

The electronic form of this issue, available as of October 11, 2012, at [www.plantphysiol.org](http://www.plantphysiol.org), is considered the journal of record.

**On the Cover:** Wheat (*Triticum aestivum*) is one of the world's most popular staple foods. It is also increasingly being used as an animal feed and in biofuel production. As the global demand for wheat is expected to almost double by 2050, there is an urgent need to increase wheat productivity through targeted improvement of agronomic traits such as nutrient use efficiency, water use efficiency, resistance to abiotic stress, and resistance to pests and pathogens. In this issue, Lee et al. (pp. 582–590) provide an update on a suite of *Barley stripe mosaic virus* (BSMV)-derived functional genomic tools for the rapid identification and functional characterization of genes in wheat and other important cereal crops or in cereal-associated organisms, which play important roles in key traits and ultimately contribute to crop productivity. One of these tools, called Virus-induced gene silencing (VIGS), is increasingly being used for functional assessment of plant genes expressed in leaves, roots, and flower/seed tissues. The cover image shows the developing preanthesis ear of a wheat plant infected with the BSMV vector carrying a fragment of the wheat *phytoene desaturase* (*PDS*) gene. Down-regulation (i.e. silencing) of *PDS* expression, a gene involved in biosynthesis of photoprotective carotenoid pigments, resulted in a characteristic photobleaching of many spikelets and awns. Photo credit: Wing-Sham Lee and Kostya Kanyuka.

## ON THE INSIDE

Peter V. Minorsky 569

## UPDATES

Plastid Proteostasis and Heterologous Protein Accumulation in Transplastomic Plants. *Francesca De Marchis, Andrea Pompa, and Michele Bellucci* 571

Barley Stripe Mosaic Virus-Mediated Tools for Investigating Gene Function in Cereal Plants and Their Pathogens: Virus-Induced Gene Silencing, Host-Mediated Gene Silencing, and Virus-Mediated Overexpression of Heterologous Protein. *Wing-Sham Lee, Kim E. Hammond-Kosack, and Kostya Kanyuka* 582

## BREAKTHROUGH TECHNOLOGIES

<sup>[C][W][OA]</sup>Fast Isogenic Mapping-by-Sequencing of Ethyl Methanesulfonate-Induced Mutant Bulks. *Benjamin Hartwig, Geo Velikkakam James, Kathryn Konrad, Korbinian Schneeberger, and Franziska Turck* 591

<sup>[W]</sup>RNA Silencing Induced by an Artificial Sequence That Prevents Proper Transcription Termination in Rice. *Taiji Kawakatsu, Yuhya Wakasa, Hiroshi Yasuda, and Fumio Takaiwa* 601

## BIOINFORMATICS

<sup>[C][W]</sup>Systematic Prediction of cis-Regulatory Elements in the *Chlamydomonas reinhardtii* Genome Using Comparative Genomics. *Jun Ding, Xiaoman Li, and Haiyan Hu* 613

## RESEARCH ARTICLES

### BIOCHEMICAL PROCESSES AND MACROMOLECULAR STRUCTURES

<sup>[C][W]</sup>Plasma Membrane Localization of *Solanum tuberosum* Remorin from Group 1, Homolog 3 Is Mediated by Conformational Changes in a Novel C-Terminal Anchor and Required for the Restriction of Potato Virus X Movement. *Artemis Perraki, Jean-Luc Cacas, Jean-Marc Crowet, Laurence Lins, Michel Castroviejo, Sylvie German-Retana, Sébastien Mongrand, and Sylvain Raffaele* 624

<sup>[W][OA]</sup>A Land-Plant-Specific Glycerol-3-Phosphate Acyltransferase Family in Arabidopsis: Substrate Specificity, *sn-2* Preference, and Evolution. *Weili Yang, Jeffrey P. Simpson, Yonghua Li-Beisson, Fred Beisson, Mike Pollard, and John B. Ohlrogge* 638

Continued on next page

- [W]Structural Characterization of Arabidopsis Leaf Arabinogalactan Polysaccharides. *Theodora Tryfona, Hui-Chung Liang, Toshihisa Kotake, Yoichi Tsumuraya, Elaine Stephens, and Paul Dupree* 653
- [W][OA]A Bifunctional Enzyme That Has Both Monoacylglycerol Acyltransferase and Acyl Hydrolase Activities. *Panneerselvam Vijayaraj, Charnitkaur B. Jashal, Anitha Vijayakumar, Sapa Hima Rani, D.K. Venkata Rao, and Ram Rajasekharan* 667
- BIOENERGETICS AND PHOTOSYNTHESIS**
- [W][OA]Antisense Reduction of NADP-Malic Enzyme in *Flaveria bidentis* Reduces Flow of CO<sub>2</sub> through the C<sub>4</sub> Cycle. *Jasper J.L. Pengelly, Jackie Tan, Robert T. Furbank, and Susanne von Caemmerer* 1070
- CELL BIOLOGY AND SIGNAL TRANSDUCTION**
- [W][OA]A Chimeric Arabinogalactan Protein Promotes Somatic Embryogenesis in Cotton Cell Culture. *Simon Poon, Robyn Louise Heath, and Adrienne Elizabeth Clarke* 684
- [C][W]The Rice Wall-Associated Receptor-Like Kinase Gene *OsDEES1* Plays a Role in Female Gametophyte Development. *Na Wang, Hui-Jia Huang, Su-Ting Ren, Jiao-Jiao Li, Ying Sun, Da-Ye Sun, and Su-Qiao Zhang* 696
- [W]Proteomic Analysis of Chloroplast-to-Chromoplast Transition in Tomato Reveals Metabolic Shifts Coupled with Disrupted Thylakoid Biogenesis Machinery and Elevated Energy-Production Components. *Cristina Barsan, Mohamed Zouine, Elie Maza, Wanping Bian, Isabel Egea, Michel Rossignol, David Bouyssie, Carole Pichereaux, Eduardo Purgatto, Mondher Bouzayen, Alain Latché, and Jean-Claude Pech* 708
- [C][W]Complexes with Mixed Primary and Secondary Cellulose Synthases Are Functional in Arabidopsis Plants. *Andrew Carroll, Nasim Mansoori, Shundai Li, Lei Lei, Samantha Vernhettes, Richard G.F. Visser, Chris Somerville, Ying Gu, and Luisa M. Trindade* 726
- DEVELOPMENT AND HORMONE ACTION**
- [C][W][OA]Dissecting Functions of *KATANIN* and *WRINKLED1* in Cotton Fiber Development by Virus-Induced Gene Silencing. *Jing Qu, Jian Ye, Yun-Feng Geng, Yan-Wei Sun, Shi-Qiang Gao, Bi-Pei Zhang, Wen Chen, and Nam-Hai Chua* 738
- [C][W][OA]Auxin and Epigenetic Regulation of *SKP2B*, an F-Box That Represses Lateral Root Formation. *Concepción Manzano, Elena Ramirez-Parra, Ilda Casimiro, Sofia Otero, Bénédicte Desvoyes, Bert De Rybel, Tom Beeckman, Pedro Casero, Crisanto Gutierrez, and Juan C. del Pozo* 749
- [W][OA]PIN Auxin Efflux Carriers Are Necessary for Pulse-Induced But Not Continuous Light-Induced Phototropism in Arabidopsis. *Ken Haga and Tatsuya Sakai* 763
- [W][OA]New Insights into Roles of Cell Wall Invertase in Early Seed Development Revealed by Comprehensive Spatial and Temporal Expression Patterns of *GhCWIN1* in Cotton. *Lu Wang and Yong-Ling Ruan* 777
- [C][W]*CHIMERIC FLORAL ORGANS1*, Encoding a Monocot-Specific MADS Box Protein, Regulates Floral Organ Identity in Rice. *Xianchun Sang, Yunfeng Li, Zengke Luo, Deyong Ren, Likui Fang, Nan Wang, Fangming Zhao, Yinghua Ling, Zhenglin Yang, Yongsheng Liu, and Guanghua He* 788
- [C][W][OA]Two Novel RING-Type Ubiquitin Ligases, *RGLG3* and *RGLG4*, Are Essential for Jasmonate-Mediated Responses in Arabidopsis. *Xu Zhang, Qian Wu, Jiao Ren, Wanqiang Qian, Shanping He, Kuowei Huang, XiangChun Yu, Yin Gao, Ping Huang, and Chengcai An* 808
- [C][W][OA]*LONO1* Encoding a Nucleoporin Is Required for Embryogenesis and Seed Viability in Arabidopsis. *Christopher Braud, Wenguang Zheng, and Wenyan Xiao* 823
- [W][OA]Characterization of the Fungal Gibberellin Desaturase as a 2-Oxoglutarate-Dependent Dioxygenase and Its Utilization for Enhancing Plant Growth. *Anjanabha Bhattacharya, Sofia Kourmpetli, Dennis A. Ward, Stephen G. Thomas, Fan Gong, Stephen J. Powers, Esther Carrera, Benjamin Taylor, Francisco Nuñez de Caceres Gonzalez, Bettina Tudzynski, Andrew L. Phillips, Michael R. Davey, and Peter Hedden* 837
- ENVIRONMENTAL STRESS AND ADAPTATION TO STRESS**
- [W][OA]Effects of Drought on Gene Expression in Maize Reproductive and Leaf Meristem Tissue Revealed by RNA-Seq. *Akshay Kakumanu, Madana M.R. Ambavaram, Curtis Klumas, Arjun Krishnan, Utlwang Batlang, Elijah Myers, Ruth Grene, and Andy Pereira* 846

- [C][W]SNF1-Related Protein Kinases Type 2 Are Involved in Plant Responses to Cadmium Stress. Anna Kulik, Anna Anielska-Mazur, Maria Bucholc, Emmanuel Koen, Katarzyna Szymańska, Agnieszka Żmieńko, Ewa Krzywińska, Izabela Wawer, Fionn McLoughlin, Dariusz Ruszkowski, Marek Figlerowicz, Christa Testerink, Aleksandra Skłodowska, David Wendehenne, and Grażyna Dobrowolska 868

## GENETICS, GENOMICS, AND MOLECULAR EVOLUTION

- [W]Expansive Evolution of the TREHALOSE-6-PHOSPHATE PHOSPHATASE Gene Family in Arabidopsis. Lies Vandesteene, Lorena López-Galvis, Kevin Vanneste, Regina Feil, Steven Maere, Willem Lammens, Filip Rolland, John E. Lunn, Nelson Avonce, Tom Beeckman, and Patrick Van Dijck 884

## PLANTS INTERACTING WITH OTHER ORGANISMS

- [W][OA]The SNARE Protein SYP71 Expressed in Vascular Tissues Is Involved in Symbiotic Nitrogen Fixation in *Lotus japonicus* Nodules. Tsuneo Hakoyama, Ryo Oi, Kazuya Hazuma, Eri Suga, Yuka Adachi, Mayumi Kobayashi, Rie Akai, Shusei Sato, Eigo Fukai, Satoshi Tabata, Satoshi Shibata, Guo-Jiang Wu, Yoshihiro Hase, Atsushi Tanaka, Masayoshi Kawaguchi, Hiroshi Kouchi, Yosuke Umehara, and Norio Suganuma 897

- [W][OA]Functional Assessment of the *Medicago truncatula* NIP/LATD Protein Demonstrates That It Is a High-Affinity Nitrate Transporter. Rammyani Bagchi, Mohammad Salehin, O. Sarah Adeyemo, Carolina Salazar, Vladimir Shulaev, D. Janine Sherrier, and Rebecca Dickstein 906

- [W]*Lotus japonicus* ARPC1 Is Required for Rhizobial Infection. Md Shakhawat Hossain, Jinqiu Liao, Euan K. James, Shusei Sato, Satoshi Tabata, Anna Jurkiewicz, Lene H. Madsen, Jens Stougaard, Loretta Ross, and Krzysztof Szczyglowski 917

- [C][W][OA]HSPRO Controls Early *Nicotiana attenuata* Seedling Growth during Interaction with the Fungus *Piriformospora indica*. Stefan Schuck, Iris Camehl, Paola A. Gilardoni, Ralf Oelmueller, Ian T. Baldwin, and Gustavo Bonaventure 929

- [C][W][OA]The Effector SPRYSEC-19 of *Globodera rostochiensis* Suppresses CC-NB-LRR-Mediated Disease Resistance in Plants. Wiebe J. Postma, Erik J. Slootweg, Sajid Rehman, Anna Finkers-Tomczak, Tom O.G. Tytgat, Kasper van Gelderen, Jose L. Lozano-Torres, Jan Roosien, Rikus Pomp, Casper van Schaik, Jaap Bakker, Aska Goverse, and Geert Smant 944

- [C][W]Nitric Oxide-Mediated Maintenance of Redox Homeostasis Contributes to NPR1-Dependent Plant Innate Immunity Triggered by Lipopolysaccharides. Aizhen Sun, Shengjun Nie, and Da Xing 1081

## WHOLE PLANT AND ECOPHYSIOLOGY

- [C][W][OA]Analysis of Xylem Sap from Functional (Nonembolized) and Nonfunctional (Embolized) Vessels of *Populus nigra*: Chemistry of Refilling. Francesca Secchi and Maciej A. Zwieniecki 955

- [W]The Grapevine Root-Specific Aquaporin *VvPIP2;4N* Controls Root Hydraulic Conductance and Leaf Gas Exchange under Well-Watered Conditions But Not under Water Stress. Irene Perrone, Giorgio Gambino, Walter Chitarra, Marco Vitali, Chiara Pagliarani, Nadia Riccomagno, Raffaella Balestrini, Ralf Kaldenhoff, Norbert Uehlein, Ivana Gribaudo, Andrea Schubert, and Claudio Lovisolo 965

- [W][OA]Diffusion Limitations in Root Uptake of Cadmium and Zinc, But Not Nickel, and Resulting Bias in the Michaelis Constant. Fien Degryse, Afsaneh Shahbazi, Liesbeth Verheyen, and Erik Smolders 1097

- [C][W][OA]Stem Transcriptome Reveals Mechanisms to Reduce the Energetic Cost of Shade-Avoidance Responses in Tomato. Juan Ignacio Cagnola, Edmundo Ploschuk, Tomás Benech-Arnold, Scott A. Finlayson, and Jorge José Casal 1110

- [W][OA]Composition and Physiological Function of the Wax Layers Coating Arabidopsis Leaves:  $\beta$ -Amyrin Negatively Affects the Intracuticular Water Barrier. Christopher Buschhaus and Reinhard Jetter 1120

- [C][W][OA]Green Revolution Trees: Semidwarfism Transgenes Modify Gibberellins, Promote Root Growth, Enhance Morphological Diversity, and Reduce Competitiveness in Hybrid Poplar. Ani A. Elias, Victor B. Busov, Kevin R. Kosola, Cathleen Ma, Elizabeth Etherington, Olga Shevchenko, Harish Gandhi, David W. Pearce, Stewart B. Rood, and Steven H. Strauss 1130

## SYSTEMS BIOLOGY, MOLECULAR BIOLOGY, AND GENE REGULATION

- [W][OA]*Transparent Testa16* Plays Multiple Roles in Plant Development and Is Involved in Lipid Synthesis and Embryo Development in Canola. Wei Deng, Guanqun Chen, Fred Peng, Martin Truksa, Crystal L. Snyder, and Randall J. Weselake 978

- <sup>[W]</sup>Roles of DICER-LIKE and ARGONAUTE Proteins in TAS-Derived Small Interfering RNA-Triggered DNA Methylation. *Liang Wu, Long Mao, and Yijun Qi* 990
- <sup>[OA]</sup>Positive Regulation of *psbA* Gene Expression by cis-Encoded Antisense RNAs in *Synechocystis* sp. PCC 6803. *Isamu Sakurai, Damir Stazic, Marion Eisenhut, Eerika Vuorio, Claudia Steglich, Wolfgang R. Hess, and Eva-Mari Aro* 1000
- <sup>[W][OA]</sup>MdCOP1 Ubiquitin E3 Ligases Interact with MdMYB1 to Regulate Light-Induced Anthocyanin Biosynthesis and Red Fruit Coloration in Apple. *Yuan-Yuan Li, Ke Mao, Cheng Zhao, Xian-Yan Zhao, Hua-Lei Zhang, Huai-Rui Shu, and Yu-Jin Hao* 1011
- <sup>[W][OA]</sup>The Effect of *TRANSPARENT TESTA2* on Seed Fatty Acid Biosynthesis and Tolerance to Environmental Stresses during Young Seedling Establishment in Arabidopsis. *Mingxun Chen, Zhong Wang, Yana Zhu, Zhilan Li, Nazim Hussain, Lijie Xuan, Wanli Guo, Guoping Zhang, and Lixi Jiang* 1023
- <sup>[W]</sup>Putative Glycosyltransferases and Other Plant Golgi Apparatus Proteins Are Revealed by LOPIT Proteomics. *Nino Nikolovski, Denis Rubtsov, Marcelo P. Segura, Godfrey P. Miles, Tim J. Stevens, Tom P.J. Dunkley, Sean Munro, Kathryn S. Lilley, and Paul Dupree* 1037
- <sup>[C][W][OA]</sup>A Set of Regioselective O-Methyltransferases Gives Rise to the Complex Pattern of Methoxylated Flavones in Sweet Basil. *Anna Berim, David C. Hyatt, and David R. Gang* 1052

## CORRECTIONS

- Posttranscriptional Control of Photosynthetic mRNA Decay under Stress Conditions Requires 3' and 5' Untranslated Regions and Correlates with Differential Polysome Association in Rice. *S.-H. Park, P.J. Chung, P. Juntawong, J. Bailey-Serres, Y.S. Kim, H. Jung, S.W. Bang, Y.-K. Kim, Y.D. Choi, and J.-K. Kim* 1145
- Photosystem II Photoinactivation, Repair, and Protection in Marine Centric Diatoms. *H. Wu, S. Roy, M. Alami, B.R. Green, and D.A. Campbell* 1146

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

<sup>[W]</sup> Indicates Web-only data.

<sup>[OA]</sup> Open Access articles can be viewed online without a subscription.