

On the Cover: Germ cells are indispensable carriers of genetic information from one generation to the next. *SPOROCTELESS/NOZZLE* (*SPL/NZZ*) was previously identified as an essential regulator of archesporial cell differentiation in the stamens and ovules of Arabidopsis. In this issue, Zhao et al. (pp. 2265–2277) demonstrate that MPK3/6 kinases are required for the differentiation of archesporial cells in Arabidopsis anthers by interacting with and phosphorylating SPL proteins. The cover image shows the specificity of the expression pattern of a newly generated $P_{SPL}:GUS$ reporter in *mpk3/+mpk6/-* flowers. While *SPL/NZZ* expression is highly specific to the primordia of the anther and ovule and is concentrated where germ cells differentiated, the upstream sequence of *SPL/NZZ* does not have the specificity. To obtain proper tools to precisely manipulate gene expression, a new cassette was constructed by replacing the first exon with a *GUS* gene. As shown in the photo, the reporter can precisely mimic the expression pattern of *SPL/NZZ* examined by in situ hybridization and can be used as a new tool for analysis of regulatory mechanisms in germ cell initiation and differentiation in Arabidopsis.

ON THE INSIDE

Peter V. Minorsky

1937

COMMENTARY

The First Broad-Spectrum Abscisic Acid Antagonist. Jeffrey Leung

This is a commentary on an accepted manuscript by Ye et al., requested by Plant Physiology.

1939

BREAKTHROUGH TECHNOLOGIES

A Viral Satellite DNA Vector (TYLCCNV) for Functional Analysis of miRNAs and siRNAs in Plants.

Zheng Ju, Dongyan Cao, Chao Gao, Jinhua Zuo, Baiqiang Zhai, Shan Li, Hongliang Zhu, Daqi Fu, Yunbo Luo, and Benzong Zhu

A new small RNA overexpression system could highly overexpress not only artificial and endogenous miRNAs but also endogenous siRNAs in Nicotiana benthamiana.

1940

RESEARCH REPORT

^[OPEN]Mechanism of Dual Targeting of the Phytochrome Signaling Component HEMERA/pTAC12 to Plastids and the Nucleus. P. Andrew Nevarez, Yongjian Qiu, Hitoshi Inoue, Chan Yul Yoo, Philip N. Benfey, Danny J. Schnell, and Meng Chen

HEMERA/pTAC12 accumulation in the nucleus requires localization to the plastids.

1953

UPDATE

^[OPEN]Pollen Development at High Temperature: From Acclimation to Collapse. Ivo Rieu, David Twell, and Nurit Firon

Pollen development at high temperature depends on a fine balance between acclimation and injury.

1967

Continued on next page

RESEARCH ARTICLES

BIOCHEMISTRY AND METABOLISM

[^{OPEN}] Aldehyde Oxidase 4 Plays a Critical Role in Delaying Silique Senescence by Catalyzing Aldehyde Detoxification. *Sudhakar Srivastava, Galina Brychkova, Dmitry Yarmolinsky, Aigerim Soltabayeva, Talya Samani, and Moshe Sagi*

AAO4 plays a critical role in delaying silique senescence by catalyzing aldehyde detoxification and generates both hydrogen peroxide and superoxide.

1977

[^{CC-BY}] Spatial and Temporal Mapping of Key Lipid Species in *Brassica napus* Seeds. *Helen K. Woodfield, Drew Sturtevant, Ljudmilla Borisjuk, Eberhard Munz, Irina A. Guschina, Kent Chapman, and John L. Harwood*

The various tissue types of oilseed rape seeds have different lipid compositions, which are established early in seed development.

1998

[^{OPEN}] Discovery and Characterization of the 3-Hydroxyacyl-ACP Dehydratase Component of the Plant Mitochondrial Fatty Acid Synthase System. *Xin Guan, Yozo Okazaki, Andrew Lithio, Ling Li, Xuefeng Zhao, Huanan Jin, Dan Nettleton, Kazuki Saito, and Basil J. Nikolau*

Identification and characterization of the mitochondrial 3-hydroxyacyl-ACP dehydratase reveal novel functionalities associated with the mitochondrial fatty acid synthase system.

2010

[^{OPEN}] Salicylic Acid-Dependent Plant Stress Signaling via Mitochondrial Succinate Dehydrogenase. *Katharina Belt, Shaobai Huang, Louise F. Thatcher, Hayley Casarotto, Karam B. Singh, Olivier Van Aken, and A. Harvey Millar*

Salicylic acid stimulates succinate dehydrogenase activity and induces mitochondrial ROS production to induce stress signaling.

2029

[^{OPEN}] Genome-Wide Prediction of Metabolic Enzymes, Pathways, and Gene Clusters in Plants. *Pascal Schlöpfer, Peifen Zhang, Chuan Wang, Taehyong Kim, Michael Banf, Lee Chae, Kate Dreher, Arvind K. Chavali, Ricardo Nilo-Poyanco, Thomas Bernard, Daniel Kahn, and Seung Y. Rhee*

A computational pipeline generates high-quality and genome-scale sets of metabolic enzymes, pathways, and gene clusters from plant genomes.

2041

Glycerolipid Characterization and Nutrient Deprivation-Associated Changes in the Green Picoalga *Ostreococcus tauri*. *Charlotte Degraeve-Guilbault, Claire Bréhélin, Richard Haslam, Olga Sayanova, Gładys Marie-Luce, Juliette Jouhet, and Florence Corellou*

*Analysis of the lipid profile of *O. tauri* revealed that those in the plastid were enriched in C18-PUFAs and the omega-3 docosahexaenoic acid was exclusively extraplastidial, but that highly unsaturated TAGs originate from both ER and plastid precursors.*

2060

[^{OPEN}] Two Acyltransferases Contribute Differently to Linolenic Acid Levels in Seed Oil. *Sofia Marmon, Drew Sturtevant, Cornelia Herrfurth, Kent Chapman, Sten Stymne, and Ivo Feussner*

*Changes in expression of DGAT1 and PDAT alter the fatty acid composition and spatial distribution of triacylglycerol and phosphatidylcholine molecular species in *Camelina sativa* seeds.*

2081

Mitochondrial ABC Transporter ATM3 Is Essential for Cytosolic Iron-Sulfur Cluster Assembly. *Jia Zuo, Zhigeng Wu, Ying Li, Zedan Shen, Xiangyang Feng, Mingyong Zhang, and Hong Ye*

Mitochondrial transporter ATM3-dependent cytosolic Fe-S cluster assembly is important for the development of lateral roots, root apical meristem, and shoot apical meristem in rice.

2096

[OPEN]Photosynthetic Trichomes Contain a Specific Rubisco with a Modified pH-Dependent Activity. *Raphaëlle Laterre, Mathieu Pottier, Claire Remacle, and Marc Boutry*

Secretory cells contain a specific Rubisco, the small subunit of which belongs to a so-far-uncharacterized phylogenetic cluster and confers a modified pH-dependent activity.

2110

CELL BIOLOGY

[OPEN]Identification of Putative Substrates of SEC2, a Chloroplast Inner Envelope Translocase. *Yubing Li, Jonathan R. Martin, Giovanni A. Aldama, Donna E. Fernandez, and Kenneth Cline*

The protein translocase SEC2 in the inner chloroplast envelope facilitates membrane integration of a subset of envelope proteins.

2121

The Non-Mendelian Green Cotyledon Gene in Soybean Encodes a Small Subunit of Photosystem II. *Kaori Kohzuma, Yutaka Sato, Hisashi Ito, Ayako Okuzaki, Mai Watanabe, Hideki Kobayashi, Michiharu Nakano, Hiroshi Yamatani, Yu Masuda, Yumi Nagashima, Hiroyuki Fukuoka, Tetsuya Yamada, Akira Kanazawa, Keisuke Kitamura, Yutaka Tabei, Masahiko Ikeuchi, Wataru Sakamoto, Ayumi Tanaka, and Makoto Kusaba*

Molecular cloning of a cytoplasmic stay-green mutant gene revealed that a small subunit of PSII is involved in chlorophyll b degradation.

2138

[OPEN]Chloroplast Preproteins Bind to the Dimer Interface of the Toc159 Receptor during Import. *Jun-Shian Chang, Lih-Jen Chen, Yi-Hung Yeh, Chwan-Deng Hsiao, and Hsou-min Li*

Preprotein-binding sites are mapped to the dimer interface and the switch II region of the Toc159 GTPase domain.

2148

ECOPHYSIOLOGY AND SUSTAINABILITY

[CC-BY]Importance of Fluctuations in Light on Plant Photosynthetic Acclimation. *Silvere Vialet-Chabrand, Jack S.A. Matthews, Andrew J. Simkin, Christine A. Raines, and Tracy Lawson*

Fluctuating light influences acclimation in Arabidopsis independently of light intensity.

2163

[OPEN]The Accumulation of miRNAs Differentially Modulated by Drought Stress Is Affected by Grafting in Grapevine. *Chiara Pagliarani, Marco Vitali, Manuela Ferrero, Nicola Vitulo, Marco Incarbone, Claudio Lovisolo, Giorgio Valle, and Andrea Schubert*

The abundance of drought-regulated miRNAs is affected by grafting in grapevine.

2180

[OPEN]Monitoring of Freezing Dynamics in Trees: A Simple Phase Shift Causes Complexity. *Guillaume Charrier, Markus Nolf, Georg Leitinger, Katline Charra-Vaskou, Adriano Losso, Ulrike Tappeiner, Thierry Améglio, and Stefan Mayr*

Monitoring of freezing in trees via nondestructive methods revealed complex spatial and temporal freezing patterns that promote internal water shifts and cavitation events.

2196

GENES, DEVELOPMENT, AND EVOLUTION

[^{OPEN}] Selection for a Zinc-Finger Protein Contributes to Seed Oil Increase during Soybean Domestication. Qing-Tian Li, Xiang Lu, Qing-Xin Song, Hao-Wei Chen, Wei Wei, Jian-Jun Tao, Xiao-Hua Bian, Ming Shen, Biao Ma, Wan-Ke Zhang, Ying-Dong Bi, Wei Li, Yong-Cai Lai, Sin-Man Lam, Guang-Hou Shui, Shou-Yi Chen, and Jin-Song Zhang

Domestication-selective GmZF351 encoding tandem CCCH zinc finger protein promotes seed oil accumulation in soybean. 2208

[^{OPEN}] Changes in Anthocyanin Production during Domestication of Citrus. Eugenio Butelli, Andrés Garcia-Lor, Concetta Licciardello, Giuseppina Las Casas, Lionel Hill, Giuseppe Reforgiato Recupero, Manjunath L. Keremane, Chandrika Ramadugu, Robert Krueger, Qiang Xu, Xiuxin Deng, Anne-Laure Fanciullino, Yann Froelicher, Luis Navarro, and Cathie Martin

Ruby, a regulatory gene encoding a MYB transcription factor, is essential for anthocyanin production, and differences in its activity determine most of the natural variation in pigmentation in Citrus and related genera. 2225

[^{OPEN}] Histone Lysine-to-Methionine Mutations Reduce Histone Methylation and Cause Developmental Pleiotropy. Dean Sanders, Shuiming Qian, Rachael Fieweger, Li Lu, James A. Dowell, John M. Denu, and Xuehua Zhong

Transgenic plants expressing H3K36M mutations have a dominant-negative effect on the endogenous histone methylation landscape, leading to pleiotropic developmental defects. 2243

[^{OPEN}] EARLY FLOWERING3 Redundancy Fine-Tunes Photoperiod Sensitivity. Andrew J.S. Rubenach, Valérie Hecht, Jacqueline K. Vander Schoor, Lim Chee Liew, Gregoire Aubert, Judith Burstin, and James L. Weller

A legume-specific duplication of the circadian clock gene ELF3 provides functional redundancy in pea and may help explain the importance of ELF3 genes in flowering time adaptation. 2253

Phosphorylation of SPOROCTELESS/NOZZLE by the MPK3/6 Kinase Is Required for Anther Development. Feng Zhao, Ya-Feng Zheng, Ting Zeng, Rui Sun, Ji-Yuan Yang, Yuan Li, Dong-Tao Ren, Hong Ma, Zhi-Hong Xu, and Shu-Nong Bai

MPK3/6 is responsible for phosphorylation of SPOROCTELESS/NOZZLE protein, which is required for its function in Arabidopsis anther development. 2265

[^{OPEN}] An Organelle RNA Recognition Motif Protein Is Required for Photosystem II Subunit *psbF* Transcript Editing. Justin B. Hackett, Xiaowen Shi, Amy T. Kobylarz, Meriah K. Lucas, Ryan L. Wessendorf, Kevin M. Hines, Stephane Bentolila, Maureen R. Hanson, and Yan Lu

*An organelle RNA recognition motif protein is required for *psbF* transcript editing and the production of efficient PSII in Arabidopsis.* 2278

The Arabidopsis Mitochondrial Protease FtSH4 Is Involved in Leaf Senescence via Regulation of WRKY-Dependent Salicylic Acid Accumulation and Signaling. Shengchun Zhang, Cui Li, Rui Wang, Yaxue Chen, Si Shu, Ruihua Huang, Daowei Zhang, Jian Li, Shi Xiao, Nan Yao, and Chengwei Yang

The mitochondria-localized protein FtSH4 regulates leaf senescence and modulates the cross talk of ROS, SA, and WRKY signaling pathways. 2294

[OPEN] The REVEILLE Clock Genes Inhibit Growth of Juvenile and Adult Plants by Control of Cell Size. Jennifer A. Gray, Akiva Shalit-Kaneh, Dalena Nhu Chu, Polly Yingshan Hsu, and Stacey L. Harmer

Myb-like transcription factors important for circadian clock function also inhibit cell expansion, affecting the size of both juvenile and adult plants.

2308

SIGNALING AND RESPONSE

The Pepper RING-Type E3 Ligase CaAIRF1 Regulates ABA and Drought Signaling via CaADIP1 Protein Phosphatase Degradation. Chae Woo Lim, Woonhee Baek, and Sung Chul Lee

RING-type E3 ligase controls clade A protein phosphatase 2C, a core ABA component indirectly or directly at the transcriptional and posttranslational levels in ABA and drought signaling.

2323

Shoot Removal Induces Chloroplast Development in Roots via Cytokinin Signaling. Koichi Kobayashi, Ai Ohmishi, Daichi Sasaki, Sho Fujii, Akira Iwase, Keiko Sugimoto, Tatsuru Masuda, and Hajime Wada

Arabidopsis roots activate cytokinin signaling in response to shoot removal independently of reduced auxin signaling and induce chloroplast development and photosynthetic remodeling.

2340

A Novel Chemical Inhibitor of ABA Signaling Targets All ABA Receptors. Yajin Ye, Lijuan Zhou, Xue Liu, Hao Liu, Deqiang Li, Minjie Cao, Haifeng Chen, Lin Xu, Jian-kang Zhu, and Yang Zhao

Small molecule AA1 as a novel antagonist of ABA targets all ABA receptors of Arabidopsis.

2356

[OPEN] STABILIZED1 Modulates Pre-mRNA Splicing for Thermotolerance. Geun-Don Kim, Young-Hee Cho, Byeong-Ha Lee, and Sang-Dong Yoo

Heat-inducible STA1 activity is involved in the pre-mRNA splicing of heat stress response genes and contributes to the establishment of heat stress tolerance in Arabidopsis.

2370

Cellulose-Derived Oligomers Act as Damage-Associated Molecular Patterns and Trigger Defense-Like Responses. Clarice de Azevedo Souza, Shundai Li, Andrew Z. Lin, Freddy Boutrot, Guido Grossmann, Cyril Zipfel, and Shauna C. Somerville

Cellobiose, a danger signal derived from breakdown of the major cell wall polymer cellulose, enhances plant defenses triggered by microbe-derived elicitors.

2383

[OPEN] Antiviral Resistance Protein Tm-2² Functions on the Plasma Membrane. Tianyuan Chen, Dan Liu, Xiaolin Niu, Junzhu Wang, Lichao Qian, Lu Han, Na Liu, Jinping Zhao, Yiguo Hong, and Yule Liu

Tomato antiviral resistance protein Tm-2² functions on the plasma membrane independent of the plasmodesmata localization of its avirulence protein.

2399

ADDENDUM

PHOTOSYSTEM II PROTEIN33, a Protein Conserved in the Plastid Lineage, Is Associated with the Chloroplast Thylakoid Membrane and Provides Stability to Photosystem II Supercomplexes in Arabidopsis. Fristedt R., Herdean A., Blaby-Haas C.E., Mamedov F., Merchant S.S., Last R.L., and Lundin B.

2411

CORRECTIONS

Silencing *CHALCONE SYNTHASE* in Maize Impedes the Incorporation of Tricin into Lignin and Increases Lignin Content. Eloy N.B., Voorend W., Lan W., Saleme M.L.S., Cesarino I., Vanholme R., Smith R.A., Goeminne G., Pallidis A., Morreel K., Nicomedes J. Jr., Ralph J., and Boerjan W. 2412

A Phylogenetically Conserved Group of Nuclear Factor-Y Transcription Factors Interact to Control Nodulation in Legumes. Baudin M., Laloum T., Lepage A., Rípodas C., Ariel F., Frances L., Crespi M., Gamas P., Blanco F.A., Zanetti M.E., de Carvalho-Niebel F., and Niebel A. 2413

RETRACTION

G-Box Binding Factor1 Reduces *CATALASE2* Expression and Regulates the Onset of Leaf Senescence in Arabidopsis. Smykowski A., Zimmermann P., and Zentgraf U. 2414

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