Symposium 08_01  Quantification of Cyclic Electron Flow in Spinach Leaf Discs  
Jiancun Kou, Shunichi Takahashi, Riichi Oguchi, Murray R Badger, Wah Soon Chow  (271)

Symposium 08_02  The Ancient Cyanobacterium Gloeobacter Violaceus PCC 7421 is Capable of State Transitions and Blue-Light Induced Fluorescence Quenching  
Gábor Bernát, Ulrich Schreiber, Igor N Stadnichuk, Matthias Rögner, Friederike Koenig  (275)

Symposium 08_03  Screening of Novel Subunits of Chloroplastic NAD(P)H Dehydrogenase in Arabidopsis  
Noriko Ishikawa, Atushi Takabayashi, Satoshi Ishida, Yasushi Hano, Kentar0 Itjiku, Fumihiko Sato, Tsuyoshi Endo  (279)

Symposium 08_04  Regulatory Systems that Quantitatively Alter Two Anionic Lipids of Chloroplasts in Chlamydomonas Reinhardti upon Sulfur-Starvation  
Koichi Sugimoto, Mikio Tsuzuki, Norihiro Sato  (282)

Symposium 08_05  Do State Transitions Control CEF1 in Higher Plants?  
Deserah D Strand, Aaron K Livingston, David M Kramer  (286)

Symposium 08_06  Study on Post-Steady-State Chlorophyll a Fluorescence Kinetics of Plants  
Chuanfei Zhong, Xiaoying Wu, Zhikui Gao, Yuntao Zhang, Guixia Wang, Jing Dong, Lina Wang, Linlin Chang, Rongfu Gao  (290)

Symposium 08_07  The Ancient Cyanobacterium Gloeobacter Violaceus PCC 7421 is Capable of State Transitions and Blue-Light Induced Fluorescence Quenching  
Gábor Bernát, Ulrich Schreiber, Igor N Stadnichuk, Matthias Rögner, Friederike Koenig  (294)

Symposium 09  Control of the Calvin-Benson Cycle

Symposium 09_01  Relationship between Photosynthesis and Respiration in Leaves Using $^{13}$C/$^{12}$C Isotope Labelling  
Salvador Nogués  (301)

Symposium 09_02  Photosynthetic Labeling and Partitioning of Major Sugars and Monoterpenes in Leaves of Plantago Lanceolata L  
Ildiko Szucs, Mayhery Escobar, Demos Leonardos, Sarah Crain, Bernard Grodzinski  (304)

Symposium 10  CO2 Concentrating Mechanisms

Symposium 10_01  The Periplasmic Carbonic Anhydrase, CAH1, is Absent in the Sequenced Chlamydomonas reinhardtii Strain, CC-503  
Bratati Mukherjee, Trang T Pham, Yunbing Ma, Tiffany A Simms, James V Moroney  (311)

Symposium 10_02  Transcriptional Analysis of the Three Phosphoglycolate Phosphatase Genes in Wild Type and the pgp1 Mutant of Chlamydomonas Reinhardtii  
Yunbing Ma, Megan M Hartman, James V Moroney  (315)
Symposium 11  C₃, C₄ and CAM and Genetic Engineering

Symposium 11_01  Effects of 1-Butanol, Neomycin, and Calcium on the Photosynthetic Characteristics of Pepc Transgenic Rice

Xia Li, Chao Wang, Chenggang Ren  (321)

Symposium 11_02  Some Physicochemical Properties of Carbonic Anhydrase in Mesembryanthemum Crystallinum Leaves

Bayramov Sh, Orujova T, Babayev H, Guliyev N  (324)

Symposium 12  Regulation of Photosynthetic Gene Expression

Symposium 12_01  GTP-Binding Proteins are Potential Messengers for Photosynald Transduction in High Plants

Karim Gasimov  (331)

Symposium 12_02  Expression of PEPC Gene, Lipid Content and Photosynthesis in Anabaena 7120

Lijun Hou, Xiaohui Jia, Dingji Shi, Xuekui Wang  (335)

Symposium 12_03  Unique Central Carbon Metabolic Pathways and Novel Enzymes in Phototrophic Bacteria Revealed by Integrative Genomics, ¹³C-Based Metabolomics and Fluxomics

Kuo-Hsiang Tang, Xueyang Feng, Anindita Bandyopadhyay, Himadri B Pakrasi, Yinjie J Tang, Robert E Blankenship  (339)

Symposium 12_04  Regulation of the Carbon and Nitrogen Balance by a Plastidic Invertase in Arabidopsis

Takanori Maruta, Kumi Otori, Tomoki Tabuchi, Noriaki Tanabe, Masahiro Tami, Shigeru Shigeoka  (344)

Symposium 12_05  Characterization of a pH-Sensitive Photosystem II Mutant in the Cyanobacterium Synechocystis sp. PCC 6803

Tina C Summerfield, Roger Young, Louis A Sherman, Julian J Eaton-Rye  (348)

Symposium 12_06  Solar-Powered Production of Biofuels and Other Petroleum Substitutes by Cyanobacteria: Stoichiometries of Reducing Equivalents and Chemical Energy, and Energy Conversion Efficiency

Wim Vermaas  (353)

Symposium 12_07  D1⁺- a New Member of D1 Protein Family in Cyanobacteria

Ciprian Chis, Abdullah Mahboob, Sergey Vassilieiev, Adriana Bica, Loredana Peca, Doug Brouce, Eva-Mari Aro, Cosmin Ionel Sicora  (358)

Symposium 12_08  Photosynthesis and Expression of Circadium Gene KaiC in Synechococcus

Xiaohui Jia, Carl H Johnson, Dingji Shi, Xiaoyan Wang, Guisen Du  (361)

Symposium 13  Computational Systems Biology

Symposium 13_01  Prediction of Cis Regulatory Elements in the Genome of Synechococcus Elongatus PCC 6301

P Parvati Sai Arun, M Subhashini, CH Santhosh, P Sankara Krishna, Jogadhenu SS Prakash  (369)

Symposium 14  Biogenesis of Photosynthetic Apparatus

Symposium 14_01  Chloroplast Biogenesis — Preliminary Structural and Proteomic Study

Lucja Rudowska, Radoslaw Mazur, Maciej Garstka, Agnieszka Mostowska  (377)

Symposium 14_02  Protochlorophyllide Forms in Etiolated Seedlings of Photoreceptor Mutants of Arabidopsis Thaliana — Is Chlorophyll Biosynthesis Controlled by Cooperation between Phytochromes and Phototropins?

Beata Myśliwa-Kurdziel, Elżbieta Turek, Przemysław Malec  (381)
Symposium 14_03  Blue-Native Page Analysis Validates Heterogeneity in the Thylakoids of *Synechocystis* 6803  
Rachna Agarwal, Andrea Matros, Michael Melzer, Hans-Peter Mock, Jayashree Krishna Sainis  
(385)

Symposium 14_04  Spatial and Temporal Regulation of Chloroplast Development in Arabidopsis Root  
Koichi Kobayashi, Tatsuru Masuda  
(389)

Symposium 14_05  The Lattice-Like Structure Observed by Vipp1-GFP in Arabidopsis Chloroplasts  
Lingang Zhang, Yusuke Kato, Koji Saigo, Ute C Voitknecht, Wataru Sakamoto  
(394)

Symposium 14_06  State Transition Mechanism in *Arabidopsis Thaliana*: Biophysical and Proteomic Studies  
Sreedhar Nellaepalli, Ottó Zsiros, László Kovács, Yadavalli Venkateswarlu, Mekala Nageswara Rao, Prasanna Mohanty, Rajagopal Subramanyam  
(398)

Symposium 15  Assembly of Photosynthetic Protein Complexes

Symposium 15_01  On the Localization of the Synthesis of Photosynthetic Proteins  
James Uniacke, Oussama Rifai, Matthew Peters, Marco Schottkowski, William Zerges  
(405)

Symposium 15_02  Function of sll1906, a Member of the Bacteriochlorophyll Delivery Family, in the Cyanobacterium *Synechocystis* sp. PCC 6803  
Cheng-I Daniel Yao, Wim Vermaas  
(409)

Symposium 15_03  Functional Analysis of PsbP-Like Protein 1 (PPL1) in Arabidopsis  
Shintaro Matsui, Seiko Ishihara, Kunio Ido, Kentaro Ifuku, Fumihiko Sato  
(415)

Symposium 15_04  Insertion of a Rigid Structural Element into the Regulatory Domain of the Chloroplast F1-ATPase Gamma Subunit for Rotational Studies  
Stephanie C Bishop, Shyam Mehta, Kim K Colvert, Daxin Zheng, Mark L Richter, Cindy L Berrie, Fei Gao  
(418)

Symposium 15_05  Functional Analysis of PsbR in PsbP Binding to Photosystem II  
Kunio Ido, Kentaro Ifuku, Fumihiko Sato  
(423)

Symposium 15_06  Functional Analysis of the Nitrogenase-Like Protochlorophyllide Reductase Encoded in Chloroplast Genome Using Cyanobacterium *Leptolyngbya Boryana*  
Haruki Yamamoto, Shohei Kurumiya, Rie Ohashi, Yuichi Fujita  
(427)

Symposium 15_07  Solution Structure and Physiological Requirements for Psb27 in *Synechocystis* sp. PCC 6803  
Peter D Mabbitt, Gilles J Rautureau, Catherine L Day, Mark G Hinds, Sigurd M Wilbanks, Julian J Eaton-Rye  
(432)

Symposium 15_08  Isolation of Complete Chloroplasts from *Chromera Velia* — the Photosynthetic Relative of Parasitic Apicomplexa  
Hao Pan, Jan Šlapeta, Dee Carter, Min Chen  
(436)

Symposium 16  Photoprotection, Photoinhibition and Dynamics

Symposium 16_01  Inhibition of Lipid Peroxidation by Plastoquinol and Other Prenyllipids  
Jolanta Gruszka, Beatrycze Nowicka, Jerzy Kruk  
(443)

Symposium 16_02  Tenuazonic Acid, a Novel Natural PSII Inhibitor, Impacts on Photosynthetic Activity by Occupying the Qb-Binding Site and Inhibiting Forward Electron Flow  
Shiguo Chen, Reto J Strasser, Sheng Qiang, Govindjee  
(447)

Symposium 16_03  Yellow Vine Syndrome of American Cranberry: a Mechanistic Assessment  
Lien-Yang Chou, Wanshu He, Xuejing Hou, Joy Patel, Aaron Rasposo, Harvey JM Hou  
(451)

Symposium 16_04  Light Acclimation of Triple Inactivation Strain of Group 2 Sigma Factors in *Synechocystis* sp. Strain PCC 6803  
Susanne Rantamäki, Taina Tyystjärvi  
(455)
Symposium 16_05  Gradients of Photoinhibition in the Interior of a Leaf Induced by Photoinhibition Lights of Different Colors

Riichi Oguchi, Peter Dowwwsstra, Takashi Fujita, Wah Soon Chow, Ichiro Terashima (459)

Symposium 16_06  Time-Resolved Fluorescence of Photosystem I in Vivo: Global and Target Analysis

VV Chukhtsina, L Tian, G Ajlani, H van Amerongen (465)

Symposium 16_07  Estimation of the Relative Sizes of the Two NPQ-Associated Dissipations in Rice

Satoshi Ishida, Fumihiko Sato, Tsuyoshi Endo (469)

Symposium 16_08  Molecular Characterization of Thylakoid Membrane-Bound Ascorbate Peroxidase in Oryza Sativa (Rice)

Suqin Zhu, Yanhong Chen, Rong Zhou, Benhua Ji (473)

Symposium 16_09  Effect of Lipids on Violaxanthin and Diadinoxanthin De-Epoxidation

Dariusz Latowski, Susann Schaller, Joanna Grzyb, Reimund Goss, Kazimierz Strzalka (477)

Symposium 16_10  The Electron Transport in psbS-Silenced Rice

Ken-ichi Morita, Satoshi Ishida, Ko Shimamoto, Fumihiko Sato, Tsuyoshi Endo (481)

Symposium 16_11  Photoprotective Function of Foliar Betacyanin in Leaves of Amaranthus Cruentus under Drought Stress

T Nakashima, T Araki, O Ueno (485)

Symposium 16_12  Presence of Flexible Non-Photochemical Quenching in Cryptophytes (Rhodomonas Salina)

Radek Kaňa, Eva Kotabová, Ondřej Prášil (489)

Symposium 16_13  The Slow S to M Fluorescence Rise is Missing in the RpaC Mutant of Synechocystis sp. (PCC 6803)

Radek Kaňa, Ondřej Komárek, Eva Kotabová, George C Papageorgiou, Govindjee, Ondřej Prášil (493)

Symposium 16_14  Significance of Protein Ordering in Grana Thylakoids for Light-Harvesting by Photosystem II and Protein Mobility

Stefanie Tietz, Chris Kinzel, Robert Yarbrough, Helmut Kirchhoff (497)

Symposium 16_15  Moderate Heat Pretreatment Alleviates the Inhibition of Photosystem II Activity Caused by the Response of Cyanobacterial Cells to High Red Light

Zhongxian Lv, Lanzhen Wei, Quanxi Wang, Hualing Mi, Weimin Ma (502)

Symposium 16_16  Ascorbate Alleviates Donor-Side Induced Photoinhibition by Acting as Alternative Electron Donor to Photosystem II

Szilvia Z Tóth, Valéria Nagy, Jos Thomas Puthur; László Kovács, Győző Garab (505)

Symposium 16_17  Involvement of Chlorophyll a Fluorescence Analyses for Identification of Sensitiveness of the Photosynthetic Apparatus to High Temperature in Selected Wheat Genotypes

Marian Brestic, Marek Zivcak, Katarina Olsovska, Jana Repkova (510)

Symposium 16_18  Lichens Assist the Drought-Induced Fluorescence Quenching of Their Photobiont Green Algae Through Arabitol

Makiko Kosugi, Akihisa Miyake, Yasuhiro Kasino, Yutaka Shibata, Kazuhiko Satoh, Shigeru Itoh (514)

Symposium 16_19  FLIM (Fluorescence Lifetime Imaging Microscopy) of Avocado Leaves during Slow Fluorescence Transient (the P to S Decline and the S to M rise)

Yichun Chen, Shizue Matsubara, Rosanna Caliandro, Govindjee, Robert M Clegg (518)

Symposium 16_20  Improving the Photosynthetic Productivity and Light Utilization in Algal Biofuel Systems: Metabolic and Physiological Characterization of a Potentially Advantageous Mutant of Chlamydomonas Reinhardtii

Y Zhou, LC Schideman, Govindjee, SI Rupassara, MJ Seufferheld (523)
Symposium 17  Perception of Environmental Stress and Acclimation

Symposium 17_01  Characterization of Energy Transfer Processes and Flash Oxygen Yields of Thylakoid Membranes Isolated from Resurrection Plant Haberlea Rhodopensis Subjected to Different Extent of Desiccation

*M Velitchkova, D Lazarova, G Mihailova, D Stanoeva, V Dolchinkova, K Georgieva* (531)

Symposium 17_02  Effect of Light on the Photosynthetic Activity during Desiccation of the Resurrection Plant Haberlea Rhodopensis

*Katya Georgieva, Snejana Doncheva, Gergana Mihailova, Snejana Petkova* (536)

Symposium 17_03  Effect of Desiccation of the Resurrection Plant Haberlea Rhodopensis at High Temperature on the Photochemical Activity of PSI and PSII

*Gergana Mihailova, Snejana Petkova, Detelin Stefanov, Katya Georgieva* (540)

Symposium 17_04  Chloroplast Structure under High Light Conditions

*Radoslaw Mazur, Lucja Rudowska, Borys Kierdaszuk, Agnieszka Mostowska, Maciej Garstka* (544)

Symposium 17_05  Effect of Salinity on Chlorophyll Content and Activity of Photosystems of Wheat Genotypes

*Ibrahim Azizov, Mayaxanum Khanisheva, Ulker Ibrahimova* (548)

Symposium 17_06  Identification of Dreb 1 Genes Involved in Drought Tolerance in Wheat (*Triticum* L.)

*Irada M Huseynova, Samira M Rustamova, Alamdar Ch Mammadov* (552)

Symposium 17_07  Detection of Tomato Yellow Leaf Curl Virus in Azerbaijan and Partial Characterization of Biochemical Properties of Naturally Infected Plants

*Irada Huseynova, Alamdar Mammadov, Nargiz Sultanova* (556)

Symposium 17_08  Antioxidant Enzymes and Functional State of PS II in Plants Grown under Various Radium (*226*Ra) Concentrations

*Saftar Y Saleymonov, Konul H Bayramova, Samira M Rustamova, Elmira M Maharamova, Irada M Huseynova* (560)

Symposium 17_09  O-J-I-P Fluorescence Rise Kinetics Reveals Differential Cold Acclimation Capability in Sugarcane Varieties Following Exposure to Frost

*Philippus DR van Heerden* (564)

Symposium 17_10  Antioxidant Defence System and Chloroplasts Photochemical Characteristics of Wheat Genotypes Subjected to Water Stress

*Samira M Rustamova, Hasan H Babayev, Irada M Huseynova* (568)

Symposium 17_11  Phosphorylation of PSII Proteins in Low Light Grown Maize in Response to the Pb Ions

*Wasilewska Wioleta, Zienkiewicz Maksymilian, Fristedt Rikard, Vener V Alexander, Romanowska Elzbieta* (572)

Symposium 17_12  A Potential Function for the γ2 Subunit (atpC2) of the Chloroplast ATP Synthase

*Kaori Kohzuma, Cristina Dal Bosco, Atsuko Kanazawa, David M Kramer, Jörg Meurer* (576)

Symposium 17_13  The Role of *sll1558* and *sll1496* Genes under Acid Stress Conditions in the Cyanobacterium *Synechocystis* sp. PCC 6803

*Mamoru Sambe, Shuichi Kitayama, Atsushi Moriyama, Junji Uchiyama, Hisataka Ohta* (579)

Symposium 17_14  Comparative Photosynthetic Analyses of Three Widely Used *Arabidopsis* Ecotypes

*Lan Yin, Rikard Fristedt, Alexander V Vener, Cornelia Spetea* (583)

Symposium 17_15  Thallium Induces Morphological Changes in the Photosynthetic Apparatus of *Synechocystis* sp. PCC6803

*Motohide Aoki, Hiroe Matsumoto, Tatsuya Takahashi, Kazuya Sato, Hidetoshi Kumata, Kitoao Fujiwara* (586)

Symposium 17_16  The Physiological Role of *Arabidopsis* Thylakoid Phosphate Transporter PHT4;1

*Patrik M Karlsson, Sonia Irigoyen, Wayne K Versaw, Cornelia Spetea* (590)
Symposium 17_17 Involvement of slr0081, a Two-component Signal-Transduction System Response Regulator, in Acid Stress Tolerance in Synechocystis sp. PCC 6803

Yu Tanaka, Mayuko Kimura, Atsushi Moriyama, Yuko Kubo, Mamoru Sambe, Junji Uchiyama, Hisataka Ohta

Symposium 17_18 Characterization of the ABC Transporter Gene slr1045 Involved in Acid-Stress Tolerance of Synechocystis sp. PCC 6803

Hiroko Tahara, Sachiko Fukai, Mamoru Sambe, Miho Kobayashi, Junji Uchiyama, Hisataka Ohta

Symposium 17_19 PsbO Degradation by Deg Proteases under Reducing Conditions

Irma N Roberts, Helder Miranda, Lâm Xuân Tâm, Thomas Kieselbach, Christine Funk

Symposium 17_20 Methylmethionine (Vitamin U) Alleviates Negative Effects of Chemical Stressors on Photosynthesis of the Green Alga Scenedesmus Opolensis

Laszlo Fodorpataki, Zsolt Gy Keresztes, Csaba Bartha, Attila L Marton, Szabolcs Barna

Symposium 17_21 Effect of Ozone on Photosynthesis and Seed Yield of Sensitive (S156) and Resistant (R123) Phaseolus Vulgaris L. Genotypes in Open-Top Chambers

Cornelius CW Scheepers, Reto J Strasser, Gert HJ Krüger

Symposium 17_22 SO2-Drought Interaction on Crop Yield, Photosynthesis and Symbiotic Nitrogen Fixation in Soybean (Glycine Max)

Heyneke E, Strauss AJ, Van Heerden PDR, Strasser RJ, Krüger GHJ

Symposium 17_23 UDP-Glucose Pyrophosphorylase Responsible for Sulfolipid Synthesis in a Green Alga Chlamydomonas Reinhardtii

Atsushi Sato, Koichi Sugimoto, Mikio Tsuzuki, Norihiro Sato

Symposium 17_24 Essential Role of Diganalactosyldiacylglycerol for Photosynthetic Growth in Synechocystis sp. PCC 6803 under High-Temperature Stress

Naoki Mizusawa, Shinya Sakata, Isamu Sakurai, Hisako Kubota, Naoki Sato, Hajime Wada

Symposium 17_25 De Novo Biosynthesis of Fatty Acids is Important for Maintenance of Photochemical Activity under Low Temperature Environments in Arabidopsis

Tsuneaki Takami, Masaru Shibata, Yoshichika Kobayashi, Toshiharu Shikanai

Symposium 17_26 Critical Temperature Derived from the Selected Chlorophyll a Fluorescence Parameters of Indigenous Vegetable Species of South Africa Treated with High Temperature

Marek Zivcak, Katarina Olsovska, Marian Brestic, Margaretha M Slabbert

Symposium 17_27 Photosynthetic Characteristics of Arctic Plants

Yameng Li, Yuxin Jiao, Qi Zhao

Symposium 17_28 The Evolution of Far-Red Light Perception in Acaryochloris Marina, a Chlorophyll d-Containing Cyanobacterium

Zane Duxbury, Robert D Willows, Penelope M Smith, Min Chen

Symposium 17_29 Effects of Ultraviolet-B Radiation on Primary Photophysical Process in Photosystem II: a Fluorescence Spectrum Analysis

Liu Xiao, Yue Ming, Ji Qianru, He Junfang

Symposium 17_30 Shape-Changes of the Fast Chlorophyll a Fluorescence Transient (OJIP) and Antioxidative Enzymes in High Salt Tolerant Mangrove Trees of Bruguiera Gymnorhiza

Ananth Bandhu Das, Reto J Strasser, Girish Kumar Rasineni, Prasanna Mohanty

Symposium 17_31 Knock-Out of Low CO2-Induced slr0006 Gene in Synechocystis sp. PCC 6803: Consequences on Growth and Proteome

Dalton Carmel, Natalia Battchikova, Maija Holmström, Paula Mulo, Eva Mari Aro

Symposium 17_32 Acid Stress Responsive Genes, slr0967 and sll0939, are Directly Involved in Low-pH Tolerance of Cyanobacterium Synechocystis sp. PCC6803

Hisataka Ohta, Yuta Kobayashi, Atsushi Moriyama, Yuko Kubo, Mamoru Sambe, Yousuke Shibata, Yohei Haseyama, Yuka Yoshino, Junji Uchiyama.
Symposium 17_33  Studies on the Effects of N and P on the Competition of Flaveria Bidentis (L.) Kunt and Chenopodium Album (L.) Grew
Qing Yang, Xuemin Guan, Yanfang Liu, Aiying Guo, Ru Long, Fengjuan Zhang  (663)

Symposium 18  Organelle Communication
Symposium 18_01  A Novel Link between Chloroplast Development and Stress Response Lessoned by Leaf-Variegated Mutant
Wataru Sakamoto, Eiko Miura, Yusuke Kato  (669)
Symposium 18_02  The Role of Plant-Specific PPR Proteins in Chloroplast RNA Editing
Kenji Okuda, Toshiharu Shikanai  (674)

Symposium 19  Marine Photosynthesis and Global Impact
Symposium 19_01 The Role of tRNAs in Cyanophages
Limor-Waisberg Keren, Carmi Asaf, Scherz Avigdor, Pilpel Yitzhak, Furman Itay.  (681)
Symposium 19_02  Newly Isolated Chl d-Containing Cyanobacteria
Yaqiong Li, Anthony Larkum, Martin Schliep, Michael Kühl, Brett Neilan, Min Chen  (686)
Symposium 19_03  How do Enzyme Dynamics Influence Rubisco Activity?
F Grant Pearce  (691)

Symposium 20  Crop Yield Improvement
Symposium 20_01 Photosynthesis, Photorespiration and Productivity of Wheat Genotypes (Triticum L.)
Jalal A Aliyev  (697)
Symposium 20_02  Response of Chlorophyll Fluorescence Parameters of Illicium Lanceolatum to Different Light Conditions
Yonghui Cao, Benzhi Zhou, Rumin Zhang, Lianhong Gu  (702)
Symposium 20_03  Effects of Elevated Root-Zone CO₂ and Root-Zone Temperature on Productivity and Photosynthesis of Aeroponically Grown Lettuce Plants
Jie He, Lin Qin, Sing Kong Lee  (707)
Symposium 20_04  Comparative Nitrogen Allocation and Partitioning of Field-Grown Gossypium Hirsutum and G. Barbadense
Yali Zhang, Yuanyuan Hu, Honghai Luo, Wangfeng Zhang  (712)
Symposium 20_05  Photosynthetic Performance of Maize Subjected to Low Temperatures
Soni S Mulakupadam, Saul Otero, Gary Lanigan, Bruce Osborne  (716)
Symposium 20_06  Stereochemical Control of Asymmetric Reduction by Deleting an Alcohol Gehydrogenase Gene of a Cyanobacterium
Hisataka Ohta, Kenjro Suzuki, Tetsuo Takemura, Kaori Akiyama, Nobuaki Umeno, Yukiko Tamai, Kaoru Nakamura  (722)
Symposium 20_07  The Different Photoprotective Mechanisms of Various Green Organs in Cotton (Gossypium Hirsutum L.)
Yuanyuan Hu, Yali Zhang, Honghai Luo, Wah Soon Chow, Wangfeng Zhang  (726)

Symposium 21  Microbial Derived Biofuels
Symposium 21_01 Functioning of the Bidirectional Hydrogenase in Different Unicellular Cyanobacteria
Éva Kiss, Péter B Kós, Min Chen, Imre Vass  (733)
Symposium 21_02 Lessons from Energy Balances for the Production Strategies of Biofuels
Christian Wilhelm, Torsten Jakob, Uwe Langner, Katja Stehfest, Heiko Wagner (737)

Symposium 21_03 Improvement of Nitrogenase-Based Photobiological Hydrogen Production by Cyanobacteria by Gene Engineering — Genetic Engineering and Culture Conditions towards Improved photobiological Hydrogen Production by Cyanobacteria
Hidehiro Sakurai, Masaharu Kitashima, Hajime Masukawa, Kazuhiro Inoue (741)

Symposium 21_04 Phycobilisome Antenna Deletion in a Cyanobacterium does Not Improve Photosynthetic Energy Conversion Efficiency or Productivity in a Bench-Scale Photobioreactor System
Lawrence E Page, Michelle Liberton, Hanayo Sato, Himadri B Pakrasi (744)

Symposium 22 Photosynthesis and New Environmental Challenges

Symposium 22_01 Measurement of Mesophyll Conductance in Tobacco, Arabidopsis and Wheat Leaves with Tunable Diode Laser Absorption Spectroscopy
Youshi Tazoe, Susanne von Caemmerer, John R Evans (751)

Symposium 22_02 Influence of Enhanced Ultraviolet-B Radiation on Photosynthesis in Flag Leaves of a Super-High-Yield Hybrid Rice during Senescence
Meiping Zhang, Guoxiang Chen (756)

Symposium 22_03 Effect of Exposure to UVA Radiation on Photosynthesis and Isoprene Emission in Populus x Euroamericana
Emanuele Pallozzi, Giovanni Marino, Alessio Fortunati, Francesco Loreto, Mauro Centritto (763)

Symposium 22_04 Effects of Salt Stress on Photosystem II Efficiency and CO2 Assimilation in Two Syrian Barley Landraces
Hazem M Kalaji, Govindjee, Karolina Bosa, J amusz Koś cielnia k, Krystyna Żuk-Gó laszewska (768)

Symposium 22_05 The Effects of Antisense Suppression of δ Subunit of Chloroplast ATP Synthase on the Rates of Chloroplast Electron Transport and CO2 Assimilation in Transgenic Tobacco
Wataru Yamori, Shunich i Takahashi, Amane Makino, G Dean Price, Murray R Badger, Susanne von Caemmerer (773)

Symposium 22_06 The Effects of Elevated CO2 Concentration on Photosynthesis and Photosystem II Photochemistry in a Fast Growing Tree Species, Gmelina Arborea Roxb
Girish K Rasineni, Attipalli R Reddy (777)

Symposium 22_07 Influence of Elevated CO2 Concentration on Photosynthesis and Biomass Yields in a Tree Species, Gmelina Arborea Roxb
Girish K Rasineni, Attipalli R Reddy (781)

Symposium 23 Global Photosynthesis and Climate Change

Symposium 23_01 The Effect of Mineral Nutrition on Photostnthetic Activity and Saponin Content of Puncture Vine (Tribulus Terrestris L.)
Georgi I Georgiev, Liliana Maslenkova, Antoaneta Ivanova, Luba Evstatieva, Albena Ivanova, Lozanka Popova (789)

Symposium 23_02 Chlorophyll d Production in Crushed Algae in Aqueous Acetone
Shinya Akutsu, Shingo Itoh, Keisuke Aoki, Hayato Furukawa, Hideaki Miyashita, Koji Iwamoto, Yoshihiro Shiraiwa, Masaaki Okuda, Masami Kobayashi (794)

Symposium 23_03 Conversion of Chl a into Chl d by Horseradish Peroxidase
Hayato Furukawa, Keisuke Aoki, Shingo Itoh, Yasuhiro Abe, Masataka Nakazato, Koji Iwamoto, Yoshihiro Shiraiwa, Hideaki Miyashita, Masaaki Okuda, Masami Kobayashi (799)
Symposium 23_04  Novel Conversion of Chl \(a\) into Chl \(d\) Catalyzed by Grated Vegetables

Shingo Itoh, Keisuke Aoki, Masataka Nakazato, Koji Iwamoto, Yoshihiro Shiraiwa, Hideaki Miyashita, Masaaki Okuda, Masami Kobayashi (804)

Symposium 23_05  Nonenzymatic Formation of Chl \(d\) from Chl \(a\) with Hydrogen Peroxide

Keisuke Aoki, Shingo Itoh, Hayato Furukawa, Masataka Nakazato, Koji Iwamoto, Yoshihiro Shiraiwa, Hideaki Miyashita, Masaaki Okuda, Masami Kobayashi (808)

Symposium 23_06  Winter Photosynthesis of Evergreen Broadleaf Trees from a Montane Cloud Forest in Subtropical China

Yongjiang Zhang, Kunfang Cao, Guillermo Goldstein (812)

Symposium 23_07  The Photosynthetic Surface Area of Apple Trees

Krzysztof Tokarz, Jan Pilarski, Maciej Kocurek (818)

Symposium 24  Photosynthesis Education

Symposium 24_01  Evolution of the Z-Scheme of Electron Transport in Oxygenic Photosynthesis

Govindjee, Lars Olof Björn, Kärin Nickelsen (827)

Symposium 24_02  The Golden Apples of the Sun: the History of Photosynthesis — so Far

Anthony WD Larkum (834)

Author Index ........................................................................................................................................................................(841)