

On the Cover: The cover depicts callose deposits in *Arabidopsis thaliana* wild-type trichome (upright) and in exocyst mutant *exo70H4* (upside down). The callose ring at the base of the wild-type trichome is a newly described structure. Kulich et al. (pp. 120–131) have named this structure the Ortmannian ring. It appears during trichome maturation and borders the callose-rich and autofluorescent secondary cell wall layer. Because the ring is always localized above the surrounding cells, it likely works also as a barrier to immobilize toxic compounds, such as heavy metals, which were found to be deposited above it. The exocyst complex is crucial for the biogenesis of the callose-rich trichome secondary cell wall, Ortmannian ring development, and thus also for heavy metal deposition in the trichomes. Cover image credits: Ivan Kulich and Zdeňka Vojtková (Faculty of Sciences, Charles University, Prague).

ON THE INSIDE

Peter V. Minorsky

1

BREAKTHROUGH TECHNOLOGIES

[OPEN] Unique Aspects of the Structure and Dynamics of Elementary I β Cellulose Microfibrils Revealed by Computational Simulations. Daniel P. Oehme, Matthew T. Downton, Monika S. Doblin, John Wagner, Michael J. Gidley, and Antony Bacic

With a reinterpretation of experimental data, computational dynamics studies suggest elementary cellulose microfibrils contain between 18 and 24 chains.

3

[OPEN] In Vivo Chemical and Structural Analysis of Plant Cuticular Waxes Using Stimulated Raman Scattering Microscopy. George R. Littlejohn, Jessica C. Mansfield, David Parker, Rob Lind, Sarah Perfect, Mark Seymour, Nicholas Smirnov, John Love, and Julian Moger

Stimulated Raman microscopy is an in vivo imaging technique that enables simultaneous chemical and structural analysis of plant cuticle.

18

RESEARCH REPORTS

[OPEN] Hydrogen Sulfide Regulates Inward-Rectifying K⁺ Channels in Conjunction with Stomatal Closure. Maria Papanatsiou, Denisse Scuffi, Michael R. Blatt, and Carlos García-Mata

Hydrogen sulfide affects inward-rectifying K⁺ channels in guard cells and implicates an additional, but as yet unidentified, signaling pathway in stomatal closure.

29

RESEARCH ARTICLES

BIOCHEMISTRY AND METABOLISM

[OPEN] Reducing Isozyme Competition Increases Target Fatty Acid Accumulation in Seed Triacylglycerols of Transgenic *Arabidopsis*. Harrie van Erp, Jay Shockey, Meng Zhang, Neil D. Adhikari, and John Browse

*Reducing isozyme competition between host and transgenic acyltransferases increases the accumulation of ricinoleic and α -eleostearic acid in seed triacylglycerol of *Arabidopsis*.*

36

Multiomics in Grape Berry Skin Revealed Specific Induction of the Stilbene Synthetic Pathway by Ultraviolet-C Irradiation. Mami Suzuki, Ryo Nakabayashi, Yoshiyuki Ogata, Nozomu Sakurai, Toshiaki Tokimatsu, Susumu Goto, Makoto Suzuki, Michal Jasinski, Enrico Martinoia, Shungo Otagaki, Shogo Matsumoto, Kazuki Saito, and Katsuhiro Shiratake

Grape berry skin shows a specific induction of the resveratrol synthetic pathway by UV-C.

47

Continued on next page

[OPEN] Autophagy Supports Biomass Production and Nitrogen Use Efficiency at the Vegetative Stage in Rice. *Shinya Wada, Yasukazu Hayashida, Masanori Izumi, Takamitsu Kurusu, Shigeru Hanamata, Keiichi Kanno, Soichi Kojima, Tomoyuki Yamaya, Kazuyuki Kuchitsu, Amane Makino, and Hiroyuki Ishida*

Characterization of a rice mutant defective in autophagy highlights its importance in nitrogen remobilization from senescent leaves, biomass increase, and nitrogen use efficiency in the vegetative plant. 60

[OPEN] Quantifying Protein Synthesis and Degradation in Arabidopsis by Dynamic $^{13}\text{CO}_2$ Labeling and Analysis of Enrichment in Individual Amino Acids in Their Free Pools and in Protein. *Hirofumi Ishihara, Toshihiro Obata, Ronan Sulpice, Alisdair R. Fernie, and Mark Stitt*

A novel $^{13}\text{CO}_2$ labeling technique measures synthesis and degradation rates for total and specific proteins and could be extended to cell wall synthesis and other determinants of growth. 74

[OPEN] The Gymnosperm Cytochrome P450 CYP750B1 Catalyzes Stereospecific Monoterpene Hydroxylation of (+)-Sabinene in Thujone Biosynthesis in Western Redcedar. *Andreas Gesell, Markus Blaukopf, Lina Madilao, Macaire M.S. Yuen, Stephen G. Withers, Jim Mattsson, John H. Russell, and Jörg Bohlmann*

Genes of thujone biosynthesis are critical for herbivore resistance in a woody Redcedar. 94

CELL BIOLOGY

[OPEN] The *Xanthomonas campestris* Type III Effector XopJ Proteolytically Degrades Proteasome Subunit RPT6. *Suayib Üstiin and Frederik Börnke*

A type III effector from Xanthomonas acts as a protease that interferes with proteasome-mediated turnover of defense signaling components. 107

[OPEN] Cell Wall Maturation of Arabidopsis Trichomes Is Dependent on Exocyst Subunit EXO70H4 and Involves Callose Deposition. *Ivan Kulich, Zdeňka Vojtková, Matouš Glanc, Jitka Ortmannová, Sergio Rasmann, and Viktor Žárský*

Arabidopsis trichomes contain an internal callose-rich and autofluorescent cell wall layer, the biogenesis of which is stimulated by UV-B irradiation and is dependent on secretory machinery. 120

[OPEN] The Arabidopsis Synaptotagmin1 Is Enriched in Endoplasmic Reticulum-Plasma Membrane Contact Sites and Confers Cellular Resistance to Mechanical Stresses. *Jessica Pérez-Sancho, Steffen Vanneste, Eunyoung Lee, Heather E. McFarlane, Alicia Esteban del Valle, Victoriano Valpuesta, Jirí Friml, Miguel A. Botella, and Abel Rosado*

A phospholipid binding protein is enriched on specific organelle contact sites and maintains the mechanical stability of plant cells upon stress exposure. 132

ECOPHYSIOLOGY AND SUSTAINABILITY

[OPEN] Investigations Concerning Cavitation and Frost Fatigue in Clonal 84K Poplar Using High-Resolution Cavitron Measurements. *Feng Feng, Fei Ding, and Melvin T. Tyree*

Frost- and drought-induced fatigue, which damages xylem vessels and makes them vulnerable to embolism, share a common mechanism. 144

[OPEN] Responses of Arabidopsis and Wheat to Rising CO_2 Depend on Nitrogen Source and Nighttime CO_2 Levels. *Jose Salvador Rubio Asensio, Shimon Rachmilevitch, and Arnold J. Bloom*

Elevated atmospheric CO_2 concentrations inhibit nitrate assimilation at night and decrease dark respiration in plants dependent on nitrate as a nitrogen source. 156

Continued on next page

[^{OPEN}]The Barley *Uniculme4* Gene Encodes a BLADE-ON-PETIOLE-Like Protein That Controls Tillering and Leaf Patterning. Elahe Tavakol, Ron Okagaki, Gabriele Verderio, Vahid Shariati J., Ahmed Hussien, Hatice Bilgic, Mike J. Scanlon, Natalie R. Todt, Timothy J. Close, Arnis Druka, Robbie Waugh, Burkhard Steuernagel, Ruvini Ariyadasa, Axel Himmelbach, Nils Stein, Gary J. Muehlbauer, and Laura Rossini

A transcriptional coactivator acts at developmental boundaries to control vegetative branching and leaf patterning. 164

GENES, DEVELOPMENT, AND EVOLUTION

[^{OPEN}]Three R2R3-MYB Transcription Factors Regulate Distinct Floral Pigmentation Patterning in *Phalaenopsis* spp. Chia-Chi Hsu, You-Yi Chen, Wen-Chieh Tsai, Wen-Huei Chen, and Hong-Hwa Chen

Three R2R3-MYB transcription factors regulate floral pigmentation in Phalaenopsis spp. for diverse floral color patterns. 175

LACCASE5 Is Required for Lignification of the *Brachypodium distachyon* Culm. Yin Wang, Oumaya Bouchabke-Coussa, Philippe Lebris, Sébastien Antelme, Camille Soulhat, Emilie Gineau, Marion Dalmais, Abdelafid Bendahmane, Halima Morin, Grégory Mouille, Frédéric Legée, Laurent Cézard, Catherine Lapierre, and Richard Sibout

A mutation in a laccase gene alters lignin deposition and cell wall recalcitrance to saccharification. 192

The Conserved Endoribonuclease YbeY Is Required for Chloroplast Ribosomal RNA Processing in *Arabidopsis*. Jinwen Liu, Wenbin Zhou, Guifeng Liu, Chuanping Yang, Yi Sun, Wenjuan Wu, Shenquan Cao, Chong Wang, Guanghui Hai, Zhifeng Wang, Ralph Bock, Jirong Huang, and Yuxiang Cheng

The Arabidopsis endoribonuclease YbeY is required for chloroplast rRNA processing, and its deficiency reduces chloroplast activity and normal plant growth. 205

[^{OPEN}]MutS HOMOLOG1-Derived Epigenetic Breeding Potential in Tomato. Xiaodong Yang, Hardik Kundariya, Ying-Zhi Xu, Ajay Sandhu, Jiantao Yu, Samuel F. Hutton, Mingfang Zhang, and Sally A. Mackenzie

Silencing of a mutator gene homolog permits the alteration of plant growth behavior and the enhancement of growth potential using a novel plant breeding strategy. 222

[^{OPEN}]A High-Resolution Tissue-Specific Proteome and Phosphoproteome Atlas of Maize Primary Roots Reveals Functional Gradients along the Root Axes. Caroline Marcon, Waqas Ahmed Malik, Justin W. Walley, Zhouxin Shen, Anja Paschold, Laurie G. Smith, Hans-Peter Piepho, Steven P. Briggs, and Frank Hochholdinger

Tissue-specific protein and phosphoprotein patterns underlie functional gradients along the maize primary root axes. 233

Parental Age Affects Somatic Mutation Rates in the Progeny of Flowering Plants. Amit Kumar Singh, Tufail Bashir, Christian Sailer, Viswanathan Gurumoorthy, Anantha Maharasi Ramakrishnan, Shanmuhapreya Dhanapal, Ueli Grossniklaus, and Ramamurthy Baskar

The reproductive age of the parents has a significant influence on the kind and rate of somatic mutations in their progeny. 247

MEMBRANES, TRANSPORT, AND BIOENERGETICS

[^{OPEN}]*Medicago truncatula* Natural Resistance-Associated Macrophage Protein1 Is Required for Iron Uptake by Rhizobia-Infected Nodule Cells. Manuel Tejada-Jiménez, Rosario Castro-Rodríguez, Igor Kryvoruchko, M. Mercedes Lucas, Michael Udvardi, Juan Imperial, and Manuel González-Guerrero

An Nramp-type transporter provides the cytosolic iron that is transferred to bacteroids for synthesis of ferroproteins involved in nitrogen fixation. 258

Continued on next page

SIGNALING AND RESPONSE

[^{OPEN}]The Micro-RNA172c-APETALA2-1 Node as a Key Regulator of the Common Bean-*Rhizobium etli* Nitrogen Fixation Symbiosis. *Bárbara Nova-Franco, Luis P. Íñiguez, Oswaldo Valdés-López, Xochitl Alvarado-Affantranger, Alfonso Leija, Sara I. Fuentes, Mario Ramírez, Sujay Paul, José L. Reyes, Lourdes Girard, and Georgina Hernández*

A common bean microRNA, that targets a transcription factor, positively controls root development and symbiotic rhizobia infection and nodulation. 273

[^{OPEN}]The Arabidopsis RNA-Binding Protein AtRGGA Regulates Tolerance to Salt and Drought Stress. *Alfredo Ambrosone, Giorgia Batelli, Roberta Nurcato, Vincenzo Aurilia, Paola Punzo, Dhinoth Kumar Bangarusamy, Ida Ruberti, Massimiliano Sassi, Antonietta Leone, Antonello Costa, and Stefania Grillo*

An Arabidopsis RNA-binding protein contributes to drought and salt stress tolerance. 292

Interaction between Glucose and Brassinosteroid during the Regulation of Lateral Root Development in Arabidopsis. *Aditi Gupta, Manjul Singh, and Ashvarya Laxmi*

Glucose and brassinosteroid signals interact via auxin redistribution and signaling to regulate lateral root emergence during seedling growth and development. 307

[^{OPEN}]The Barley Powdery Mildew Candidate Secreted Effector Protein CSEP0105 Inhibits the Chaperone Activity of a Small Heat Shock Protein. *Ali Abdurehim Ahmed, Carsten Pedersen, Torsten Schultz-Larsen, Mark Kwaaitaal, Hans Jørgen Lyngs Jørgensen, and Hans Thordal-Christensen*

A candidate effector protein contributes to fungal aggressiveness by targeting and inhibiting a host small heat shock protein. 321

S-Sulfhydration: A Cysteine Posttranslational Modification in Plant Systems. *Ángeles Aroca, Antonio Serna, Cecilia Gotor, and Luis C. Romero*

The identification of S-sulfhydration as a protein posttranslational modification shows evidence of the mechanism of action of hydrogen sulfide as a signaling molecule in plant systems. 334

[^{OPEN}]Salt Stress Reduces Root Meristem Size by Nitric Oxide-Mediated Modulation of Auxin Accumulation and Signaling in Arabidopsis. *Wen Liu, Rong-Jun Li, Tong-Tong Han, Wei Cai, Zheng-Wei Fu, and Ying-Tang Lu*

Nitric oxide functions downstream of salt stress to modulate auxin response for salt-mediated inhibition of root meristem development. 343

SYSTEMS AND SYNTHETIC BIOLOGY

[^{OPEN}]Network Analysis of Postharvest Senescence Process in Citrus Fruits Revealed by Transcriptomic and Metabolomic Profiling. *Yuduan Ding, Jiwei Chang, Qiaoli Ma, Lingling Chen, Shuzhen Liu, Shuai Jin, Jingwen Han, Rangwei Xu, Andan Zhu, Jing Guo, Yi Luo, Juan Xu, Qiang Xu, YunLiu Zeng, Xiuxin Deng, and Yunjiang Cheng*

The difference in flesh-rind transport of nutrients and water due to the anatomic structural differences among citrus varieties might be an important factor that influences fruit senescence behavior. 357

CORRECTIONS

In Vivo ³¹P-Nuclear Magnetic Resonance Studies of Glyphosate Uptake, Vacuolar Sequestration, and Tonoplast Pump Activity in Glyphosate-Resistant Horseweed. *Ge X., d'Avignon D.A., Ackerman J.J.H., and Sammons R.D.* 377

Continued on next page

Continued from preceding page

Endosidin 7 Specifically Arrests Late Cytokinesis and Inhibits Callose Biosynthesis, Revealing Distinct Trafficking Events during Cell Plate Maturation. *Park E., Díaz-Moreno S.M., Davis D.J., Wilkop T.E., Bulone V., and Drakakaki G.* 378

A Comprehensive Analysis of MicroProteins Reveals Their Potentially Widespread Mechanism of Transcriptional Regulation. *Magnani E., de Klein N., Nam H.-I., Kim J.-G., Pham K., Fiume E., Mudgett M.B., and Rhee S.Y.* 379

[OPEN] Articles can be viewed without a subscription.