

**On the Cover:** In maturing *Arabidopsis* seeds, embryonic vacuoles are remodelled to become protein storage vacuoles. Shown here, the vacuolar membrane is labelled by the potassium channel TPK1-GFP (green) while storage material accumulating in the lumen is stained with the acidotropic dye Neutral Red (red). Credit: Dr Mistanne Feeney, University of Warwick.

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<sup>[OPEN]</sup>The Role of Trehalose 6-Phosphate in Crop Yield and Resilience.  
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## BREAKTHROUGH TECHNOLOGIES

<sup>[OPEN]</sup>Multiplex Fluorescent, Activity-Based Protein Profiling Identifies Active  $\alpha$ -Glycosidases and Other Hydrolases in Plants. *Amjad M. Husaini, Kyoko Morimoto, Balakumaran Chandrasekar, Steven Kelly, Farnusch Kaschani, Daniel Palmero, Jianbing Jiang, Markus Kaiser, Oussama Ahrazem, Hermen S. Overkleeft, and Renier A. L. van der Hoorn*  
*Activity profiling with biotinylated and fluorescent probes targeting  $\alpha$ -glycosidases in plants is applied to saffron crocus and combined with other hydrolase probes.* 24

Chloroplast  $Ca^{2+}$  Fluxes into and across Thylakoids Revealed by Thylakoid-Targeted Aequorin Probes. *Simone Sello, Roberto Moscatiello, Norbert Mehlmer, Manuela Leonardelli, Luca Carraretto, Enrico Cortese, Filippo G. Zanella, Barbara Baldan, Ildikò Szabò, Ute C. Vothknecht, and Lorella Navazio*  
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- [OPEN]Soft X-Ray Imaging of Cellular Carbon and Nitrogen Distributions in Heterocystous Cyanobacteria. Takahiro Teramoto, Chihiro Azai, Kazuki Terauchi, Masashi Yoshimura, and Toshiaki Ohta  
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- [OPEN]Measurement of Gross Photosynthesis, Respiration in the Light, and Mesophyll Conductance Using H<sub>2</sub><sup>18</sup>O Labeling. Paul P. G. Gauthier, Mark O. Battle, Kevin L. Griffin, and Michael L. Bender  
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## RESEARCH REPORTS

- [OPEN]Perception of Sunflecks by the UV-B Photoreceptor UV RESISTANCE LOCUS8. Victoria Moriconi, Melanie Binkert, Cecilia Costigliolo, Romina Sellaro, Roman Ulm, and Jorge J. Casal  
*Sunflecks that penetrate through canopy gaps transiently interrupt shade and modify the activity of the UV-B photoreceptor UVR8 to mediate growth and gene expression responses.* 75

- Out of Water: The Origin and Early Diversification of Plant R-Genes. Yuxia Gao, Wenqiang Wang, Tian Zhang, Zhen Gong, Huayao Zhao, and Guan-Zhu Han  
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- [OPEN]Large Crown Root Number Improves Topsoil Foraging and Phosphorus Acquisition. Baoru Sun, Yingzhi Gao, and Jonathan P. Lynch  
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- [OPEN]Temporal-Specific Interaction of NF-YC and CURLY LEAF during the Floral Transition Regulates Flowering. Xu Liu, Yuhua Yang, Yilong Hu, Limeng Zhou, Yuge Li, and Xingliang Hou  
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## RESEARCH ARTICLES

### BIOCHEMISTRY AND METABOLISM

- [OPEN]Reduced Aroenate Dehydratase Expression: Ramifications for Photosynthesis and Metabolism. Ricarda Höhner, Joaquim V. Marques, Tetsuro Ito, Yoshiaki Amakura, Alan D. Budgeon, Jr., Karl Weitz, Kim K. Hixson, Laurence B. Davin, Helmut Kirchhoff, and Norman G. Lewis  
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- [OPEN]Darkened Leaves Use Different Metabolic Strategies for Senescence and Survival. Simon R. Law, Daria Chrobok, Marta Juvany, Nicolas Delhomme, Pernilla Lindén, Bastiaan Brouwer, Abdul Ahad, Thomas Moritz, Stefan Jansson, Per Gardeström, and Olivier Keech  
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[OPEN] Exploiting CELLULOSE SYNTHASE (CESA) Class Specificity to Probe Cellulose Microfibril Biosynthesis. *Manoj Kumar, Laxmi Mishra, Paul Carr, Michael Pilling, Peter Gardner, Shawn D. Mansfield, and Simon Turner*

*Mutagenesis reveals which CESA protein classes have the greatest influence on the regulation of cellulose microfibril biosynthesis in the Arabidopsis secondary cell wall.*

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[OPEN] *Rht18* Semidwarfism in Wheat Is Due to Increased GA 2-oxidaseA9 Expression and Reduced GA Content. *Brett A. Ford, Eloise Foo, Robert Sharwood, Miroslava Karafiatova, Jan Vrána, Colleen MacMillan, David S. Nichols, Burkhard Steuernagel, Cristobal Uauy, Jaroslav Doležel, Peter M. Chandler, and Wolfgang Spielmeier*

*In the wheat Rht18 semidwarf, increased expression of GA2oxA9 metabolizes GA<sub>12</sub> precursor to inactive GA<sub>110</sub>, thereby reducing flux through the GA biosynthetic pathway, lowering the content of bioactive GA and reducing growth.*

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[OPEN] Betaine Lipid Is Crucial for Adapting to Low Temperature and Phosphate Deficiency in *Nannochloropsis*. *Hiroki Murakami, Takashi Nobusawa, Koichi Hori, Mie Shimojima, and Hiroyuki Ohta*

*In Nannochloropsis oceanica, betaine lipid is not only important as a surrogate for phospholipids during phosphate deficiency, but is also required for adaptation to low temperature conditions.*

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[OPEN] Scopoletin 8-Hydroxylase-Mediated Fraxetin Production Is Crucial for Iron Mobilization. *Huei-Hsuan Tsai, Jorge Rodríguez-Celma, Ping Lan, Yu-Ching Wu, Isabel Cristina Vélez-Bermúdez, and Wolfgang Schmidt*

*In Arabidopsis thaliana, scopoletin 8-hydroxylase mediates the final step in the biosynthesis of fraxetin, a coumarin with a catechol moiety, which is secreted by roots of iron-deficient plants at elevated pH to mobilize iron.*

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[OPEN] Biotin Attachment Domain-Containing Proteins Irreversibly Inhibit Acetyl CoA Carboxylase. *Jantana Keereetaweep, Hui Liu, Zhiyang Zhai, and John Shanklin*

*Biotin Attachment Domain-Containing Proteins contribute to irreversible inhibition of ACCase under normal growth conditions and under conditions of fatty acid oversupply in Arabidopsis thaliana.*

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## CELL BIOLOGY

[OPEN] The ADAPTOR PROTEIN-3 Complex Mediates Pollen Tube Growth by Coordinating Vacuolar Targeting and Organization. *Qiang-Nan Feng, Xin Liang, Sha Li, and Yan Zhang*

*The dynamic organization of vacuoles and the association of tonoplast cargo protein PAT10 are impaired and lead to reduced pollen tube growth in adaptor protein-3 mutants.*

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[OPEN] ALY RNA-Binding Proteins Are Required for Nucleocytoplasmic mRNA Transport and Modulate Plant Growth and Development. *Christina Pfaff, Hans F. Ehrnsberger, María Flores-Tornero, Brian B. Sørensen, Thomas Schubert, Gernot Längst, Joachim Griesenbeck, Stefanie Sprunck, Marion Grasser, and Klaus D. Grasser*

*Arabidopsis expresses four ALY family nuclear RNA-binding proteins that interact with the RNA helicase UAP56, and their depletion causes nuclear mRNA accumulation and developmental defects.*

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[OPEN] Protein Storage Vacuoles Originate from Remodeled Preexisting Vacuoles in *Arabidopsis thaliana*. *Mistianne Feeney, Maike Kittelmann, Rima Menassa, Chris Hawes, and Lorenzo Frigerio*

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- [OPEN]Rice Morphology Determinant-Mediated Actin Filament Organization Contributes to Pollen Tube Growth. *Gang Li, Xiujuan Yang, Xiaoqing Zhang, Yu Song, Wanqi Liang, and Dabing Zhang*  
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## ECOPHYSIOLOGY AND SUSTAINABILITY

- [OPEN]The Impacts of Phosphorus Deficiency on the Photosynthetic Electron Transport Chain. *Andreas Carstensen, Andrei Herdean, Sidsel Birkelund Schmidt, Anurag Sharma, Cornelia Spetea, Mathias Pribil, and Søren Husted*  
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## GENES, DEVELOPMENT, AND EVOLUTION

- [OPEN]FERTILIZATION-INDEPENDENT SEED-Polycomb Repressive Complex 2 Plays a Dual Role in Regulating Type I MADS-Box Genes in Early Endosperm Development. *Shanshan Zhang, Dongfang Wang, Huajian Zhang, Megan I. Skaggs, Alan Lloyd, Di Ran, Lingling An, Karen S. Schumaker, Gary N. Drews, and Ramin Yadegari*  
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- RECX Interacts with Mitochondrial RECA to Maintain Mitochondrial Genome Stability. *Masaki Odahara and Yasuhiko Sekine*  
*Physcomitrella patens RECX maintains mitochondrial genome stability by interacting with the mitochondrial recombinase RECA1.* 300

- [OPEN]The Linker Histone GH1-HMGA1 Is Involved in Telomere Stability and DNA Damage Repair. *Cyril Charbonnel, Oleh Rymarenko, Olivier Da Ines, Fatiha Benyahya, Charles I. White, Falk Butter, and Simon Amiard*  
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## MEMBRANES, TRANSPORT, AND BIOENERGETICS

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*A chloroplast protein known to be involved in membrane biogenesis and maintenance displays a novel type of GTPase activity requiring oligomerization through its N-terminus.* 328

## SIGNALING AND RESPONSE

- [OPEN]Polyamines Regulate Strawberry Fruit Ripening by Abscisic Acid, Auxin, and Ethylene. *Jiaxuan Guo, Shufang Wang, Xiaoyang Yu, Rui Dong, Yuzhong Li, Xurong Mei, and Yuanyue Shen*  
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- [OPEN]Magnaporthe oryzae Induces the Expression of a MicroRNA to Suppress the Immune Response in Rice. *Xin Zhang, Yalin Bao, Deqi Shan, Zhihui Wang, Xiaoning Song, Zhaoyun Wang, Jiansheng Wang, Liqiang He, Liang Wu, Zhengguang Zhang, Dongdong Niu, Hailing Jin, and Hongwei Zhao*  
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- [OPEN] Heterologous Expression of *AtBBX21* Enhances the Rate of Photosynthesis and Alleviates Photoinhibition in *Solanum tuberosum*. Carlos D. Crocco, Gabriel Gomez Ocampo, Edmundo L. Ploschuk, Anita Mantese, and Javier F. Botto  
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- [OPEN] Ribosomal RNA Biogenesis and Its Response to Chilling Stress in *Oryza sativa*. Runlai Hang, Zhen Wang, Xian Deng, Chunyan Liu, Bin Yan, Chao Yang, Xianwei Song, Beixin Mo, and Xiaofeng Cao  
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- [OPEN] The Potato MAP3K StVIK Is Required for the *Phytophthora infestans* RXLR Effector Pi17316 to Promote Disease. Fraser Murphy, Qin He, Miles Armstrong, Licida M. Giuliani, Petra C. Boevink, Wei Zhang, Zhendong Tian, Paul R. J. Birch, and Eleanor M. Gilroy  
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- [OPEN] Interaction of 2',3'-cAMP with Rbp47b Plays a Role in Stress Granule Formation. Monika Kosmacz, Marcin Luzarowski, Olga Kerber, Ewa Leniak, Emilio Gutiérrez-Beltrán, Juan Camilo Moreno, Michał Gorka, Jagoda Szlachetko, Daniel Veyel, Alexander Graf, and Aleksandra Skirycz  
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## SYSTEMS AND SYNTHETIC BIOLOGY

- [OPEN] Predicted Arabidopsis Interactome Resource and Gene Set Linkage Analysis: A Transcriptomic Analysis Resource. Heng Yao, Xiaoxuan Wang, Pengcheng Chen, Ling Hai, Kang Jin, Lixia Yao, Chuanzao Mao, and Xin Chen  
*The Predicted Arabidopsis Interactome Resource (PAIR) is a database of high-confidence functional associations between Arabidopsis genes that integrates functional association evidence and enables a network-driven approach for interpreting transcriptomic changes functionally impacting biological processes.* 422

## CORRECTION

- 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. 434

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