

On the Cover: Anthers develop from undifferentiated meristematic cells into an organized set of tissues that produce pollen in plants. The cover image shows a high-pressure frozen freeze-substituted pre-meiotic barley anther including middle layer (bright green), tapetum (yellow-green), nuclei (blue) and mitochondria (red). Original article by Bélanger et al. provides novel developmental insights and evolutionary significance of phasiRNA biogenesis in maize, barley and rice. Image credit: Sébastien Bélanger & Kirk J Czymmek.

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^[OPEN]Transcriptomic and Proteomic Insights into *Amborella trichopoda* Male Gametophyte Functions. *María Flores-Tornero, Frank Vogler, Marek Mutwil, David Potěšil, Ivana Ihnatová, Zbyněk Zdráhal, Stefanie Sprunck, and Thomas Dresselhaus*
Transcriptomic and proteomic data from the basal angiosperm Amborella provide a resource to understand the evolution of male gametophyte functions in flowering plants. 1640

^[OPEN]Mutagenomics: A Rapid, High-Throughput Method to Identify Causative Mutations from a Genetic Screen. *Charles Hodgens, Nicole Chang, G. Eric Schaller, and Joseph J. Kieber*
A method for the high-throughput identification of causative genes corresponding to mutations identified in a genetic screen is developed and applied to a screen for cytokinin mutants. 1658

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^[OPEN]A Novel Single-Domain Na⁺-Selective Voltage-Gated Channel in Photosynthetic Eukaryotes. *Katherine E. Helliwell, Abdul Chrachri, Julie A. Koester, Susan Wharam, Alison R. Taylor, Glen L. Wheeler, and Colin Brownlee*
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- Light-Induced Basic/Helix-Loop-Helix64 Enhances Anthocyanin Biosynthesis and Undergoes CONSTITUTIVELY PHOTOMORPHOGENIC1-Mediated Degradation in Pear. *Ruiyan Tao, Wenjie Yu, Yuhao Gao, Junbei Ni, Lei Yin, Xiao Zhang, Hongxu Li, Dongsheng Wang, Songling Bai, and Yuanwen Teng*
A light-responsive pear protein belonging to the bHLH family enhances anthocyanin biosynthesis under light and is degraded by the 26S proteasome in darkness. 1684
- Ubiquitination of S₄-RNase by S-LOCUS F-BOX LIKE2 Contributes to Self-Compatibility of Sweet Cherry 'Lapins'. *Yang Li, Xuwei Duan, Chuanbao Wu, Jie Yu, Chunsheng Liu, Jing Wang, Xiaoming Zhang, Guohua Yan, Feng Jiang, Tianzhong Li, Kaichun Zhang, and Wei Li*
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- [OPEN]Phosphatidylglycerol Composition Is Central to Chilling Damage in the Arabidopsis *fab1* Mutant. *Jinpeng Gao, Daniel Lunn, James G. Wallis, and John Browse*
Arabidopsis fab1 mutants die at 2°C; however, reducing levels of high-melting-point phosphatidylglycerol species through expression of a chloroplast-targeted 16:0 desaturase rescues fab1 plants. 1717
- Molecular Basis for Chemical Evolution of Flavones to Flavonols and Anthocyanins in Land Plants. *Dan-Dan Li, Rong Ni, Ping-Ping Wang, Xiao-Shuang Zhang, Piao-Yi Wang, Ting-Ting Zhu, Chun-Jing Sun, Chang-Jun Liu, Hong-Xiang Lou, and Ai-Xia Cheng*
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- Six Uridine-Diphosphate Glycosyltransferases Catalyze the Glycosylation of Bioactive C₁₃-Apocarotenols. *Guangxin Sun, Natalia Putkaradze, Sina Bohnacker, Rafal Jonczyk, Tarik Fida, Thomas Hoffmann, Rita Bernhardt, Katja Härtl, and Wilfried Schwab*
Six transferases in Nicotiana benthamiana and Mentha × piperita catalyze the glycosylation of a range of hydroxylated α- and β-ionone/ionol derivatives. 1744
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The Chlamydomonas CXC domain phosphoprotein Compromised Hydrolysis of TAG7 shows cell-cycle-dependent changes in protein abundance and a portion associates with RB/MAT3, a cell cycle regulator. 1762
- [OPEN]The NAC Transcription Factors OsNAC20 and OsNAC26 Regulate Starch and Storage Protein Synthesis. *Juan Wang, Zichun Chen, Qing Zhang, Shanshan Meng, and Cunxu Wei*
The NAC transcription factors OsNAC20 and OsNAC26 influence starch and storage protein accumulation by directly regulating the expression of starch and storage protein synthesis-related genes. 1775
- [OPEN]CfrA, a Novel Carbon Flow Regulator, Adapts Carbon Metabolism to Nitrogen Deficiency in Cyanobacteria. *M. Isabel Muro-Pastor, Aureo Cutillas-Farray, Laura Pérez-Rodríguez, Julia Pérez-Saavedra, Ana Vega-de Armas, Ana Paredes, Rocío Robles-Rengel, and Francisco J. Florencio*
Carbon flow regulator A (CfrA) is a novel cyanobacterial regulatory protein involved in the redirection of carbon flow toward glycogen storage in response to nitrogen deficiency. 1792
- ### CELL BIOLOGY
- [OPEN]ZmMTOPIVIB Enables DNA Double-Strand Break Formation and Bipolar Spindle Assembly during Maize Meiosis. *Ju-Li Jing, Ting Zhang, Yu-Hsin Kao, Tzu-Han Huang, Chung-Ju Rachel Wang, and Yan He*
The dual roles of the topoisomerase-encoding MTOPIVIB in meiotic double-strand break formation and bipolar spindle assembly and are evolutionarily conserved in monocot plants. 1811

[OPEN]EXO70A2 Is Critical for Exocyst Complex Function in Pollen Development. *Vedrana Marković, Fatima Corčková, Martin Potocký, Ivan Kulich, Přemysl Pejchar, Eva Kollárová, Lukáš Synek, and Viktor Žárský*
A pollen-specific component of the exocyst, a protein complex regulating cellular secretion, plays an important role in pollen development and function in Arabidopsis. 1823

[OPEN]Transpiration from Tomato Fruit Occurs Primarily via Trichome-Associated Transcuticular Polar Pores. *Eric A. Fich, Josef Fisher, Dani Zamir, and Jocelyn K.C. Rose*
Hydrophilic pores created by trichomes in the tomato fruit cuticle provide the main route for postharvest transpirational water loss. 1840

[OPEN]Kinase Partner Protein Plays a Key Role in Controlling the Speed and Shape of Pollen Tube Growth in Tomato. *Hai-Kuan Liu, Yu-Jie Li, Shu-Jie Wang, Ting-Lu Yuan, Wei-Jie Huang, Xin Dong, Jia-Qi Pei, Dong Zhang, Sheila McCormick, and Wei-Hua Tang*
A tomato kinase partner protein links actin cytoskeleton regulators to pollen receptor kinase signaling and Rho-of-Plants GTPase activation, thereby modulating pollen tube growth. 1853

Holliday Junction Resolvase MOC1 Maintains Plastid and Mitochondrial Genome Integrity in Algae and Bryophytes. *Yusuke Kobayashi, Masaki Odahara, Yasuhiko Sekine, Takashi Hamaji, Sumire Fujiwara, Yoshiki Nishimura, and Shin-ya Miyagishima*
Monokaryotic Chloroplast1 acts in recombination surveillance of plastid and mitochondrial DNA by preventing ectopic recombination between short dispersed repeats. 1870

[OPEN]Dual-Localized WHIRLY1 Affects Salicylic Acid Biosynthesis via Coordination of ISOCHORISMATE SYNTHASE1, PHENYLALANINE AMMONIA LYASE1, and S-ADENOSYL-L-METHIONINE-DEPENDENT METHYLTRANSFERASE1. *Wenfang Lin, Hong Zhang, Dongmei Huang, Dirk Schenke, Daguang Cai, Binghua Wu, and Ying Miao*
Arabidopsis nuclear- and chloroplast-localized WHIRLY1 adjusts SA content in cells via ICS1, PAL1, and BSMT1 to regulate senescence in a developmental-dependent manner. 1884

ECOPHYSIOLOGY AND SUSTAINABILITY

The K⁺ and NO₃⁻ Interaction Mediated by NITRATE TRANSPORTER1.1 Ensures Better Plant Growth under K⁺-Limiting Conditions. *Xian Zhi Fang, Xing Xing Liu, Ya Xing Zhu, Jia Yuan Ye, and Chong Wei Jin*
NITRATE TRANSPORTER 1.1 favors the uptake and allocation of K⁺, which respectively depends on its coordination with the K⁺ transporters in the epidermis, cortex and central vasculature of roots. 1900

Increased Cuticle Permeability Caused by a New Allele of ACETYL-COA CARBOXYLASE1 Enhances CO₂ Uptake. *Keina Monda, Atsushi Mabuchi, Sho Takahashi, Juntaro Negi, Ryoma Tohmori, Ichiro Terashima, Wataru Yamori, and Koh Iba*
In Arabidopsis, carbon dioxide uptake efficiency is enhanced more by increased cuticle permeability than by increased stomatal opening. 1917

GENES, DEVELOPMENT AND EVOLUTION

[OPEN]Toward "Smart Canopy" Sorghum: Discovery of the Genetic Control of Leaf Angle Across Layers. *Maria Betsabe Mantilla-Perez, Yin Bao, Lie Tang, Patrick S. Schnable, and Maria G. Salas-Fernandez*
Leaf angle across the sorghum canopy is genetically controlled by both common and layer-specific loci, which holds potential for the development of an optimized canopy associated with higher yields. 1927

[OPEN]Heterotrimeric G-Protein Interactions Are Conserved Despite Regulatory Element Loss in Some Plants. *Nikita Bhatnagar and Sona Pandey*
The functional networks between the G-protein α -subunit and its regulatory protein, RGS, are conserved in plants, and despite the absence of RGS in many monocots, their corresponding G α proteins have retained the ability to be deactivated by nonnative RGS in planta. 1941

- [OPEN] Changes in Alternative Splicing in Response to Domestication and Polyploidization in Wheat. *Kuohai Yu, Man Feng, Guanghui Yang, Lv Sun, Zhen Qin, Jie Cao, Jingjing Wen, Haoran Li, Yan Zhou, Xiangping Chen, Huiru Peng, Yingyin Yao, Zhaorong Hu, Weilong Guo, Qixin Sun, Zhongfu Ni, Keith Adams, and Mingming Xin*
Transcriptomic analyses of several wheat species with different ploidies reveal alternative splicing changes in domestication or polyploidization. 1955
- [OPEN] The H3K27me3 Demethylase RELATIVE OF EARLY FLOWERING6 Suppresses Seed Dormancy by Inducing Abscisic Acid Catabolism. *Huhui Chen, Jianhua Tong, Wei Fu, Zhenwei Liang, Jiuxiao Ruan, Yaoguang Yu, Xin Song, Liangbing Yuan, Langtao Xiao, Jun Liu, Yuhai Cui, Shangzhi Huang, and Chenlong Li*
H3K27me3 demethylase REF6 suppresses seed dormancy and promotes seed germination by enhancing the catabolism of the plant hormone abscisic acid. 1969
- A Missense Mutation in a Large Subunit of Ribonucleotide Reductase Confers Temperature-Gated Tassel Formation. *Shiyi Xie, Hongbing Luo, Yumin Huang, Yaxin Wang, Wei Ru, Yunlu Shi, Wei Huang, Hai Wang, Zhaobin Dong, and Weiwei Jin*
Temperature-dependent shoot apical meristem development is conferred by temperature-gated interactions between ribonucleotide reductase subunits. 1979
- [OPEN] Origins and Evolution of Cuticle Biosynthetic Machinery in Land Plants. *Lingyao Kong, Yanna Liu, Pengfei Zhi, Xiaoyu Wang, Bo Xu, Zhizhong Gong, and Cheng Chang*
Portions of the cuticle biosynthetic machinery originated in the last common ancestor of embryophytes and underwent evolution and diversification in land plants. 1998
- [OPEN] The PPR-SMR Protein ATP4 Is Required for Editing the Chloroplast *rps8* mRNA in Rice and Maize. *Jinghong Zhang, Yipo Guo, Qian Fang, Yongli Zhu, Yang Zhang, Xuejiao Liu, Yongjun Lin, Alice Barkan, and Fei Zhou*
*The PPR-SMR protein ATP4 is required for RNA editing of the chloroplast encoded *rps8* gene in rice and maize, and the defect in *rps8* expression underlies a cold-sensitive phenotype in rice.* 2011
- [OPEN] SMALL ORGAN4 Is a Ribosome Biogenesis Factor Involved in 5.8S Ribosomal RNA Maturation. *Rosa Micol-Ponce, Raquel Sarmiento-Mañúis, Sara Fontcuberta-Cervera, Adrián Cabezas-Fuster, Anne de Bures, Julio Sáez-Vásquez, and María Rosa Ponce*
SMALL ORGAN4 (SMO4) is the Arabidopsis putative ortholog of yeast ribosome biogenesis factor Nop53; loss of SMO4 function causes nucleolar hypertrophy and overaccumulation of 5.8S and 18S rRNA precursors. 2022
- MEMBRANES, TRANSPORT AND BIOENERGETICS**
- [OPEN] PSI of the Colonial Alga *Botryococcus braunii* Has an Unusually Large Antenna Size. *Tomas E. van den Berg, Rameez Arshad, Wojciech J. Nawrocki, Egbert J. Boekema, Roman Kouřil, and Roberta Croce*
*The green alga *B. braunii* lives in colonies where cells are shading each other and it has developed a large capacity for harvesting light while maintaining a high light-to-energy conversion efficiency.* 2040
- The Lipid Composition of *Euglena gracilis* Middle Plastid Membrane Resembles That of Primary Plastid Envelopes. *Lucia Tomečková, Aleš Tomčala, Miroslav Oborník, and Vladimír Hampl*
*The lipid composition of *E. gracilis* plastid envelopes suggests that the two innermost membranes are rich in glycosyldiacylglycerols, indicating their similarity to primary plastid membranes.* 2052
- [CC-BY] Spatial Profiles of Phosphate in Roots Indicate Developmental Control of Uptake, Recycling, and Sequestration. *Abira Sahu, Swayoma Banerjee, Aditi Subramani Raju, Tzyy-Jen Chiou, L. Rene Garcia, and Wayne K. Versaw*
Distinct spatiotemporal patterns for the uptake, recycling, and vacuolar sequestration of phosphate in the root indicate developmental control of cytosolic phosphate homeostasis. 2064
- [OPEN] Collaboration between NDH and KEA3 Allows Maximally Efficient Photosynthesis after a Long Dark Adaptation. *Leonardo Basso, Wataru Yamori, Ildiko Szabo, and Toshiharu Shikanai*
After overnight dark adaptation, one of the cyclic electron transport pathways collaborates with the thylakoid H⁺/K⁺ antiporter to efficiently induce photosynthesis. 2078

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ELONGATED HYPOCOTYL5 Negatively Regulates DECREASE WAX BIOSYNTHESIS to Increase Survival during UV-B Stress. Prince Saini, Shivani Bhatia, Monika Mahajan, Anshul Kaushik, Sangram Keshari Sahu, Asis Kumar, Santosh B. Satbhai, Manoj Kumar Patel, Shweta Saxena, Om Prakash Chaurasia, Maneesh Lingwan, Shyam Kumar Masakapalli, and Ram Kishor Yadav

A light signalling integrating factor improves the tolerance of Arabidopsis thaliana in UV-B stress by decreasing the expression level of a negative regulator.

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[OPEN]The Halophyte Seashore Paspalum Uses Adaxial Leaf Papillae for Sodium Sequestration. John J. Spiekerman and Katrien M. Devos

The halophytic turfgrass seashore paspalum sequesters sodium in adaxial leaf papillae, providing evidence for the presence of functioning sequestration structures in the Panicoideae grass subfamily.

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[OPEN]The Transcription Factor EIL1 Participates in the Regulation of Sulfur-Deficiency Response. Christof Dietzen, Anna Koprivova, Sarah J. Whitcomb, Gregor Langen, Timothy O. Jobe, Rainer Hoefgen, and Stanislav Kopriva

The transcription factor EIL1 has an additive role to SLIM1 in the regulation of sulfur-deficiency response.

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[OPEN]A Gas-and-Brake Mechanism of bHLH Proteins Modulates Shade Avoidance. Sara Buti, Chrysoula K. Pantazopoulou, Kasper van Gelderen, Valérie Hoogers, Emilie Reinen, and Ronald Pierik

KIDARI is a positive regulator of shade avoidance and part of a three-layered network of bHLH transcription factor interactions.

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[OPEN]The Microtubule-Associated Protein CLASP Is Translationally Regulated in Light-Dependent Root Apical Meristem Growth. Laryssa Halat, Katherine Gyte, and Geoffrey Wasteneys

The microtubule-associated protein CLASP is regulated at the translational level when root meristem growth is inhibited in dark-grown plants.

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SIFERL Interacts with S-Adenosylmethionine Synthetase to Regulate Fruit Ripening. Dongchao Ji, Xiaomin Cui, Guozheng Qin, Tong Chen, and Shiping Tian

The tomato membrane protein SIFERL regulates fruit ripening by modulating ethylene production.

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Cytidine-to-Uridine RNA Editing Factor NbMORF8 Negatively Regulates Plant Immunity to Phytophthora Pathogens. Yang Yang, Guangjin Fan, Yan Zhao, Qujiang Wen, Peng Wu, Yuling Meng, and Weixing Shan

A mitochondrion- and chloroplast-targeted RNA-editing factor negatively regulates plant immunity to Phytophthora pathogens by suppressing effector accumulation, ROS burst, and SA signaling.

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[OPEN]Regulation of a Cytochrome P450 Gene CYP94B1 by WRKY33 Transcription Factor Controls Apoplastic Barrier Formation in Roots to Confer Salt Tolerance. Pannaga Krishnamurthy, Bhushan Vishal, Wan Jing Ho, Felicia Chien Joo Lok, Felicia Si Min Lee, and Prakash P. Kumar

The WRKY33 transcription factor regulates expression of a cytochrome P450 gene and enhances suberin deposition in the endodermal cells of roots, which confers salt tolerance to Arabidopsis plants.

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Melatonin Is Involved in Citrus Response to the Pathogen Huanglongbing via Modulation of Phytohormonal Biosynthesis. Yasser Nehela and Nabil Killiny

The auxin-like metabolite melatonin regulates the production of citrus phytohormones upon infection with the huanglongbing pathogen and infestation with its vector.

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CORRECTION

The Local Phosphate Deficiency Response Activates Endoplasmic Reticulum Stress-Dependent Autophagy.

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