

The electronic form of this issue, available as of December 11, 2007, at www.plantphysiol.org, is considered the journal of record.

On the Cover: The cover of this *Focus Issue* devoted to the Vector Systems for Plant Research and Biotechnology depicts stylized plasmid molecules with single and multiple genes of interest or fluorescent markers of different colors. These vectors are shown against the background of a confocal scanning laser micrograph of a tobacco leaf that visualizes chloroplast autofluorescence (blue signal) and the cell nuclei that accumulated of the transgenically expressed DsRed2 fluorescent marker fused to the VIP1 nuclear protein (red signal). This issue highlights novel systems for multiple gene expression, protein tagging, induction, and suppression of gene silencing, specialized vectors for monocot transformation, and virus-based vectors. Importantly, special emphasis is made on simplicity of use and applicability of the system to a wide range of model plants and crop species. Cover design by Tzvi Tzfira (University of Michigan, Ann Arbor), Stanislav V. Kozlovsky (Moscow State University, Russia), and Vitaly Citovsky (State University of New York, Stony Brook). Confocal images were taken at the confocal microscopy facility of the Department of Molecular, Cellular, and Developmental Biology, University of Michigan.

FOCUS ISSUE ON VECTOR SYSTEMS FOR PLANT RESEARCH AND BIOTECHNOLOGY

EDITORIAL

Advanced Expression Vector Systems: New Weapons for Plant Research and Biotechnology. *Tzvi Tzfira, Stanislav V. Kozlovsky, and Vitaly Citovsky* 1087

UPDATES

The Analysis of Protein-Protein Interactions in Plants by Bimolecular Fluorescence Complementation. *Nir Ohad, Keren Shichrur, and Shaul Yalovsky* 1090

^[C]New Gateways to Discovery. *Michael M. Goodin, Romit Chakrabarty, Rituparna Banerjee, Sharon Yelton, and Seth DeBolt* 1100

Heterologous Expression of Viral RNA Interference Suppressors: RISC Management. *Herman B. Scholthof* 1110

^[C]Delivery of Multiple Transgenes to Plant Cells. *Mery Dafny-Yelin and Tzvi Tzfira* 1118

Chloroplast Vector Systems for Biotechnology Applications. *Dheeraj Verma and Henry Daniell* 1129

Recombinational Cloning with Plant Gateway Vectors. *Mansour Karimi, Ann Depicker, and Pierre Hilson* 1144

Current Status of Binary Vectors and Superbinary Vectors. *Toshiyuki Komori, Teruyuki Imayama, Norio Kato, Yuji Ishida, Jun Ueki, and Toshihiko Komari* 1155

BREAKTHROUGH TECHNOLOGIES

^{[W][OA]}A Ligation-Independent Cloning Tobacco Rattle Virus Vector for High-Throughput Virus-Induced Gene Silencing Identifies Roles for *NbMADS4-1* and *-2* in Floral Development. *Yiyu Dong, Tessa M. Burch-Smith, Yule Liu, Padmavathi Mamillapalli, and Savithramma P. Dinesh-Kumar* 1161

Generation of Single-Copy T-DNA Transformants in *Arabidopsis* by the CRE/*loxP* Recombination-Mediated Resolution System. *Sylvie De Buck, Ingrid Peck, Chris De Wilde, Gordana Marjanac, Jonah Nolf, Annelies De Paepe, and Ann Depicker* 1171

^{[W][OA]}Building Blocks for Plant Gene Assembly. *Mansour Karimi, Annick Bleys, Rudy Vanderhaeghen, and Pierre Hilson* 1183

^{[W][OA]}A Set of Modular Binary Vectors for Transformation of Cereals. *Axel Himmelbach, Uwe Zierold, Götz Hensel, Jan Riechen, Dimitar Douchkov, Patrick Schweizer, and Jochen Kumlehn* 1192

^{[C][W][OA]}A Guide to Choosing Vectors for Transformation of the Plastid Genome of Higher Plants. *Kerry Ann Lutz, Arun Kumar Azhagiri, Tarinee Tungsuchat-Huang, and Pal Maliga* 1201

^[W]The pCLEAN Dual Binary Vector System for *Agrobacterium*-Mediated Plant Transformation. *Vera Thole, Barbara Worland, John W. Snape, and Philippe Vain* 1211

Continued on next page

- ^[W|IOA]Marker-Free Transgenic Plants through Genetically Programmed Auto-Excision. *Dimitri Verweire, Kristof Verleyen, Sylvie De Buck, Martine Claeys, and Geert Angenon* 1220
- ^[C|IOA]TRBO: A High-Efficiency Tobacco Mosaic Virus RNA-Based Overexpression Vector. *John A. Lindbo* 1232

RESEARCH ARTICLES

- ^[OA]Reverse Genetics of Floral Scent: Application of Tobacco Rattle Virus-Based Gene Silencing in Petunia. *Ben Spitzer, Michal Moyal Ben Zvi, Marianna Ovadis, Elena Marheva, Oren Barkai, Orit Edelbaum, Ira Marton, Tania Masci, Michal Alon, Shai Morin, Ilana Rogachev, Asaph Aharoni, and Alexander Vainstein* 1241
- ^[C|IOA]A Universal Expression/Silencing Vector in Plants. *Yuval Peretz, Rita Mozes-Koch, Fuad Akad, Edna Tanne, Henryk Czosnek, and Ilan Sela* 1251
- ^[OA]Yeast-Plant Coupled Vector System for Identification of Nuclear Proteins. *Adi Zaltsman, Bu-Young Yi, Alexander Krichevsky, Yedidya Gafni, and Vitaly Citovsky* 1264
- ^[OA]pSAT RNA Interference Vectors: A Modular Series for Multiple Gene Down-Regulation in Plants. *Mery Dafny-Yelin, Sang-Min Chung, Ellen L. Frankman, and Tzvi Tzfira* 1272
- Stable Recombinase-Mediated Cassette Exchange in Arabidopsis Using *Agrobacterium tumefaciens*. *Jeanine D. Louwse, Miranda C.M. van Lier, Dirk M. van der Steen, Clementine M.T. de Vlaam, Paul J.J. Hooykaas, and Annette C. Vergunst* 1282
- ^[OA]Novel Plant Transformation Vectors Containing the Superpromoter. *Lan-Ying Lee, Maria E. Kononov, Burgund Bassuner, Bronwyn R. Frame, Kan Wang, and Stanton B. Gelvin* 1294

REGULAR ISSUE

ON THE INSIDE

- Peter V. Minorsky* 1301

LETTER TO THE EDITOR

- Toward Sequencing Cotton (*Gossypium*) Genomes. *Z. Jeffrey Chen, Brian E. Scheffler, Elizabeth Dennis, Barbara A. Triplett, Tianzhen Zhang, Wangzhen Guo, Xiaoya Chen, David M. Stelly, Pablo D. Rabinowicz, Christopher D. Town, Tony Arioli, Curt Brubaker, Roy G. Cantrell, Jean-Marc Lacape, Mauricio Ulloa, Peng Chee, Alan R. Gingle, Candace H. Haigler, Richard Percy, Sukumar Saha, Thea Wilkins, Robert J. Wright, Allen Van Deynze, Yuxian Zhu, Shuxun Yu, Ibrokhim Abdurakhmonov, Ishwarappa Katageri, P. Ananda Kumar, Mehboob-ur-Rahman, Yusuf Zafar, John Z. Yu, Russell J. Kohel, Jonathan F. Wendel, and Andrew H. Paterson* 1303

GENOME ANALYSIS

- ^[W|IOA]Identification and Characterization of Lineage-Specific Genes within the Poaceae. *Matthew A. Campbell, Wei Zhu, Ning Jiang, Haining Lin, Shu Ouyang, Kevin L. Childs, Brian J. Haas, John P. Hamilton, and C. Robin Buell* 1311

BIOCHEMICAL PROCESSES AND MACROMOLECULAR STRUCTURES

- ^[W|IOA]A Trafficking Pathway for Anthocyanins Overlaps with the Endoplasmic Reticulum-to-Vacuole Protein-Sorting Route in Arabidopsis and Contributes to the Formation of Vacuolar Inclusions. *Frantisek Poustka, Niloufer G. Irani, Antje Feller, Yuhua Lu, Lucille Pourcel, Kenneth Frame, and Erich Grotewold* 1323
- In Situ Molecular Identification of the Plastid ω 3 Fatty Acid Desaturase FAD7 from Soybean: Evidence of Thylakoid Membrane Localization. *Vanesa Andreu, Raquel Collados, Pilar S. Testillano, María del Carmen Risueño, Rafael Picorel, and Miguel Alfonso* 1336
- ^[C|IW]The Arabidopsis *DESPERADO/AtWBC11* Transporter Is Required for Cutin and Wax Secretion. *David Panikashvili, Sigal Savaldi-Goldstein, Tali Mandel, Tamar Yifhar, Rochus B. Franke, René Höfer, Lukas Schreiber, Joanne Chory, and Asaph Aharoni* 1345

- [W][OA] Oxo-Phytodienoic Acid-Containing Galactolipids in Arabidopsis: Jasmonate Signaling Dependence. *Olga Kourtchenko, Mats X. Andersson, Mats Hamberg, Åsa Brunnström, Cornelia Göbel, Kerry L. McPhail, William H. Gerwick, Ivo Feussner, and Mats Ellerström* 1658
- [OA] Arabidopsis Seedlings Deficient in a Plastidic Pyruvate Kinase Are Unable to Utilize Seed Storage Compounds for Germination and Establishment. *Carl Andre and Christoph Benning* 1670
- BIOENERGETICS AND PHOTOSYNTHESIS**
- [CI][OA] Digalactosyldiacylglycerol Is Required for Stabilization of the Oxygen-Evolving Complex in Photosystem II. *Isamu Sakurai, Naoki Mizusawa, Hajime Wada, and Naoki Sato* 1361
- [W][OA] Role of the PsbI Protein in Photosystem II Assembly and Repair in the Cyanobacterium *Synechocystis* sp. PCC 6803. *Marika Dobáková, Martin Tichý, and Josef Komenda* 1681
- CELL BIOLOGY AND SIGNAL TRANSDUCTION**
- [W] Fluorescent Reporter Proteins for the Tonoplast and the Vacuolar Lumen Identify a Single Vacuolar Compartment in Arabidopsis Cells. *Paul R. Hunter, Christian P. Craddock, Sara Di Benedetto, Lynne M. Roberts, and Lorenzo Frigerio* 1371
- [W][OA] Newly Formed Vacuoles in Root Meristems of Barley and Pea Seedlings Have Characteristics of Both Protein Storage and Lytic Vacuoles. *Andrea Olbrich, Stefan Hillmer, Giselbert Hinz, Peter Oliviussøn, and David G. Robinson* 1383
- [CI][OA] Arabidopsis INOSITOL TRANSPORTER2 Mediates H⁺ Symport of Different Inositol Epimers and Derivatives across the Plasma Membrane. *Sabine Schneider, Alexander Schneider, Patrick Udvardi, Ulrich Hammes, Monika Gramann, Petra Dietrich, and Norbert Sauer* 1395
- [W][OA] Silencing of the Mitochondrial Ascorbate Synthesizing Enzyme L-Galactono-1,4-Lactone Dehydrogenase Affects Plant and Fruit Development in Tomato. *Moftah Alhaghdow, Fabien Mounet, Louise Gilbert, Adriano Nunes-Nesi, Virginie Garcia, Daniel Just, Johann Petit, Bertrand Beauvoit, Alisdair R. Fernie, Christophe Rothan, and Pierre Baldet* 1408
- [CI][W][OA] A Role for F-Actin in Hexokinase-Mediated Glucose Signaling. *Rajagopal Balasubramanian, Abhijit Karve, Muthugapatti Kandasamy, Richard B. Meagher, and Brandon d. Moore* 1423
- [CI][OA] The 14-3-3 Proteins μ and ν Influence Transition to Flowering and Early Phytochrome Response. *John D. Mayfield, Kevin M. Folta, Anna-Lisa Paul, and Robert J. Ferl* 1692
- DEVELOPMENT AND HORMONE ACTION**
- [CI][OA] A *BELL1*-Like Gene of Potato Is Light Activated and Wound Inducible. *Mithu Chatterjee, Anjan K. Banerjee, and David J. Hannapel* 1435
- [CI][OA] Maize *Brittle stalk2* Encodes a COBRA-Like Protein Expressed in Early Organ Development But Required for Tissue Flexibility at Maturity. *Anoop Sindhu, Tiffany Langewisch, Anna Olek, Dilbag S. Multani, Maureen C. McCann, Wilfred Vermerris, Nicholas C. Carpita, and Gurmukh Johal* 1444
- [OA] Phosphate Starvation Root Architecture and Anthocyanin Accumulation Responses Are Modulated by the Gibberellin-DELLA Signaling Pathway in Arabidopsis. *Caiyu Jiang, Xiuhua Gao, Lili Liao, Nicholas P. Harberd, and Xiangdong Fu* 1460
- [CI][W][OA] The F-Box Protein MAX2 Functions as a Positive Regulator of Photomorphogenesis in Arabidopsis. *Hui Shen, Phi Luong, and Enamul Huq* 1471
- [W][OA] *OsMADS51* Is a Short-Day Flowering Promoter That Functions Upstream of *Ehd1*, *OsMADS14*, and *Hd3a*. *Song Lim Kim, Shinyoung Lee, Hyo Jung Kim, Hong Gil Nam, and Gynheung An* 1484
- [W][OA] Conserved C-Terminal Motifs of the Arabidopsis Proteins APETALA3 and PISTILLATA Are Dispensable for Floral Organ Identity Function. *Eileen Piwarzyk, Yingzhen Yang, and Thomas Jack* 1495
- [CI][OA] Cytokinin Receptors Are Involved in Alkamide Regulation of Root and Shoot Development in Arabidopsis. *José López-Bucio, Mayra Millán-Godínez, Alfonso Méndez-Bravo, Alina Morquecho-Contreras, Enrique Ramírez-Chávez, Jorge Molina-Torres, Anahí Pérez-Torres, Masayuki Higuchi, Tatsuo Kakimoto, and Luis Herrera-Estrella* 1703
- ENVIRONMENTAL STRESS AND ADAPTATION TO STRESS**
- [CI][W] Zeaxanthin Has Enhanced Antioxidant Capacity with Respect to All Other Xanthophylls in Arabidopsis Leaves and Functions Independent of Binding to PSII Antennae. *Michel Havaux, Luca Dall'Osto, and Roberto Bassi* 1506

- ^[W]Differential Expression of the TFIIIA Regulatory Pathway in Response to Salt Stress between *Medicago truncatula* Genotypes. *Laura de Lorenzo, Francisco Merchan, Sandrine Blanchet, Manuel Megías, Florian Frugier, Martin Crespi, and Carolina Sousa* 1521
- ^{[W][OA]}Cell Wall Proteome in the Maize Primary Root Elongation Zone. II. Region-Specific Changes in Water Soluble and Lightly Ionically Bound Proteins under Water Deficit. *Jinming Zhu, Sophie Alvarez, Ellen L. Marsh, Mary E. LeNoble, In-Jeong Cho, Mayandi Sivaguru, Sixue Chen, Henry T. Nguyen, Yajun Wu, Daniel P. Schachtman, and Robert E. Sharp* 1533
- ^{[CI][W]}Root Plasma Membrane Transporters Controlling K⁺/Na⁺ Homeostasis in Salt-Stressed Barley. *Zhonghua Chen, Igor I. Pottosin, Tracey A. Cuin, Anja T. Fuglsang, Mark Tester, Deepa Jha, Isaac Zepeda-Jazo, Meixue Zhou, Michael G. Palmgren, Ian A. Newman, and Sergey Shabala* 1714

GENETICS, GENOMICS, AND MOLECULAR EVOLUTION

- ^[OA]Genetic Interactions between DNA Demethylation and Methylation in Arabidopsis. *Jon Penterman, Rie Uzawa, and Robert L. Fischer* 1549
- ^{[CI][W]}Genomic Organization and Evolutionary Conservation of Plant D-Type Cyclins. *Margit Menges, Giulio Pavesi, Piero Morandini, Laszlo Bögre, and James A.H. Murray* 1558

PLANTS INTERACTING WITH OTHER ORGANISMS

- ^{[W][OA]}Alternative Splicing and mRNA Levels of the Disease Resistance Gene *RPS4* Are Induced during Defense Responses. *Xue-Cheng Zhang and Walter Gassmann* 1577
- ^[W]Induction of a Small Heat Shock Protein and Its Functional Roles in *Nicotiana* Plants in the Defense Response against *Ralstonia solanacearum*. *Milimo Maimbo, Kouhei Ohnishi, Yasufumi Hikichi, Hirofumi Yoshioka, and Akinori Kiba* 1588
- ^[W]Antisense Repression of the *Medicago truncatula* Nodule-Enhanced Sucrose Synthase Leads to a Handicapped Nitrogen Fixation Mirrored by Specific Alterations in the Symbiotic Transcriptome and Metabolome. *Markus C. Baier, Aiko Barsch, Helge Küster, and Natalija Hohnjec* 1600
- ^[OA]Fungal Symbiosis in Rice Requires an Ortholog of a Legume Common Symbiosis Gene Encoding a Ca²⁺/Calmodulin-Dependent Protein Kinase. *Caiyan Chen, Muqiang Gao, Jinyuan Liu, and Hongyan Zhu* 1619

WHOLE PLANT AND ECOPHYSIOLOGY

- ^{[CI][OA]}Ethylene and Not Embolism Is Required for Wound-Induced Tylose Development in Stems of Grapevines. *Qiang Sun, Thomas L. Rost, Michael S. Reid, and Mark A. Matthews* 1629

SYSTEMS BIOLOGY, MOLECULAR BIOLOGY, AND GENE REGULATION

- ^[W]Two DEAD-Box Proteins May Be Part of RNA-Dependent High-Molecular-Mass Protein Complexes in Arabidopsis Mitochondria. *Annemarie Matthes, Stephanie Schmidt-Gattung, Daniela Köhler, Joachim Forner, Steffen Wildum, Monika Raabe, Henning Urlaub, and Stefan Binder* 1637
- ^{[CI][W][OA]}Mutation in Nicotianamine Aminotransferase Stimulated the Fe(II) Acquisition System and Led to Iron Accumulation in Rice. *Longjun Cheng, Fang Wang, Huixia Shou, Fangliang Huang, Luqing Zheng, Fei He, Jinhui Li, Fang-jie Zhao, Daisei Ueno, Jian Feng Ma, and Ping Wu* 1647
- ^[OA]The Isoenzyme 7 of Tobacco NAD(H)-Dependent Glutamate Dehydrogenase Exhibits High Deaminating and Low Aminating Activities in Vivo. *Damianos S. Skopelitis, Nikolaos V. Paranychanakis, Antonios Kowvarakis, Apostolis Spyros, Euripides G. Stephanou, and Kalliopi A. Roubelakis-Angelakis* 1726
- ^{[W][OA]}Nitrite Acts as a Transcriptome Signal at Micromolar Concentrations in Arabidopsis Roots. *Rongchen Wang, Xiujian Xing, and Nigel Crawford* 1735

^[CI] 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.