

**On the Cover:** The cover image shows xylem vessel elements converted from mesophyll cells in cotyledons by the application of cytokinin, auxin, and brassinosteroid (the KDB system), and then stained by safranin-O. The image was captured using a confocal laser scanning microscope system (Zeiss LSM 710) by Tian Tian Tan, followed by image processing with Adobe Photoshop by Misato Ohtani and Taku Demura.

## ON THE INSIDE

*Peter V. Minorsky* 1879

## EDITORIALS

*Plant Physiology* Launches Associate Features Editors. *Michael R. Blatt and Mary Williams* 1881

New Faces behind the Scenes. *Michael R. Blatt* 1883

## LETTERS TO THE EDITOR

Auxin and Vesicle Traffic. 1884

Questionable Evidence for Auxin-Carrying Secretory Vesicles. *David G. Robinson, Chris Hawes, Stefan Hillmer, Gerd Jürgens, Claus Schwechheimer, York-Dieter Stierhof, and Corrado Viotti*

Vesicles Accumulating Auxin in Vitro Are Not "Presynaptic." *Rainer Hertel* 1889

## COMMENTARIES

Coordinating Cell Walls and Cell Growth: A Role for LRX Extensin Chimeras. *Patricia Bedinger* 1890

A Novel Role of Ring Chromosomes as Evolutionary Drivers of Herbicide Resistance. *Yunqing Yu* 1892

## TOPICAL REVIEW

[OPEN] Plant Lipid Droplets and Their Associated Proteins: Potential for Rapid Advances. *Anthony H.C. Huang*

*Plant lipid droplets and their associated oleosin and other proteins have evolved and diversified in functions and cell species specificities and have been probed for commercial uses.* 1894

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## BREAKTHROUGH TECHNOLOGIES

[<sup>OPEN</sup>] A New Barley Stripe Mosaic Virus Allows Large Protein Overexpression for Rapid Function Analysis.  
Arnaud Cheuk and Mario Houde

*A new BSMV system with high cargo capacity allows large protein overexpression for rapid functional genomic and proteomic studies in monocot and dicot plant species.* 1919

## RESEARCH REPORT

[<sup>OPEN</sup>] Gene Duplication and Aneuploidy Trigger Rapid Evolution of Herbicide Resistance in Common Waterhemp. Dal-Hoe Koo, Mithila Jugulam, Karthik Putta, Ivan B. Cuwaca, Dallas E. Peterson, Randall S. Currie, Bernd Friebe, and Bikram S. Gill

*Aneuploidy primes evolution of herbicide resistance in weeds.* 1932

[<sup>CC-BY</sup>] Acclimation to Fluctuating Light Impacts the Rapidity of Response and Diurnal Rhythm of Stomatal Conductance. Jack S.A. Matthews, Silvere Vialet-Chabrand, and Tracy Lawson

*Fluctuating light influences stomatal responses in Arabidopsis independently of the growth light intensity.* 1939

## RESEARCH ARTICLES

### BIOCHEMISTRY AND METABOLISM

[<sup>OPEN</sup>] N-Glycoproteomic Characterization of Mannosidase and Xylosyltransferase Mutant Strains of *Chlamydomonas reinhardtii*. Stefan Schulze, Anne Oltmanns, Nick Machnik, Gai Liu, Nannan Xu, Niklas Jarmatz, Martin Scholz, Kazuhiko Sugimoto, Christian Fufezan, Kaiyao Huang, and Michael Hippler

*Insertional mutagenesis of mannosidase 1A and xylosyltransferase 1A results in altered N-glycan compositions, indicating diverse roles in the trimming and modification of N-glycans in C. reinhardtii.* 1952

[<sup>OPEN</sup>] A Connection between Lysine and Serotonin Metabolism in Rice Endosperm.

Qing-Qing Yang, Dong-Sheng Zhao, Chang-Quan Zhang, Hong-Yu Wu, Qian-Feng Li, Ming-Hong Gu, Samuel Sai-Ming Sun, and Qiao-Quan Liu

*Serotonin biosynthesis is dramatically elevated, and closely linked with dark-brown color of the endosperm, in high-lysine rice.* 1965

### CELL BIOLOGY

[<sup>OPEN</sup>] LRX Proteins Play a Crucial Role in Pollen Grain and Pollen Tube Cell Wall Development.

Tohmyui Ndinyanka Fabrice, Hannes Vogler, Christian Draeger, Gautam Munglani, Shibu Gupta, Aline G. Herger, Paul Knox, Ueli Grossniklaus, and Christoph Ringli

*LRX extensins are extracellular proteins that associate with and influence processes at the plasma membrane that are important for pollen grain germination and pollen tube growth.* 1981

[<sup>OPEN</sup>] Pollen-Expressed Leucine-Rich Repeat Extensins Are Essential for Pollen Germination and Growth.

Xiaoxiao Wang, Kaiyue Wang, Guimin Yin, Xiaoyu Liu, Mei Liu, Nana Cao, Yazhou Duan, Hui Gao, Wanlei Wang, Weina Ge, Jing Wang, Rui Li, and Yi Guo

*Four Leu-rich repeat extensin chimeras, LRX8–11, are redundantly involved in pollen germination and pollen tube growth in Arabidopsis.* 1993

[<sup>OPEN</sup>] Recovery from N Deprivation Is a Transcriptionally and Functionally Distinct State in *Chlamydomonas*.  
Chia-Hong Tsai, Sahra Uygun, Rebecca Roston, Shin-Han Shiu, and Christoph Benning

*Recovery from N deprivation follows a distinct transcriptional program in Chlamydomonas.*

2007

The Cytokinin Oxidase/Dehydrogenase CKX1 Is a Membrane-Bound Protein Requiring Homooligomerization in the Endoplasmic Reticulum for Its Cellular Activity. Michael C.E. Niemann, Henriette Weber, Tomáš Hluska, Georgeta Leonte, Samantha M. Anderson, Ondřej Novák, Alessandro Senes, and Tomáš Werner

*The Arabidopsis cytokinin oxidase/dehydrogenase CKX1 plays a key role in cytokinin degradation in the endoplasmic reticulum.*

2024

[<sup>OPEN</sup>] Exocyst Subunit EXO70H4 Has a Specific Role in Callose Synthase Secretion and Silica Accumulation. Ivan Kulich, Zdeňka Vojtková, Peter Sabol, Jitka Ortmannová, Vilém Neděla, Eva Tihlaříková, and Viktor Žárský

*Exocyst subunit EXO70H4 localizes to the apical subdomain of the trichome. Here, it is responsible for callose synthase secretion; callose is essential for cell wall silicification.*

2040

[<sup>OPEN</sup>] Potato Mop-Top Virus Co-Opts the Stress Sensor HIP26 for Long-Distance Movement. Graham H. Cowan, Alison G. Roberts, Susan Jones, Pankaj Kumar, Pruthvi B Kalyandurg, Jose F. Gil, Eugene I. Savenkov, Piers A. Hemsley, and Lesley Torrance

*After a virus movement protein interacts with the HIP26 stress sensor, the complex relocates to the nucleus, activating the drought stress response and thereby facilitating virus long-distance movement.*

2052

[<sup>OPEN</sup>] Ethylene Signaling Modulates Cortical Microtubule Reassembly in Response to Salt Stress. Liru Dou, Kai Kai He, Takumi Higaki, Xiangfeng Wang, and Tonglin Mao

*The plant hormone ethylene and its associated signaling pathway are involved in cortical microtubule reassembly, a process that is critical for the salt-stress response in Arabidopsis.*

2071

## ECOPHYSIOLOGY AND SUSTAINABILITY

Knockdown of Rice MicroRNA166 Confers Drought Resistance by Causing Leaf Rolling and Altering Stem Xylem Development. Jinshan Zhang, Hui Zhang, Ashish Kumar Srivastava, Yujie Pan, Jinjuan Bai, Jingjing Fang, Huazhong Shi, and Jian-Kang Zhu

*Knockdown of microRNA166 increases drought resistance in rice via decreased stem water conductivity and reduced leaf transpiration rates.*

2082

## GENES, DEVELOPMENT AND EVOLUTION

[<sup>OPEN</sup>] Identification of Transcriptional and Receptor Networks That Control Root Responses to Ethylene. Alexandria F. Harkey, Justin M. Watkins, Amy L. Olex, Kathleen T. DiNapoli, Daniel R. Lewis, Jacquelyn S. Fetrow, Brad M. Binder, and Gloria K. Muday

*The kinetics of changes in the ethylene transcriptome in light-grown roots combined with mutant analyses reveal a central role of the ETR1 receptor and a limited role of EIN3 in root development.*

2095

[<sup>OPEN</sup>] Characterization of Multiple C2 Domain and Transmembrane Region Proteins in Arabidopsis. Lu Liu, Chunying Li, Zhe Liang, and Hao Yu

*MCTPs exhibit diverse and overlapping patterns of gene expression and protein localization, and might be involved in Arabidopsis development with potential functional divergence or redundancy.*

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[OPEN]The Long Intergenic Noncoding RNA (LincRNA) Landscape of the Soybean Genome.

Agnieszka A. Golicz, Mohan B. Singh, and Prem L. Bhalla

*The soybean genome encodes over 6,000 long intergenic noncoding RNAs implicated in many biological processes, including transcription, development, and possibly influencing agronomic traits.*

2133

[OPEN]The OsFBK1 E3 Ligase Subunit Affects Anther and Root Secondary Cell Wall Thickenings by Mediating Turnover of a Cinnamoyl-CoA Reductase. Pratikshya Borah and Jitendra P. Khurana

*OsFBK1 mediates the turnover of OsCCR14 via the 26S proteasome pathway, resulting in changes in secondary cell wall content in anthers and roots, without changes in auxin signaling.*

2148

[OPEN]Genome-Wide Analysis of the Arabidopsis Replication Timing Program.

Lorenzo Concia, Ashley M. Brooks, Emily Wheeler, Gregory J. Zynda, Emily E. Wear, Chantal LeBlanc, Jawon Song, Tae-Jin Lee, Pete E. Pascuzzi, Robert A. Martienssen, Matthew W. Vaughn, William F. Thompson, and Linda Hanley-Bowdoin

*The Arabidopsis thaliana genome replicates in two noninteracting compartments during early/mid and late S phase.*

2166

[OPEN]CELLULASE6 and MANNANASE7 Affect Cell Differentiation and Silique Dehiscence.

Hanjun He, Mei Bai, Panpan Tong, Yanting Hu, Ming Yang, and Hong Wu

*Arabidopsis CEL6 and MAN7 proteins affect cell morphology and silique dehiscence, which can be manipulated to different degrees by altering their activities.*

2186

[OPEN]A Pectin Methyltransferase Inhibitor Enhances Resistance to *Verticillium* Wilt.

Nana Liu, Yun Sun, Yakun Pei, Xueyan Zhang, Ping Wang, Xiancai Li, Fuguang Li, and Yuxia Hou

*A cotton pectin methyltransferase inhibitor interacts with pectin methyltransferases, rendering plants more resistant to fungal infection.*

2202

[OPEN]ER-Anchored Transcription Factors bZIP17 and bZIP28 Regulate Root Elongation.

June-Sik Kim, Kazuko Yamaguchi-Shinozaki, and Kazuo Shinozaki

*The bZIP17 and bZIP28 transcription factors have noncanonical target genes and redundantly contribute to both ER homeostasis and root elongation.*

2221

[OPEN]Thioredoxin-Mediated ROS Homeostasis Explains Natural Variation in Plant Regeneration.

Hui Zhang, Ting Ting Zhang, Hui Liu, De Ying Shi, Meng Wang, Xiao Min Bie, Xing Guo Li, and Xian Sheng Zhang

*Thioredoxin-dependent redox modification regulates plant regeneration via modulation of ROS homeostasis.*

2231

[OPEN]Plant Temperature Acclimation and Growth Rely on Cytosolic Ribosome Biogenesis Factor Homologs.

Olga Beine-Golovchuk, Alexandre Augusto Pereira Firmino, Adrianna Dąbrowska, Stefanie Schmidt, Alexander Erban, Dirk Walther, Ellen Zuther, Dirk K. Hincha, and Joachim Kopka

*REI1-LIKE ribosome biogenesis factor homologs guide cold acclimation and 60S subunit accumulation for plant growth at alternating temperatures.*

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[OPEN] Stable Accumulation of Photosystem II Requires ONE-HELIX PROTEIN1 (OHP1) of the Light Harvesting-Like Family. *Fumiyoshi Myouga, Kaori Takahashi, Ryoichi Tanaka, Noriko Nagata, Anett Z. Kiss, Christiane Funk, Yuko Nomura, Hirofumi Nakagami, Stefan Jansson, and Kazuo Shinozaki*

*The OHP1 complex is indispensable for protein synthesis and the assembly machinery during de novo synthesis of photosystem II in plants.* 2277

[OPEN] Natural Variation Underlies Differences in ETHYLENE RESPONSE FACTOR17 Activity in Fruit Peel Degreening. *Zhenyun Han, Yanan Hu, Yuanda Lv, Jocelyn K.C. Rose, Yaqiang Sun, Fei Shen, Yi Wang, Xinzhong Zhang, Xuefeng Xu, Ting Wu, and Zhenhai Han*

*ERF17 transcriptional regulation activity in apple fruit peel degreening increases with serine repeat number.* 2292

## MEMBRANES, TRANSPORT AND BIOENERGETICS

[OPEN] Mitochondria Affect Photosynthetic Electron Transport and Photosensitivity in a Green Alga. *Véronique Larosa, Andrea Meneghesso, Nicoletta La Rocca, Janina Steinbeck, Michael Hippler, Ildikò Szabò, and Tomas Morosinotto*

*Alteration of photosynthetic electron transport, caused by a mitochondrial mutation, showed experimentally that algae better endure light damage targeting photosystem II instead of photosystem I.* 2305

[OPEN] An Iron-Activated Citrate Transporter, MtMATE67, Is Required for Symbiotic Nitrogen Fixation. *Igor S. Kryvoruchko, Pratyush Routray, Senjuti Sinharoy, Ivone Torres-Jerez, Manuel Tejada-Jiménez, Lydia A. Finney, Jin Nakashima, Catalina I. Pislariu, Vagner A. Benedito, Manuel González-Guerrero, Daniel M. Roberts, and Michael K. Udvardi*

*The nodule-specific transporter MtMATE67 is activated by iron and is required for symbiotic nitrogen fixation in Medicago truncatula.* 2315

Sugar Transporter STP7 Specificity for L-Arabinose and D-Xylose Contrasts with the Typical Hexose Transporters STP8 and STP12. *Theresa Rottmann, Franz Klebl, Sabine Schneider, Dominik Kischka, David Rüscher, Norbert Sauer, and Ruth Stadler*

*The hexose transporters STP8 and STP12 may contribute to the nutrition of reproductive tissues, whereas the pentose-specific STP7 might be involved in cell wall sugar recycling in Arabidopsis.* 2330

Fine-Tuning of Photosynthesis Requires CURVATURE THYLAKOID1-Mediated Thylakoid Plasticity. *Mathias Pribil, Omar Sandoval-Ibáñez, Wenteng Xu, Anurag Sharma, Mathias Labs, Qiuping Liu, Carolina Galgenmüller, Trang Schneider, Malgorzata Wessels, Shizue Matsubara, Stefan Jansson, Gerhard Wanner, and Dario Leister*

*The CURT1A component of the CURT1 protein complex mediates thylakoid membrane curvature and modulates photosynthesis to maintain plant fitness during fluctuating environmental conditions.* 2351

## SIGNALING AND RESPONSE

The B-Box Domain Protein BBX21 Promotes Photomorphogenesis. *Dongqing Xu, Yan Jiang, Jian Li, Magnus Holm, and Xing Wang Deng*

*The second B-box domain in BBX21 is essential for its direct binding of T/G-box cis-element present in the HY5 promoter, regulating HY5 and HY5-controlled gene expression and promoting photomorphogenesis.* 2365

[OPEN] Transcriptomic Insights into Phenological Development and Cold Tolerance of Wheat Grown in the Field. Qiang Li, Brook Byrns, Mohamed A. Badawi, Abdoulaye Banire Diallo, Jean Danyluk, Fathey Sarhan, Debbie Laudencia-Chingcuanco, Jitao Zou, and D. Brian Fowler

*Transcriptome profiling of spring and winter wheat and their near-isogenic lines growing under field conditions reveals the regulatory interactions between vegetative/reproductive transition and cold tolerance.*

2376

[OPEN] Sulforaphane Modifies Histone H3, Unpacks Chromatin, and Primes Defense. Britta Schillheim, Irina Jansen, Stephani Baum, Alexander Beesley, Carsten Bolm, and Uwe Conrath

*A plant secondary metabolite modifies chromatin, primes defense, and controls plant disease in Arabidopsis.*

2395

[OPEN] The sHSP22 Heat-Shock Protein Requires the ABI1 Protein Phosphatase to Modulate Polar Auxin Transport and Downstream Responses. Yanli Li, Yaqiong Li, Yongchang Liu, Yaorong Wu, and Qi Xie

*Endoplasmic reticulum-localized small heat shock protein sHSP22 integrates ABA and auxin signaling in Arabidopsis.*

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[OPEN] The G Protein  $\beta$ -Subunit, AGB1, Interacts with FERONIA in RALF1-Regulated Stomatal Movement. Yunqing Yu, David Chakravorty, and Sarah M. Assmann

*The G protein  $\beta$ -subunit, AGB1, interacts physically with receptor-like kinase FERONIA, and AGB1 plus extra-large G $\alpha$  proteins and G $\gamma$  proteins participate in RALF1-FER regulation of stomatal movement.*

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[OPEN] The Deubiquitinase OTU5 Regulates Root Responses to Phosphate Starvation. Der-Fen Suen, Yi-Hsiu Tsai, Ya-Tan Cheng, Ramalingam Radjacommar, Ram Nivas Ahirwar, Hongyong Fu, and Wolfgang Schmidt

*The deubiquitinase OTU5 is required for the interpretation of environmental cues that alter the abundance of root hair- and chromatin-related proteins.*

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Heat Shock Factor HsfA1a Is Essential for R Gene-Mediated Nematode Resistance and Triggers H<sub>2</sub>O<sub>2</sub> Production. Jie Zhou, Xue-Chen Xu, Jia-Jian Cao, Ling-Ling Yin, Xiao-Jian Xia, Kai Shi, Yan-Hong Zhou, and Jing-Quan Yu

*HsfA1a is essential for Mi-1.2-mediated resistance to Meloidogyne incognita and regulates Wfi1 transcription and H<sub>2</sub>O<sub>2</sub> production.*

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[OPEN] Control of Retrograde Signaling by Rapid Turnover of GENOMES UNCOUPLED1. Guo-Zhang Wu, Camille Chalvin, Matthijs Hoelscher, Etienne H. Meyer, Xu Na Wu, and Ralph Bock

*New insights into the regulation of GUN1 uncover its function in early chloroplast biogenesis and suggest a role in developmental phase transitions.*

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[OPEN] A Poly(A) Ribonuclease Controls the Cellotriose-Based Interaction between Piriformospora indica and Its Host Arabidopsis. Joy M. Johnson, Johannes Thürich, Elena K. Petutschnig, Lothar Altschmied, Doreen Meichsner, Irena Sherameti, Julian Dindas, Anna Mrozinska, Christian Paetz, Sandra S. Scholz, Alexandra C.U. Furch, Volker Lipka, Rainer Hedrich, Bernd Schneider, Aleš Svatoš, and Ralf Oelmüller

*The elicitor-active cell wall moiety of the endophytic fungus Piriformospora indica, cellotriose, modulates the plant-fungus symbiosis by activating a poly(A) ribonuclease in Arabidopsis.*

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[OPEN] PROHIBITIN3 Forms Complexes with ISOCHORISMATE SYNTHASE1 to Regulate Stress-Induced Salicylic Acid Biosynthesis in Arabidopsis. Aldo Seguel, Joanna Jelenska, Ariel Herrera-Vásquez, Sharon K. Marr, Michael B. Joyce, Kelsey R. Gagesch, Nadia Shakoob, Shang-Chuan Jiang, Alejandro Fonseca, Mary C. Wildermuth, Jean T. Greenberg, and Loreto Holuigue

*A PROHIBITIN-family protein promotes salicylic acid production via the isochorismate pathway in response to stress.*

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Hydrogen Sulfide Increases Production of NADPH Oxidase-Dependent Hydrogen Peroxide and Phospholipase D-Derived Phosphatidic Acid in Guard Cell Signaling. Denise Scuffi, Thomas Nietzel, Luciano M. Di Fino, Andreas J. Meyer, Lorenzo Lamattina, Markus Schwarzländer, Ana M. Laxalt, and Carlos García-Mata

*The gasotransmitter hydrogen sulfide regulates RBOHD- and RBOHF-dependent hydrogen peroxide production and phospholipase D $\alpha$ 1 (PLD $\alpha$ 1) and PLD $\delta$  during stomatal closure.*

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[OPEN] Lipopolysaccharides Trigger Two Successive Bursts of Reactive Oxygen Species at Distinct Cellular Locations. Keke Shang-Guan, Min Wang, Nang Myint Phyu Sin Htwe, Ping Li, Yaoshen Li, Fan Qi, Dawei Zhang, Min Cao, Chanhong Kim, Haiyong Weng, Haiyan Cen, Ian M. Black, Parastoo Azadi, Russell W. Carlson, Gary Stacey, and Yan Liang

*Lipopolysaccharides induce a long-lasting burst of reactive oxygen species that is largely associated with chloroplasts.*

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## SYSTEMS AND SYNTHETIC BIOLOGY

[OPEN] Pausing of Chloroplast Ribosomes Is Induced by Multiple Features and Is Linked to the Assembly of Photosynthetic Complexes. Piotr Gawroński, Poul Erik Jensen, Stanisław Karpiński, Dario Leister, and Lars B. Scharff

*Ribosome pausing in chloroplasts is caused by multiple features of mRNA and nascent peptide chain and influences transmembrane protein folding and cofactor integration.*

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## CORRECTIONS

Thioredoxin-Mediated ROS Homeostasis Explains Natural Variation in Plant Regeneration. Zhang H., Zhang T.T., Liu H., Shi D.Y., Wang M., Bie X.M., Li X.G., and Zhang X.S.

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Genome-Wide Prediction of Metabolic Enzymes, Pathways, and Gene Clusters in Plants. Schläpfer P., Zhang P., Wang C., Kim T., Banf M., Chae L., Dreher K., Chavali A.K., Nilo-Poyanco R., Bernard T., Kahn D., and Rhee S.Y.

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