

**On the Cover:** The leaf epidermis manifests some fascinating cell shapes. This rendering is based on a scanning electron micrograph of the epidermis of an Arabidopsis cotyledon and illustrates pairs of kidney-shaped guard cells (red) interspersed between pavement cells which form wavy shapes that interlock into a jigsaw puzzle pattern. The wavy cell contours are an orchestration of the cytoskeleton and cell wall mechanics within development. Image by: Amir J. Bidhendi and Anja Geitmann.

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Purple Is the New Orange: Anthocyanin Regulation Coming Together in Carrot. *Nathaniel Butler* 12

## UPDATE

[<sup>OPEN</sup>]The Synthetic Biology Toolkit for Photosynthetic Microorganisms. *Konstantinos Vavitsas, Pierre Crozet, Marcos Hamborg Vinde, Fiona Davies, Stéphane D. Lemaire, and Claudia E. Vickers*

*Photosynthetic microorganisms offer novel characteristics as synthetic biology chassis, and the toolbox of components and techniques for cyanobacteria and algae is rapidly increasing.* 14

## RESEARCH ARTICLES

### BREAKTHROUGH TECHNOLOGIES

[<sup>OPEN</sup>]Recovering Wind-Induced Plant Motion in Dense Field Environments via Deep Learning and Multiple Object Tracking. *Jonathon A. Gibbs, Alexandra J. Burgess, Michael P. Pound, Tony P. Pridmore, and Erik H. Murchie*

*Deep learning combined with multiple object tracking detects ear tips in images and videos of field-grown wheat and can recover simple movement patterns caused by wind.* 28

### BIOCHEMISTRY AND METABOLISM

[<sup>OPEN</sup>]A Conserved Sequence from Heat-Adapted Species Improves Rubisco Activase Thermostability in Wheat. *Andrew P. Scafaro, Nadine Bautsoens, Bart den Boer, Jeroen Van Rie, and Alexander Gallé*

*Eleven amino acids conserved in Rubisco activase (Rca) variants present in warm-adapted species increase the thermostability of wheat Rca by 7°C.* 43

[<sup>OPEN</sup>]WRINKLED1 Regulates BIOTIN ATTACHMENT DOMAIN-CONTAINING Proteins that Inhibit Fatty Acid Synthesis. *Hui Liu, Zhiyang Zhai, Kate Kuczynski, Jantana Keereetaweep, Jorg Schwender, and John Shanklin*

*WRINKLED1 regulates genes for fatty acid synthesis as well as inhibitors of fatty acid synthesis (BADCs) in a homeostatic mechanism.* 55

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[OPEN] Ectopic Defense Gene Expression Is Associated with Growth Defects in *Medicago truncatula* Lignin Pathway Mutants. Chan Man Ha, Dennis Fine, Anil Bhatia, Xiaolan Rao, Madhavi Z. Martin, Nancy L. Engle, Daniel J. Wherritt, Timothy J. Tschaplinski, Lloyd W. Sumner, and Richard A. Dixon

*Growth defects arising from lignin modification are associated with the extent, but not the nature, of ectopic expression of defense pathways.*

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[OPEN] eIFiso4G Augments the Synthesis of Specific Plant Proteins Involved in Normal Chloroplast Function. Andrew D. Lellis, Ryan M. Patrick, Laura K. Mayberry, Argelia Lorence, Zachary C. Campbell, Johnna L. Roose, Laurie K. Frankel, Terry M. Bricker, Hanjo A. Hellmann, Roderick W. Mayberry, Ana Solis Zavala, Grace S. Choy, Dennis C. Wylie, Mustafa Abdul-Moheeth, Adeeb Masood, Amy G. Prater, Hailey E. Van Hoorn, Nicola A. Cole, and Karen S. Browning

*The absence of eIFiso4G decreases the levels of some proteins, whereas overexpression of eIFiso4G1 restores synthesis of the decreased proteins, normal chloroplast function/appearance, and plant fitness.*

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## CELL BIOLOGY

Arabidopsis Class II TCP Transcription Factors Integrate with the FT–FD Module to Control Flowering. Daibo Li, Haiyan Zhang, Minghui Mou, Yanli Chen, Shengyuan Xiang, Ligang Chen, and Diqiu Yu

*Class II TCP TFs interact with FD and act directly at the AP1 promoter to control flowering.*

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PI4KIII $\beta$  Activity Regulates Lateral Root Formation Driven by Endocytic Trafficking to the Vacuole. Carlos Rubilar-Hernández, Claudio Osorio-Navarro, Francisca Cabello, and Lorena Norambuena

*Phosphatidylinositol 4-kinase III $\beta$  activity regulates the endocytic trafficking that promotes lateral root organogenesis via a pathway that functions independently of an auxin receptor complex.*

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[OPEN] Pectin Chemistry and Cellulose Crystallinity Govern Pavement Cell Morphogenesis in a Multi-Step Mechanism. Bara Altartouri, Amir J Bidhendi, Tomomi Tani, Johnny Suzuki, Christina Conrad, Youssef Chebli, Na Liu, Chithra Karunakaran, Giuliano Scarcelli, and Anja Geitmann

*Demethylated pectin is involved in initiating morphogenetic events in pavement cells, and crystalline cellulose plays a role during feedback-mediated augmentation of waviness.*

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[OPEN] Plasma Membrane-Associated Receptor-like Kinases Relocalize to Plasmodesmata in Response to Osmotic Stress. Magali S. Grison, Philip Kirk, Marie L. Brault, Xu Na Wu, Waltraud X. Schulze, Yoselin Benitez-Alfonso, Françoise Immel, and Emmanuelle M. Bayer

*Osmotic stress triggers rapid reorganization of the receptor kinases QSK1 and IMK2 at plasmodesmata and induces callose-mediated plasmodesmata closure.*

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[OPEN] An Auxin Transport Inhibitor Targets Villin-Mediated Actin Dynamics to Regulate Polar Auxin Transport. Minxia Zou, Haiyun Ren, and Jiejie Li

*Villins are required for the action of an auxin transport inhibitor on actin cytoskeleton and polar auxin transport in Arabidopsis.*

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## GENES, DEVELOPMENT AND EVOLUTION

[OPEN] Wheat TaSPL8 Modulates Leaf Angle Through Auxin and Brassinosteroid Signaling. Kaiye Liu, Jie Cao, Kuohai Yu, Xinye Liu, Yujiao Gao, Qian Chen, Wenjia Zhang, Huiru Peng, Jinkun Du, Mingming Xin, Zhaorong Hu, Weilong Guo, Vincenzo Rossi, Zhongfu Ni, Qixin Sun, and Yingyin Yao

*Wheat TaSPL8 regulates lamina joint development and leaf angle through auxin signaling and the brassinosteroid biosynthesis pathway.*

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Changing Carrot Color: Insertions in DcMYB7 Alter the Regulation of Anthocyanin Biosynthesis and Modification. Zhi-Sheng Xu, Qing-Qing Yang, Kai Feng, and Ai-Sheng Xiong

*Insertion of a nonfunctional DcMYB7 duplication or transposons into the promoter region of DcMYB7 in nonpurple carrots blocks anthocyanin biosynthesis and modification.*

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MicroRNA166 Monitors *SPOROCTELESS/NOZZLE* for Building of the Anther Internal Boundary. Xiaorong Li, Heng Lian, Qiuxia Zhao, and Yuke He

*miR166 and its target PHB monitor SPL/NZZ gene dynamically in construction of internal boundary and formation of dehiscence zones in anthers.* 208

[OPEN] A Multiprotein Complex Regulates Interference-Sensitive Crossover Formation in Rice. Jie Zhang, Chong Wang, James D. Higgins, Yu-Jin Kim, Sunok Moon, Ki-Hong Jung, Shuying Qu, and Wanqi Liang

*In rice, OsSHOC1 and OsPTD constitute an XPF-ERCC1-like complex and collaborate with OsMSH5, OsHEI10, and OsZIP4 to control class I meiotic crossover formation.* 221

[OPEN] The B3-Domain Transcription Factor VAL1 Regulates the Floral Transition by Repressing *FLOWERING LOCUS T*. Yanjun Jing, Qiang Guo, and Rongcheng Lin

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METHIONINE SYNTHASE1 Is Involved in Chromatin Silencing by Maintaining DNA and Histone Methylation. Xiaojing Yan, Liang Ma, Hongying Pang, Ping Wang, Lei Liu, Yanxia Cheng, Jinkui Cheng, Yan Guo, and Quanzi Li

*ATMS1 plays a key role in regulating DNA and histone methylations by its function in the one-carbon metabolism pathway.* 249

## MEMBRANES, TRANSPORT AND BIOENERGETICS

[OPEN] Magnesium Deficiency Triggers SGR-Mediated Chlorophyll Degradation for Magnesium Remobilization. Yu Yang Peng, Li Li Liao, Sheng Liu, Miao Miao Nie, Jian Li, Lu Dan Zhang, Jian Feng Ma, and Zhi Chang Chen

*Mid-aged leaves of rice upregulate OsSGR expression to accelerate chlorophyll degradation for Mg remobilization and photooxidative protection under Mg-limited conditions.* 262

[OPEN] A Vacuolar Phytosiderophore Transporter Alters Iron and Zinc Accumulation in Polished Rice Grains. Jing Che, Kengo Yokosho, Naoki Yamaji, and Jian Feng Ma

*Knockout of a vacuolar transporter for a phytosiderophore enhances iron and zinc accumulation in polished rice grains through increasing solubilization of these metals deposited in the node.* 276

## SIGNALING AND RESPONSE

NPR1 Promotes Its Own and Target Gene Expression in Plant Defense by Recruiting CDK8. Jian Chen, Rajinikanth Mohan, Yuqiang Zhang, Min Li, Huan Chen, Ian Arthur Palmer, Ming Chang, Guang Qi, Steven H. Spoel, Tesfaye Mengiste, Daowen Wang, Fengquan Liu, and Zheng Qing Fu

*CDK8 positively regulates SAR by interacting with NPR1, transcription factors, and connecting RNA polymerase II to regulate NPR1 and PR1 expression.* 289

The Clock Gene *TOC1* in Shoots, Not Roots, Determines Fitness of *Nicotiana attenuata* under Drought. Henrique F. Valim, Erica McGale, Felipe Yon, Rayko Halitschke, Variluska Fragoso, Meredith C. Schuman, and Ian T. Baldwin

*The circadian clock gene TOC1 functions in shoots, allowing plants to produce seed when water is limited.* 305

[OPEN] Salt Enhances Disease Resistance and Suppresses Cell Death in Ceramide Kinase Mutants. Yu-Bing Yang, Jian Yin, Li-Qun Huang, Jian Li, Ding-Kang Chen, and Nan Yao

*Salt inhibits cell death in *acd5* mutants, partly via a mechanism that depends on salicylic acid-*abscisic acid* interactions, and enhances disease resistance, independent of pathogen-associated molecular pattern-triggered responses.* 319

[OPEN] SPX4 Acts on PHR1-Dependent and -Independent Regulation of Shoot Phosphorus Status in Arabidopsis. Marina Borges Osorio, Sophia Ng, Oliver Berkowitz, Inge De Clercq, Chuanzao Mao, Huixia Shou, James Whelan, and Ricarda Jost

*SPX4 localizes to both the cytosol and nucleus, acting as a dose-dependent modulator of PHR1-dependent and PHR1-independent phosphate-starvation responses in shoots.* 332

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[<sup>OPEN</sup>] Mutation of a Conserved Motif of PP2C.D Phosphatases Confers SAUR Immunity and Constitutive Activity. *Jeh Haur Wong, Angela K. Spartz, Mee Yeon Park, Minmin Du, and William M. Gray*

*Single missense mutations in a conserved motif of PP2C.D proteins abolish SAUR binding, leading to constitutive phosphatase activity that restricts cell expansion.*

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## SYSTEMS AND SYNTHETIC BIOLOGY

[<sup>OPEN</sup>] The Tomato Translational Landscape Revealed by Transcriptome Assembly and Ribosome Profiling. *Hsin-Yen Larry Wu, Gaoyuan Song, Justin W. Walley, and Polly Yingshan Hsu*

*Ribosome profiling revealed previously unannotated ORFs, elucidated evolutionarily conserved and unique translational features, and identified regulatory mechanisms hidden in the tomato genome.*

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[<sup>OPEN</sup>] Articles can be viewed online without a subscription.