

The electronic form of this issue, available as of September 12, 2011, at www.plantphysiol.org, is considered the journal of record.

On the Cover: Chloroplasts play vital roles in photosynthesis and various other metabolic processes, and their development depends on the import of thousands of nucleus-encoded proteins from the cytosol. The chloroplast β -barrel proteins Toc75 (Translocon at the outer envelope membrane of chloroplasts, 75 kD) and OEP80 (Outer Envelope Protein, 80 kD) are both members of the Omp85 superfamily, whose constituents are ubiquitously distributed in the outer membranes of gram-negative bacteria and mitochondria as well as in plastids. Toc75 functions as a translocation channel during chloroplast protein import, whereas the role of OEP80 remains uncertain. Both proteins are essential because *Arabidopsis thaliana* knockout mutants abort during embryogenesis, a fact that has, until now, precluded functional, in vivo studies in plants. In this issue, Huang et al. (147–159) describe the use of dexamethasone-inducible RNA interference to circumvent this problem by silencing the expression of the proteins in *Arabidopsis* plants. The results reveal that both proteins are important for the normal development of chloroplasts and nonphotosynthetic plastids during postembryonic growth. Similarities between the Toc75 and OEP80 knockdown phenotypes, together with the observation that Toc75 levels are reduced in OEP80-silenced plants, suggest that OEP80 may be important for the biogenesis of Toc75 and possibly other outer membrane β -barrel proteins, as has been proposed previously. In this scenario, OEP80's function would be analogous to those of other Omp85-related proteins in bacteria and mitochondria. The left side of the cover image shows wild-type (top) and Toc75 knockdown (bottom) plants growing on dexamethasone-containing medium, whereas the right side shows corresponding transmission electron micrographs of typical chloroplasts in the two genotypes. Cover design and images by Qihua Ling, Weihua Huang, Natalie Allcock, Stefan Hyman, and Paul Jarvis.

ON THE INSIDE

Peter V. Minorsky

1

UPDATES

^[W]Brachypodium as a Model for the Grasses: Today and the Future. Jelena Brkljacic, Erich Grotewold, Randy Scholl, Todd Mockler, David F. Garvin, Philippe Vain, Thomas Brutnell, Richard Sibout, Michael Bevan, Hikmet Budak, Ana L. Caicedo, Caixia Gao, Yong Gu, Samuel P. Hazen, Ben F. Holt III, Shin-Young Hong, Mark Jordan, Antonio J. Manzaneda, Thomas Mitchell-Olds, Keiichi Mochida, Luis A.J. Mur, Chung-Mo Park, John Sedbrook, Michelle Watt, Shao Jian Zheng, and John P. Vogel

3

GENOME ANALYSIS

^{[W][OA]}A White Spruce Gene Catalog for Conifer Genome Analyses. Philippe Rigault, Brian Boyle, Pierre Lepage, Janice E.K. Cooke, Jean Bousquet, and John J. MacKay

14

BREAKTHROUGH TECHNOLOGIES

^{[W][OA]}A Novel Image-Analysis Toolbox Enabling Quantitative Analysis of Root System Architecture. Guillaume Lobet, Loïc Pagès, and Xavier Draye

29

RESEARCH ARTICLES

BIOCHEMICAL PROCESSES AND MACROMOLECULAR STRUCTURES

^{[C][W][OA]}A Novel Isoform of Sucrose Synthase Is Targeted to the Cell Wall during Secondary Cell Wall Synthesis in Cotton Fiber. Elizabeth Brill, Michel van Thournout, Rosemary G. White, Danny Llewellyn, Peter M. Campbell, Steven Engelen, Yong-Ling Ruan, Tony Arioli, and Robert T. Furbank

40

Continued on next page

[W][OA]	Analysis of a Range of Catabolic Mutants Provides Evidence That Phytanoyl-Coenzyme A Does Not Act as a Substrate of the Electron-Transfer Flavoprotein/Electron-Transfer Flavoprotein:Ubiquinone Oxidoreductase Complex in Arabidopsis during Dark-Induced Senescence. Wagner L. Araújo, Kimitsune Ishizaki, Adriano Nunes-Nesi, Takayuki Tohge, Tony R. Larson, Ina Krahnert, Ilse Balbo, Sandra Witt, Peter Dörmann, Ian A. Graham, Christopher J. Leaver, and Alisdair R. Fernie	55
[W]	The Cytosolic Kinases STY8, STY17, and STY46 Are Involved in Chloroplast Differentiation in Arabidopsis. Giorgia Lamberti, Irene L. Gügel, Jörg Meurer, Jürgen Soll, and Serena Schwenkert	70
[C][W][OA]	Synthesis of Hydroxylated Sterols in Transgenic Arabidopsis Plants Alters Growth and Steroid Metabolism. Lisa Beste, Nurun Nahar, Kerstin Dalman, Shozo Fujioka, Lisbeth Jonsson, Paresh C. Dutta, and Folke Sitbon	426
[C][W][OA]	Subfunctionalization of Cellulose Synthases in Seed Coat Epidermal Cells Mediates Secondary Radial Wall Synthesis and Mucilage Attachment. Venugopal Mendu, Jonathan S. Griffiths, Staffan Persson, Jozsef Stork, A. Bruce Downie, Cătălin Voiniciuc, George W. Haughn, and Seth DeBolt	441
[W][OA]	A Peroxygenase Pathway Involved in the Biosynthesis of Epoxy Fatty Acids in Oat. Dauenpen Meesapyodsuk and Xiao Qiu	454
[C][W][OA]	Purification and Biochemical Characterization of a Novel Ecto-Apyrase, MP67, from <i>Mimosa pudica</i> . Riku Okuhata, Takeshi Takishima, Naoaki Nishimura, Shogo Ueda, Takahide Tsuchiya, and Nobuyuki Kanzawa	464
BIOENERGETICS AND PHOTOSYNTHESIS		
[W]	Experimental Evidence of Phosphoenolpyruvate Resynthesis from Pyruvate in Illuminated Leaves. Guillaume Tcherkez, Aline Mahé, Edouard Boex-Fontvoille, Elisabeth Gout, Florence Guérard, and Richard Bligny	86
[W][OA]	Functional Analysis of Two Isoforms of Leaf-Type Ferredoxin-NADP ⁺ -Oxidoreductase in Rice Using the Heterologous Expression System of Arabidopsis. Mieko Higuchi-Takeuchi, Takanari Ichikawa, Youichi Kondou, Keiko Matsui, Yukako Hasegawa, Mika Kawashima, Kintake Sonoike, Masaki Mori, Hirohiko Hirochika, and Minami Matsui	96
[W]	Impaired Function of the Tonoplast-Localized Sucrose Transporter in Rice, OsSUT2, Limits the Transport of Vacuolar Reserve Sucrose and Affects Plant Growth. Joon-Seob Eom, Jung-Il Cho, Anke Reinders, Sang-Won Lee, Youngchul Yoo, Pham Quoc Tuan, Sang-Bong Choi, Geul Bang, Youn-Il Park, Man-Ho Cho, Seong Hee Bhoo, Gynheung An, Tae-Ryong Hahn, John M. Ward, and Jong-Seong Jeon	109
[C][W][OA]	Enhancing Arabidopsis Leaf Growth by Engineering the BRASSINOSTEROID INSENSITIVE1 Receptor Kinase. Man-Ho Oh, Jindong Sun, Dong Ha Oh, Raymond E. Zielinski, Steven D. Clouse, and Steven C. Huber	120
CELL BIOLOGY AND SIGNAL TRANSDUCTION		
[W][OA]	Small Heat Shock Protein Hsp17.8 Functions as an AKR2A Cofactor in the Targeting of Chloroplast Outer Membrane Proteins in Arabidopsis. Dae Heon Kim, Zheng-Yi Xu, Yun Jeong Na, Yun-Joo Yoo, Junho Lee, Eun-Ju Sohn, and Inhwan Hwang	132
[W][OA]	In Vivo Analyses of the Roles of Essential Omp85-Related Proteins in the Chloroplast Outer Envelope Membrane. Weihua Huang, Qihua Ling, Jocelyn Bédard, Kathryn Lilley, and Paul Jarvis	147
[C][W][OA]	Growth Arrest by Trehalose-6-Phosphate: An Astonishing Case of Primary Metabolite Control over Growth by Way of the SnRK1 Signaling Pathway. Thierry L. Delatte, Prapti Sedijani, Youichi Kondou, Minami Matsui, Gerhardus J. de Jong, Govert W. Somsen, Anika Wiese-Klinkenberg, Lucia F. Primavesi, Matthew J. Paul, and Henriette Schlupepmann	160
[W][OA]	Propidium Iodide Competes with Ca ²⁺ to Label Pectin in Pollen Tubes and Arabidopsis Root Hairs. Caleb M. Rounds, Eric Lubeck, Peter K. Hepler, and Lawrence J. Winship	175
[C][W]	Mechanisms of Molecular Mimicry of Plant CLE Peptide Ligands by the Parasitic Nematode <i>Globodera rostochiensis</i> . Yongfeng Guo, Jun Ni, Robert Denver, Xiaohong Wang, and Steven E. Clark	476
DEVELOPMENT AND HORMONE ACTION		
[W][OA]	Abscisic Acid Plays an Important Role in the Regulation of Strawberry Fruit Ripening. Hai-Feng Jia, Ye-Mao Chai, Chun-Li Li, Dong Lu, Jing-Jing Luo, Ling Qin, and Yuan-Yue Shen	188

[W]Perturbation of Polyamine Catabolism Can Strongly Affect Root Development and Xylem Differentiation. *Alessandra Tisi, Rodolfo Federico, Sandra Moreno, Sergio Lucretti, Panagiotis N. Moschou, Kalliopi A. Roubelakis-Angelakis, Riccardo Angelini, and Alessandra Cona* 200

[W][OA]Rice Ethylene-Response AP2/ERF Factor OsEATB Restricts Internode Elongation by Down-Regulating a Gibberellin Biosynthetic Gene. *Weimei Qi, Fan Sun, Qianjie Wang, Mingluan Chen, Yunqing Huang, Yu-Qi Feng, Xiaojin Luo, and Jinshui Yang* 216

ENVIRONMENTAL STRESS AND ADAPTATION TO STRESS

[C][W][OA]Inositol Polyphosphate 5-Phosphatase7 Regulates the Production of Reactive Oxygen Species and Salt Tolerance in Arabidopsis. *Yuval Kaye, Yael Golani, Yaniv Singer, Yehoram Leshem, Gil Cohen, Mustafa Ercetin, Glenda Gillaspay, and Alex Levine* 229

[C][W][OA]The SINA E3 Ligase OsDIS1 Negatively Regulates Drought Response in Rice. *Yuese Ning, Chachawan Jantasuriyarat, Qingzhen Zhao, Huawei Zhang, Songbiao Chen, Jinling Liu, Lijing Liu, Sanyuan Tang, Chan Ho Park, Xuejun Wang, Xionglun Liu, Liangying Dai, Qi Xie, and Guo-Liang Wang* 242

[W][OA]Perturbations of Amino Acid Metabolism Associated with Glyphosate-Dependent Inhibition of Shikimic Acid Metabolism Affect Cellular Redox Homeostasis and Alter the Abundance of Proteins Involved in Photosynthesis and Photorespiration. *Pedro Diaz Vivancos, Simon P. Driscoll, Christopher A. Bulman, Liu Ying, Kaveh Emami, Achim Treumann, Caroline Mauve, Graham Noctor, and Christine H. Foyer* 256

[W][OA]OsPHF1 Regulates the Plasma Membrane Localization of Low- and High-Affinity Inorganic Phosphate Transporters and Determines Inorganic Phosphate Uptake and Translocation in Rice. *Jieyu Chen, Yu Liu, Jun Ni, Yifeng Wang, Youhuang Bai, Jing Shi, Jian Gan, Zhongchang Wu, and Ping Wu* 269

[C][W][OA]Characterization of the Phosphate Starvation-Induced *Glycerol-3-phosphate permease* Gene Family in Arabidopsis. *Madhuvanathi Ramaiah, Ajay Jain, James C. Baldwin, Athikkattuvalasu S. Karthikeyan, and Kashchandra G. Raghothama* 279

[W][OA]Essential Role of Tissue-Specific Proline Synthesis and Catabolism in Growth and Redox Balance at Low Water Potential. *Sandeep Sharma, Joji Grace Villamor, and Paul E. Verslues* 292

[C][W][OA]Functional and Expressional Analyses of *PmDAM* Genes Associated with Endodormancy in Japanese Apricot. *Ryuta Sasaki, Hisayo Yamane, Tomomi Ooka, Hiroaki Jotatsu, Yuto Kitamura, Takashi Akagi, and Ryutaro Tao* 485

PLANTS INTERACTING WITH OTHER ORGANISMS

[C]The Jasmonate Pathway Is a Key Player in Systemically Induced Defense against Root Knot Nematodes in Rice. *Kamrun Nahar, Tina Kyndt, David De Vleeschauwer, Monica Höfte, and Godelieve Gheysen* 305

[W][OA]Benzoxazinoid Metabolites Regulate Innate Immunity against Aphids and Fungi in Maize. *Shakoor Ahmad, Nathalie Veyrat, Ruth Gordon-Weeks, Yuhua Zhang, Janet Martin, Lesley Smart, Gaétan Glauser, Matthias Erb, Victor Flors, Monika Frey, and Jurriaan Ton* 317

[C][W][OA]The *ROOT DETERMINED NODULATION1* Gene Regulates Nodule Number in Roots of *Medicago truncatula* and Defines a Highly Conserved, Uncharacterized Plant Gene Family. *Elise L. Schnabel, Tessema K. Kassaw, Lucinda S. Smith, John F. Marsh, Giles E. Oldroyd, Sharon R. Long, and Julia A. Frugoli* 328

[W][OA]Ectopic Expression of *AtJMT* in *Nicotiana attenuata*: Creating a Metabolic Sink Has Tissue-Specific Consequences for the Jasmonate Metabolic Network and Silences Downstream Gene Expression. *Michael Stitz, Klaus Gase, Ian T. Baldwin, and Emmanuel Gaquerel* 341

[W][OA]Biphasic Gene Expression Changes Elicited by *Phakopsora pachyrhizi* in Soybean Correlate with Fungal Penetration and Haustoria Formation. *Katherine T. Schneider, Martijn van de Mortel, Timothy J. Bancroft, Edward Braun, Dan Nettleton, Rex T. Nelson, Reid D. Frederick, Thomas J. Baum, Michelle A. Graham, and Steven A. Whitham* 355

WHOLE PLANT AND ECOPHYSIOLOGY

- ^[OA]Responses of Legume Versus Nonlegume Tropical Tree Seedlings to Elevated CO₂ Concentration. Lucas A. Cernusak, Klaus Winter, Carlos Martínez, Edwin Correa, Jorge Aranda, Milton Garcia, Carlos Jaramillo, and Benjamin L. Turner 372
- ^[W]Investigating the Contribution of the Phosphate Transport Pathway to Arsenic Accumulation in Rice. Zhongchang Wu, Hongyan Ren, Steve P. McGrath, Ping Wu, and Fang-Jie Zhao 498
- ^[OA]Association between Carbonyl Sulfide Uptake and ¹⁸Δ during Gas Exchange in C₃ and C₄ Leaves. Keren Stimler, Joseph A. Berry, Steve A. Montzka, and Dan Yakir 509

SYSTEMS BIOLOGY, MOLECULAR BIOLOGY, AND GENE REGULATION

- ^[W]Intracompartamental and Intercompartmental Transcriptional Networks Coordinate the Expression of Genes for Organellar Functions. Dario Leister, Xi Wang, Georg Haberer, Klaus F.X. Mayer, and Tatjana Kleine 386
- ^{[W][OA]}Systems Biology of Tomato Fruit Development: Combined Transcript, Protein, and Metabolite Analysis of Tomato Transcription Factor (*nor*, *rin*) and Ethylene Receptor (*Nr*) Mutants Reveals Novel Regulatory Interactions. Sonia Osorio, Rob Alba, Cynthia M.B. Damasceno, Gloria Lopez-Casado, Marc Lohse, Maria Inés Zanor, Takayuki Tohge, Björn Usadel, Jocelyn K.C. Rose, Zhangjun Fei, James J. Giovannoni, and Alisdair R. Fernie 405
- ^{[W][OA]}Plastid-to-Nucleus Retrograde Signals Are Essential for the Expression of Nuclear Starch Biosynthesis Genes during Amyloplast Differentiation in Tobacco BY-2 Cultured Cells. Kazuhiko Enami, Tomoki Ozawa, Noriko Motohashi, Masayuki Nakamura, Kan Tanaka, and Mitsumasa Hanaoka 518

CORRECTIONS

- Broad-Spectrum Suppression of Innate Immunity Is Required for Colonization of Arabidopsis Roots by the Fungus *Piriformospora indica*. S. Jacobs, B. Zechmann, A. Molitor, M. Trujillo, E. Petutschnig, V. Lipka, K.-H. Kogel, and P. Schäfer 531

^[C] Some figures in this article are displayed in color online but in black and white in the print edition.

^[W] Indicates Web-only data.

^[OA] Open Access articles can be viewed online without a subscription.