On the Cover: Chloroplast movement is mediated by the actin cytoskeleton. The chloroplast-actin (cp-actin) filaments that are specifically localized on the chloroplast envelope are rapidly reorganized according to the intensity and position of incident blue light. Suetsugu et al. (pp. 1155–1167) showed that PLASTID MOVEMENT IMPAIRED1 (PMI1) mediates chloroplast photorelocation movement via the regulation of cp-actin filaments and is essential for nuclear photorelocation movement in Arabidopsis (Arabidopsis thaliana) mesophyll cells. PMI1 and the homolog PLASTID MOVEMENT IMPAIRED1-RELATED1 are required for photorelocation movements of both plastids and nuclei in Arabidopsis pavement cells. The cover shows the cp-actin filament distribution at the rim of the chloroplasts during avoidance response in reaction to strong blue light focused on the central part of the cell. Cover image credits: Sam-Geun Kong, Kyushu University, Japan.
A CRISPR/Cas9 toolbox for multiplexed plant genome editing and transcriptional regulation. Levi G. Loeder, Dengwei Zhang, Nicholas J. Baltes, Joseph W. Paul III, Xu Tang, Xuelian Zheng, Daniel F. Voytas, Tsung-Fu Hsieh, Yong Zhang, and Yiping Qi

A CRISPR/Cas9 toolbox enables multiplex genome editing and transcriptional regulation of genes in plants.

RESEARCH REPORTS

Direct Recording of Trans-Plasma Membrane Electron Currents Mediated by a Member of the Cytochrome b561 Family of Soybean. Cristiana Picco, Joachim Scholz-Starke, Margherita Festa, Alex Costa, Francesca Sparla, Paolo Trost, and Armando Carpaneto

Electron currents mediated by a soybean cytochrome b561 protein are detected and functionally characterized using a classical electrophysiological approach.

SCIENTIFIC CORRESPONDENCE

On the Extent of Tyrosine Phosphorylation in Chloroplasts. Qintao Lu, Stefan Helm, Anja Rödiger, and Sacha Baginsky

Reanalysis of published mass spectrometry data on Tyr-phosphorylated chloroplast proteins indicates that the majority of peptide spectrum matches reporting Tyr phosphorylation are ambiguous.


Evidence for Trp-independent IAA synthesis is critically reevaluated in the light of tryptophan synthase proteome data, local IAA synthesis and Trp, indole-3-pyruvate, and IAA turnover.

UPDATES

Analysis of Small Ubiquitin-Like Modifier (SUMO) Targets Reflects the Essential Nature of Protein SUMOylation and Provides Insight to Elucidate the Role of SUMO in Plant Development. Nabil Elrouby

Analysis of the mechanisms, regulation, and consequences of protein SUMOylation in plants and other eukaryotes highlights the conservation and importance of this process across taxa.

Cellular Signaling Pathways and Posttranslational Modifications Mediated by Nematode Effector Proteins. Tarek Hewezi

Plant-parasitic nematodes produce a diverse arsenal of effector proteins that interfere with defined cellular processes in host plants to promote successful parasitism.

RESEARCH ARTICLES

BIOCHEMISTRY AND METABOLISM

Salt-Related MYB1 Coordinates Abscisic Acid Biosynthesis and Signaling during Salt Stress in Arabidopsis. Ting Wang, Takayuki Tolge, Alexander Ivanov, Bernd Mueller-Roeber, Alisdair R. Fernie, Marek Mutwil, Jos H.M. Schippers, and Staffan Persson

A salt-related transcription factor regulates abscisic acid synthesis and signaling genes in germinating Arabidopsis seeds under saline conditions.


A glycolate oxidase metabolizes L-lactate to pyruvate in vivo and may ensure the maintenance of low levels of L-lactate after its formation under normoxia.

Continued on next page
Regulation of Nicotine Biosynthesis by an Endogenous Target Mimicry of MicroRNA in Tobacco. Fangfang Li, Weidi Wang, Nan Zhao, Bingguang Xiao, Peijian Cao, Xingfu Wu, Chuyu Ye, Enhui Shen, Jie Qiu, Qian-Hao Zhu, Jiahua Xie, Xueping Zhou, and Longjiang Fan

Endogenous target mimicry of an miRNA affects nicotine biosynthesis.


Salt treatment of maize increased the sugar sensing metabolite trehalose-6-phosphate, as well as sucrose and hexose sugars, leading to reductions in spikelet growth, silk growth and kernel set.

The Identification of Maize and Arabidopsis Type I FLAVONE SYNTHASEs Links Flavones with Hormones and Biotic Interactions. María Lorena Falcone Ferreyra, Julia Emiliani, Eduardo José Rodríguez, Valeria Alina Campos-Bermudez, Erich Grotewold, and Paula Casati

Two novel flavone synthase enzymes from maize and Arabidopsis integrate flavone metabolism with hormone and biotic stress responses.

Overexpression of Arabidopsis Ceramide Synthases Differentially Affects Growth, Sphingolipid Metabolism, Programmed Cell Death, and Mycotoxin Resistance. Kyle D. Luttgeharm, Ming Chen, Amit Mehra, Rebecca E. Cahoon, Jonathan E. Markham, and Edgar B. Cahoon

Overexpression of ceramide synthases has strongly divergent physiological and metabolic effects with implications for improved plant performance.

Methylated Cytokinin from the Phytopathogen Rhodococcus fascians Mimic Plant Hormone Activity. Venkatesan Radhika, Nanae Ueda, Yuuri Tsuboi, Mikiko Kojima, Jun Kikuchi, Takuji Kudo, and Hitoshi Sakakibara

Methylated cytokinins contribute to pathogenesis as hormone-mimics.

Isolation and Characterization of O-methyltransferases Involved in the Biosynthesis of Glaucine in Glaucium flavum. Limei Chang, Jillian M. Hagel, and Peter J. Facchini

A subset of multifunctional O-methyltransferases is involved in the formation of the tetra-O-methylated benzylisoquinoline alkaloid glaucine.

CELL BIOLOGY

Ligand-Mediated cis-Inhibition of Receptor Signaling in the Self-Incompatibility Response of the Brassicaceae. Titima Tantikanjana and June B. Nasrallah

Coexpression of the receptor and ligand that function in crucifer self-incompatibility inhibits receptor signaling and abrogates the ability of stigma epidermal cells to arrest self pollen.

PLASTID MOVEMENT IMPAIRED1 and PLASTID MOVEMENT IMPAIRED1-RELATED1 Mediate Photorelocation Movements of Both Chloroplasts and Nuclei. Noriyuki Suetsugu, Takeshi Higa, Sam-Geun Kong, and Masamitsu Wada

Two C2 domain proteins regulate light-mediated movements of plastids and nuclei in both mesophyll and pavement cells.

Intracellular targeting of guard cell carbonic anhydrases is characterized and modeled in relation to their roles in CO₂ control of stomatal movements.

Rice TUTOU1 Encodes a Suppressor of cAMP Receptor-Like Protein That Is Important for Actin Organization and Panicle Development. Jiaoteng Bai, Xudong Zhu, Qing Wang, Jian Zhang, Hongqi Chen, Guojun Dong, Lei Zhu, Huakun Zheng, Qingjun Xie, Jingjiang Nian, Fan Chen, Ying Fu, Qian Qian, and Jianru Zuo

An actin nucleation protein affects rice panicle development as well as root growth.

ECOPHYSIOLOGY AND SUSTAINABILITY

High-Resolution Three-Dimensional Structural Data Quantify the Impact of Photoinhibition on Long-Term Carbon Gain in Wheat Canopies in the Field. Alexandra J. Burgess, Renata Retkute, Michael P. Pound, John Foulkes, Simon P. Preston, Oliver E. Jensen, Tony P. Pridmore, and Erik H. Murchie

A digital reconstruction method models the effect of photoinhibition on daily canopy photosynthesis in three contrasting wheat canopies.

Stomatal Blue Light Response Is Present in Early Vascular Plants. Michio Doi, Yuki Kitagawa, and Ken-ichiro Shimazaki

Blue light responses of stomata occur in a wide lineage of plants except the fern species of Polypodiopsida.

GENES, DEVELOPMENT, AND EVOLUTION


The functional characterization of two Arabidopsis floral repressors unravels their role and regulation at low ambient temperatures.

EARLY SENESCENCE1 Encodes a SCAR-LIKE PROTEIN2 That Affects Water Loss in Rice. Yuchun Rao, Yaolong Yang, Jie Xu, Xiaoqian Li, Yujia Leng, Liping Dai, Lichao Huang, Guosheng Shao, Deyong Ren, Jiang Hu, Longbiao Guo, Jianwei Pan, and Dali Zeng

An actin nucleation protein affects water loss by regulating stomatal density.

Meta-Analysis of Arabidopsis KANADI1 Direct Target Genes Identifies a Basic Growth-Promoting Module Acting Upstream of Hormonal Signaling Pathways. Yakun Xie, Daniel Straub, Tenai Eguen, Ronny Brandt, Mark Stahl, Jaime F. Martínez-García, and Stephan Wenkel

The comparative study of the gene targets of the KANADI1 transcription factor indicates that it is part of a basic growth-promoting module.


Several species from an ancient legume lineage independently evolved a novel class of cysteine-rich peptides to impose a differentiation process on their endosymbionts.
Second-Site Mutagenesis of a Hypomorphic argonaute1 Allele Identifies SUPERKILLER3 as an Endogenous Suppressor of Transgene Posttranscriptional Gene Silencing. Agnès Yu, Baptiste Saudemont, Nathalie Bouteiller, Emilie Eteira-Matelot, Gersende Lepère, Jean-Sébastien Parent, Jean-Benoît Morel, Jun Cao, Taline Elmayan, and Hervé Vaucheret

Addressing RNAs to the 3′-to-5′ exoribonuclease of the cytoplasmic exosome counteracts posttranscriptional transgene silencing.

SENCESCENCE-SUPPRESSED PROTEIN PHOSPHATASE Directly Interacts with the Cytoplasmic Domain of SENESCENCE-ASSOCIATED RECEPTOR-LIKE KINASE and Negatively Regulates Leaf Senescence in Arabidopsis. Dong Xiao, Yanjiao Cui, Fan Xu, Xinxin Xu, Guanxiao Gao, Yaxin Wang, Zhaoxia Guo, Dan Wang, and Ning Ning Wang

A protein phosphatase negatively regulates Arabidopsis leaf senescence through dephosphorylating a senescence-promoting receptor-like kinase.

MEMBRANES, TRANSPORT, AND BIOENERGETICS

Genetic and Physical Interaction Studies Reveal Functional Similarities between ALBINO3 and ALBINO4 in Arabidopsis. Raphael Trösch, Mats Töpel, Ursula Flores-Pérez, and Paul Jarvis

A thylakoid membrane protein shares functional similarity and physical interactions with the homologous protein insertase, despite sequence-level divergence in a critical C-terminal domain.

Lack of Phosphatidylglycerol Inhibits Chlorophyll Biosynthesis at Multiple Sites and Limits Chlorophyllide Reutilization in Synechocystis sp. Strain PCC 6803. Jana Kopečná, Jan Příhoda, Vendula Kroňová, Aleš Tomčal, Mihály Kis, Zoltán Gombos, Josef Komenda, and Roman Sobotka

The lack of lipid phosphatidylglycerol inhibits chlorophyll biosynthesis and induces accumulation of an aberrant protein complex containing monomeric PSI and CP43 antenna of PSII.


Characterization of spinach grana membranes by contact mode atomic force microscopy in aqueous medium distinguishes molecular features and the distribution of the lumen-exposed domains of PSII.

Overexpression of BAX INHIBITOR-1 Links Plasma Membrane Microdomain Proteins to Stress. Toshiki Ishikawa, Toshihiko Aki, Shuichi Yanagisawa, Hirofumi Uchimiya, and Maki Kawai-Yamada

Overexpression of a cell death suppressor modulates sphingolipid and protein composition of plasma membrane microdomains, leading to enhanced tolerance to stress.

Phosphorylation and Dephosphorylation of the Presequence of Precursor MULTIPLE ORGANELLAR RNA EDITING FACTOR3 during Import into Mitochondria from Arabidopsis. Yee-Song Law, Renshan Zhang, Xiaojian Guan, Shifeng Cheng, Feng Sun, Owen Duncan, Monika W. Murcha, James Whelan, and Boon Leong Lim

Phosphorylation of the presequence of an RNA editing factor by cytosolic kinases and its dephosphorylation by an outer mitochondrial membrane phosphatase contribute to mitochondrial import of the factor protein.

SIGNALING AND RESPONSE

Changes in the Common Bean Transcriptome in Response to Secreted and Surface Signal Molecules of Rhizobium etli. Virginia Dalla Via, Candela Narduzzi, Orlando Mario Aguilar, María Eugenia Zanetti, and Flavio Antonio Blanco

Transcriptional profiling of common bean roots exposed to rhizobial molecules uncovers unique aspects of root nodule symbiosis, including early modulation of genes encoding circadian clock components.
Overaccumulation of γ-Glutamylcysteine in a Jasmonate-Hypersensitive Arabidopsis Mutant Causes Jasmonate-Dependent Growth Inhibition.  
Hsin-Ho Wei, Martha Rowe, Jean-Jack M. Riethoven, Ryan Grove, Jiri Adamec, Yusuke Jikumaru, and Paul Staswick

The glutathione precursor γ-glutamylcysteine modulates plant growth inhibition by the jasmonate hormone.

Viktoriya Avramova, Hamada Abdelgawad, Zhengfeng Zhang, Bartosz Fotschki, Romina Casadevall, Lucia Vergauwen, Dries Knapen, Edith Taleisnik, Yves Guisez, Han Asard, and Gerrit T.S. Beemster

Drought inhibits cell division and expansion in the maize leaf growth zone by reducing antioxidant levels and increases photosynthetic capacity to allow for enhanced growth upon recovery.

The Calcium Ion Is a Second Messenger in the Nitrate Signaling Pathway of Arabidopsis.  
Eleodoro Riveras, José M. Alvarez, Elena A. Vidal, Carolina Oses, Andrea Vega, and Rodrigo A. Gutiérrez

Nitrate sensed by the NRT1.1/NPF6.3 nitrate transceptor activates a PLC activity which causes an increase in the concentration of cytoplasmic Ca²⁺ and stimulates expression of nitrate responsive genes.

The RING E3 Ligase KEEP ON GOING Modulates JASMONATE ZIM-DOMAIN12 Stability.  
Laurens Pauwels, Andrés Ritter, Jonas Goossens, Astrid Nagels Durand, Hongxia Liu, Yangnan Gu, Jan Geerinck, Marla Boter, Robin Vanden Bossche, Rebecca De Clercq, Jelle Van Leene, Kris Gevaert, Geert De Jaeger, Roberto Solano, Sophia Stone, Roger W. Innes, Judy Callis, and Alain Goossens

An E3 ubiquitin ligase involved in abscisic acid signaling modulates the stability of a central jasmonate signaling component.

CORRECTIONS


RBFL1, A Plant Homolog of the Bacterial Ribosome-Binding Factor RbfA, Acts in Processing of the Chloroplast 16S Ribosomal RNA.  