

On the Cover: Two specimens of Norway spruce growing at the Austrian alpine timberline. Conifers growing at the alpine timberline have to withstand harsh environmental conditions. In winter, trees suffer from intense frost drought and freeze-thaw cycles. The image shows *Picea abies* covered by snow (which may at least temporarily protect the tree from winter stress). In this issue, Losso et al. demonstrate pronounced seasonal changes in the surface tension (γ) of the xylem sap in *Picea abies* and *Pinus mugo*. During alpine winter, γ decreased down to 50 mN m⁻¹ compared to summer values of ca. 68 mN m⁻¹. As xylem sap γ plays a key role in stabilizing air-water interfaces at the pits and thus in embolism avoidance, low winter γ may force xylem dysfunction. Accordingly, the authors demonstrate that experimentally lowered γ can induce relevant reductions in embolism resistance and estimate up to 1 MPa seasonal variation in vulnerability threshold. Photo by Stefan Mayr.

ON THE INSIDE

Peter V. Minorsky

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BREAKTHROUGH TECHNOLOGIES

^[OPEN]PaCeQuant: A Tool for High-Throughput Quantification of Pavement Cell Shape Characteristics.

Birgit Möller, Yvonne Poeschl, Romina Plötner, and Katharina Bürstenbinder

An ImageJ-based tool enables rapid and unbiased quantification of multiple shape features in leaf epidermis pavement cells.

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RESEARCH ARTICLES

BIOCHEMISTRY AND METABOLISM

^[OPEN]Different Routes for Conifer- and Sinapaldehyde and Higher Saccharification upon

Deficiency in the Dehydrogenase CAD1. Rebecca Van Acker, Annabelle Déjardin, Sandrien Desmet, Lennart Hoengenaert, Ruben Vanholme, Kris Morreel, Françoise Laurans, Hoon Kim, Nicholas Santoro, Cliff Foster, Geert Goeminne, Frédéric Légée, Catherine Lapierre, Gilles Pilate, John Ralph, and Wout Boerjan

Down-regulation of CAD1 in poplar leads to different metabolic routes for coniferaldehyde and sinapaldehyde and alters lignin amount and structure, improving the physicochemical properties of wood for saccharification.

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^[OPEN]Silencing CAFFEOYL SHIKIMATE ESTERASE Affects Lignification and Improves Saccharification in Poplar. Marina de Lyra Soriano Saleme, Igor Cesarino, Lívia Vargas, Hoon Kim, Ruben Vanholme, Geert Goeminne, Rebecca Van Acker, Fernando Campos de Assis Fonseca, Andreas Pallidis, Wannes Voorend, José Nicomedes Junior, Dharshana Padmakshan, Jan Van Doorselaere, John Ralph, and Wout Boerjan

Down-regulation of CSE in poplar reduces lignin content, leading to a higher glucose release per plant upon saccharification.

1040

^[OPEN]Highly Decorated Lignins in Leaf Tissues of the Canary Island Date Palm *Phoenix canariensis*. Steven D. Karlen, Rebecca A. Smith, Hoon Kim, Dharshana Padmakshan, Allison Bartuce, Justin K. Mobley, Heather C.A. Free, Bronwen G. Smith, Philip J. Harris, and John Ralph

Phoenix canariensis leaf lignins vary between tissue region and contain an array of pendent groups.

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Impaired Malate and Fumarate Accumulation Due to the Mutation of the Tonoplast Dicarboxylate Transporter Has Little Effects on Stomatal Behavior. *David B. Medeiros, Kallyne A. Barros, Jessica Aline S. Barros, Rebeca P. Omena-Garcia, Stéphanie Arrivault, Lilian M.V.P. Sanglard, Kelly C. Detmann, Willian Batista Silva, Danilo M. Daloso, Fábio M. DaMatta, Adriano Nunes-Nesi, Alisdair R. Fernie, and Wagner L. Araújo*

Manipulation of tonoplastic organic acid transport by inhibition of the tDT impacts mitochondrion metabolism, while the overall stomatal and photosynthetic performance is not affected. 1068

[OPEN]S5H/DMR6 Encodes a Salicylic Acid 5-Hydroxylase That Fine-Tunes Salicylic Acid Homeostasis. *Yanjun Zhang, Li Zhao, Jiangzhe Zhao, Yujia Li, Jinbin Wang, Rong Guo, Susheng Gan, Chang-Jun Liu, and Kewei Zhang*

SALICYLIC ACID 5-HYDROXYLASE catalyzes the formation of 2,5-DHBA both in vitro and in vivo and fine-tunes SA homeostasis in Arabidopsis. 1082

A Synthetic Glycan Microarray Enables Epitope Mapping of Plant Cell Wall Glycan-Directed Antibodies. *Colin Ruprecht, Max P. Bartetzko, Deborah Senf, Pietro Dallabernadina, Irene Boos, Mathias C.F. Andersen, Toshihisa Kotake, J. Paul Knox, Michael G. Hahn, Mads H. Clausen, and Fabian Pfrengle*

Determining exact epitopes for cell wall-directed monoclonal antibodies provides the basis for a detailed elucidation of polysaccharide structures at the cellular level. 1094

CELL BIOLOGY

[OPEN]SIPP, a Novel Mitochondrial Phosphate Carrier, Mediates in Self-Incompatibility. *Liliana E. García-Valencia, Carlos E. Bravo-Alberto, Hen-Ming Wu, Rogelio Rodríguez-Sotres, Alice Y. Cheung, and Felipe Cruz-García*

SIPP mediates self-incompatibility in Nicotiana and interacts with StEP in mitochondria of pollen tubes. 1105

ECOPHYSIOLOGY AND SUSTAINABILITY

[OPEN]Abscisic Acid Down-Regulates Hydraulic Conductance of Grapevine Leaves in Isohydric Genotypes Only. *Aude Coupel-Ledru, Stephen D. Tyerman, Diane Masclef, Eric Lebon, Angélique Christophe, Everard J. Edwards, and Thierry Simonneau*

Abscisic acid reduces the water transport capacity of grapevine leaves, most notably in isohydric genotypes. 1121

[OPEN]Xylem Sap Surface Tension May Be Crucial for Hydraulic Safety. *Adriano Losso, Barbara Beikircher, Birgit Dämon, Silvia Kikuta, Peter Schmid, and Stefan Mayr*

Xylem sap surface tension of two timberline conifers remarkably changed across seasons and revealed pronounced effects on tree hydraulic safety. 1135

GENES, DEVELOPMENT, AND EVOLUTION

[OPEN]Cytokinin-Auxin Crosstalk in the Gynoecial Primordium Ensures Correct Domain Patterning. *Christina Joy Müller, Emma Larsson, Lukáš Spíchal, and Eva Sundberg*

Cytokinin promotes auxin biosynthesis in and efflux from the medial gynoecial domain in Arabidopsis, whereas auxin blocks cytokinin from apical and lateral domains to regulate patterning. 1144

[OPEN] Wounding Triggers Callus Formation via Dynamic Hormonal and Transcriptional Changes. Momoko Ikeuchi, Akira Iwase, Bart Rymen, Alice Lambolez, Mikiko Kojima, Yumiko Takebayashi, Jefri Heyman, Shunsuke Watanabe, Mitsunori Seo, Lieven De Veylder, Hitoshi Sakakibara, and Keiko Sugimoto

Wounding triggers callus formation in Arabidopsis through the activation of cytokinin biosynthesis and AP2/ERF-mediated developmental pathway.

1158

MiR408 Regulates Grain Yield and Photosynthesis via a Phytocyanin Protein. Jin-Ping Zhang, Yang Yu, Yan-Zhao Feng, Yan-Fei Zhou, Fan Zhang, Yu-Wei Yang, Meng-Qi Lei, Yu-Chan Zhang, and Yue-Qin Chen

MiR408 positively regulates rice grain yield by targeting the uclacyanin gene OsUCL8 and, in turn, affects photosynthesis.

1175

[OPEN] Cytological and Transcriptomic Analyses Reveal Important Roles of CLE19 in Pollen Exine Formation. Shuangshuang Wang, Jianan Lu, Xiu-Fen Song, Shi-Chao Ren, Chenjiang You, Jie Xu, Chun-Ming Liu, Hong Ma, and Fang Chang

The proper amount of CLE19 is required for the normal formation of pollen exine through regulating the expression of AMS and its downstream networks.

1186

[OPEN] Light and Plastid Signals Regulate Different Sets of Genes in the Albino Mutant Pap7-1. Björn Grübler, Livia Merendino, Sven O. Twardziok, Morgane Mininno, Guillaume Allorent, Fabien Chevalier, Monique Liebers, Robert Blanvillain, Klaus F. X. Mayer, Silva Lerbs-Mache, Stéphane Ravel, and Thomas Pfannschmidt

The albino pap7-1 mutant of Arabidopsis reveals the relative impact of light and plastid developmental stage on the expression of nuclear genes involved in metabolism and photosynthesis.

1203

The TRAF Mediated Gametogenesis Progression (TRAMGaP) Gene Is Required for Megaspore Mother Cell Specification and Gametophyte Development. Sunil Kumar Singh, Vajinder Kumar, Ramamurthy Srinivasan, Paramvir Singh Ahuja, Shripad Ramchandra Bhat, and Yelam Sreenivasulu

TRAMGaP gene coordinates the expression of diverse sets of genes to modulate MMC specification and gametophyte development in Arabidopsis.

1220

A uORF Represses the Transcription Factor AtHB1 in Aerial Tissues to Avoid a Deleterious Phenotype. Pamela A. Ribone, Matías Capella, Agustín L. Arce, and Raquel L. Chan

An upstream ORF encoded in an homeodomain-leucine zipper I gene and regulated by a chloroplast signal causes ribosome stalling in aerial tissues that had been exposed to light.

1238

MEMBRANES, TRANSPORT, AND BIOENERGETICS

[OPEN] Iron-Nicotianamine Transporters Are Required for Proper Long Distance Iron Signaling. Rakesh K. Kumar, Heng-Hsuan Chu, Celina Abundis, Kenneth Vasques, David Chan Rodriguez, Ju-Chen Chia, Rong Huang, Olena K. Vatamaniuk, and Elsbeth L. Walker

Loss of iron-nicotianamine transporters causes mislocalization of iron in Arabidopsis leaves that leads to profound defects in the long-distance signaling of iron status to roots.

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The Nitrate Transporter Family Protein LjNPF8.6 Controls the N-Fixing Nodule Activity. Vladimir Totev Valkov, Alessandra Rogato, Ludovico Martins Alves, Stefano Sol, Mélanie Noguero, Sophie Léran, Benoit Lacombe, and Maurizio Chiurazzi

Nitrate Transporter 1/Peptide Transporter Family protein NPF8.6 plays a key role in nodule functioning in *Lotus japonicus*.

1269

^[OPEN]Paralogs of the C-Terminal Domain of the Cyanobacterial Orange Carotenoid Protein Are Carotenoid Donors to Helical Carotenoid Proteins. Fernando Muzzopappa, Adjélé Wilson, Vinosa Yogarajah, Sandrine Cot, François Perreau, Cédric Montigny, Céline Bourcier de Carbon, and Diana Kirilovsky

The cyanobacterial CTDHs, homodimers sharing one carotenoid molecule, are capable of taking the carotenoid from membranes and easily giving it to other proteins.

1283

SIGNALING AND RESPONSE

^[OPEN]A Histone Code Reader and a Transcriptional Activator Interact to Regulate Genes for Salt Tolerance. Wei Wei, Jian-Jun Tao, Hao-Wei Chen, Qing-Tian Li, Wan-Ke Zhang, Biao Ma, Qing Lin, Jin-Song Zhang, and Shou-Yi Chen

GmPHD6 and its coactivator, LHP1, form a transcriptional regulation complex in which GmPHD6 targets gene promoters, whereas LHP1 activates their expression under salt stress in soybean.

1304

^[OPEN]A Nucleus-Localized Long Non-Coding RNA Enhances Drought and Salt Stress Tolerance. Tao Qin, Huayan Zhao, Peng Cui, Nour Albeshar, and Liming Xiong

A long noncoding RNA enhances *Arabidopsis* tolerance to drought and salt stress by modulating the expression of stress-related genes.

1321

Transcription Factor OsWRKY53 Positively Regulates Brassinosteroid Signaling and Plant Architecture. Xiaojie Tian, Xiufeng Li, Wenjia Zhou, Yuekun Ren, Zhenyu Wang, Zhiqi Liu, Jiaqi Tang, Hongning Tong, Jun Fang, and Qingyun Bu

OsWRKY53 is a novel positive regulator of rice BR signaling, and its phosphorylation by OsMAPK6 is indispensable for its function in rice.

1337

^[OPEN]Overexpression of RING Domain E3 Ligase ZmXerico1 Confers Drought Tolerance through Regulation of ABA Homeostasis. Norbert Brugière, Wenjing Zhang, Qingzhang Xu, Eric J. Scolaro, Cheng Lu, Robel Y. Kahsay, Rie Kise, Libby Trecker, Robert W. Williams, Salim Hakimi, Xiping Niu, Renee Lafitte, and Jeffrey E. Habben

Overexpression of ZmXerico1 RING-H2 protein improves water use efficiency and drought tolerance in transgenic maize plants through reduction in ABA8OX protein stability and ABA degradation.

1350

^[OPEN]Systematic Mutagenesis of Serine Hydroxymethyltransferase Reveals an Essential Role in Nematode Resistance. Pramod K. Kandoth, Shiming Liu, Elizabeth Prenger, Andrew Ludwig, Naoufal Lakhssassi, Robert Heinz, Zhou Zhou, Amanda Howland, Joshua Gunther, Samantha Eidson, Andi Dhroso, Peter LaFayette, Donna Tucker, Sarah Johnson, James Anderson, Alaa Alaswad, Siloia R. Cianzio, Wayne A. Parrott, Dmitry Korkin, Khalid Meksem, and Melissa G. Mitchum

A soybean serine hydroxymethyltransferase has a unique and essential role in soybean cyst nematode resistance.

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[^{OPEN}] Carnosic Acid and Carnosol, Two Major Antioxidants of Rosemary, Act through Different Mechanisms. Margot Loussouarn, Anja Krieger-Liszakay, Ljubica Svilar, Antoine Bily, Simona Birtić, and Michel Havaux

Rosemary leaves contain two phenolic diterpenes, carnosic acid and carnosol, which provide protection against oxidative stress by distinct mechanisms involving ROS scavenging or inhibition of lipid oxidation.

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DELLA-GAF1 Complex Is a Main Component in Gibberellin Feedback Regulation of GA20 Oxidase 2. Jutarou Fukazawa, Masahiko Mori, Satoshi Watanabe, Chika Miyamoto, Takeshi Ito, and Yohsuke Takahashi

GAF1-binding sites are necessary for GA feedback regulation of AtGA20ox2 in transgenic Arabidopsis, indicating that the DELLA-GAF1 complex is a main component of the GA feedback regulation of AtGA20ox2.

1395

Nitric Oxide Mediates Nitrite-Sensing and Acclimation and Triggers a Remodeling of Lipids. Lina-Juana Dolch, Josselin Lupette, Guillaume Tourcier, Mariette Bedhomme, Séverine Collin, Leonardo Magneschi, Melissa Conte, Khawla Seddiki, Christelle Richard, Erwan Corre, Laurent Fourage, Frédéric Laeuffer, Robert Richards, Michael Reith, Fabrice Rébeillé, Juliette Jouhet, Patrick McGinn, and Eric Maréchal

In *Phaedactylum*, NO produced from nitrite by the nitrate reductase up-regulates the expression of genes involved in nitrite assimilation into amino acids and triggers a remodeling of lipids.

1407

[^{OPEN}] A Genetic Screen for Impaired Systemic RNAi Highlights the Crucial Role of DICER-LIKE 2. Christelle Taochy, Nial R. Gursansky, Jiangling Cao, Stephen J. Fletcher, Uwe Dressel, Neena Mitter, Matthew R. Tucker, Anna M.G. Koltunow, John L. Bowman, Hervé Vaucheret, and Bernard J. Carroll

DCL2 is required for efficient RDR6-dependent systemic posttranslational gene silencing, recruiting RNA-DEPENDENT RNA POLYMERASE6 and promoting the production of dsRNA that is mainly processed into 21-nucleotide siRNAs by DCL4 in wild-type plants.

1424

Type B Response Regulators Act As Central Integrators in Transcriptional Control of the Auxin Biosynthesis Enzyme TAA1. Zhenwei Yan, Xin Liu, Karin Ljung, Shuning Li, Wanying Zhao, Fan Yang, Meiling Wang, and Yi Tao

Transcriptional regulation of TAA1 by various developmental, hormonal and environmental signals is directly regulated by Arabidopsis type B ARRs, which serve as central integrators.

1438

[^{OPEN}] Selinene Volatiles Are Essential Precursors for Maize Defense Promoting Fungal Pathogen Resistance. Yezhang Ding, Alisa Huffaker, Tobias G. Köllner, Philipp Weckwerth, Christelle A.M. Robert, Joseph L. Spencer, Alexander E. Lipka, and Eric A. Schmelz

Maize terpene synthase21 encodes a β -selinene synthase enabling the production of antifungal defenses.

1455

[OPEN] The RING-Type E3 Ligase XBAT35.2 Is Involved in Cell Death Induction and Pathogen Response. *Hongxia Liu, Sridhar Ravichandran, Ooi-kock Teh, Sarah McVey, Carly Lilley, Howard J. Teresinski, Carmen Gonzalez-Ferrer, Robert T. Mullen, Daniel Hofius, Balakrishnan Prithiviraj, and Sophia L. Stone*

The Arabidopsis RING-type E3 ligase XBAT35.2 induces cell death, reduces susceptibility to pathogens, and is involved in the proteasome-dependent turnover of defense-related ACD11.

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[OPEN] Histone Deacetylase Is Required for GA-Induced Programmed Cell Death in Maize Aleurone Layers. *Haoli Hou, Xueke Zheng, Hao Zhang, Mengxia Yue, Yan Hu, Hong Zhou, Qing Wang, Chengshen Xie, Pu Wang, and Lijia Li*

GA induces PCD in maize aleurone layers through down-regulating the HAT activity and thereby indirectly increasing the relative HDAC activity, followed by the ROS-mediated signaling pathway.

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[OPEN] Articles can be viewed without a subscription.