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Trafficking of Maize Aquaporins to the Plasma Membrane

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On the Cover: Aquaporins are essential molecular players in plant water relations, nutrition, and signaling processes. Plant genomes encode multiple aquaporin isoforms, which display a large variety of subcellular localization patterns. In particular, maize (*Zea mays*) aquaporins belonging to the plasma membrane intrinsic protein (PIP) ZmPIP1 and ZmPIP2 groups are respectively located in the endoplasmic reticulum (ER) and the plasma membrane (PM) when they are expressed alone in maize cells. In this issue, Chevalier et al. (pp. 125–138) undertook a systematic protein domain-exchange approach, which revealed a critical role of the third transmembrane helix in the trafficking of ZmPIP2s to the PM, in both maize mesophyll protoplasts and leaf epidermal cells transformed by biolistic DNA delivery. Single-transmembrane domain proteins confirmed the ability of the third transmembrane helix of ZmPIP1s and ZmPIP2s to discriminate between ER and PM localization. More specifically, the conserved L127 and A131 residues of ZmPIP2;5 are required for ER export. The cover image shows confocal microscopy images of maize mesophyll protoplasts expressing wild-type and mutated ZmPIPs tagged with the monomeric yellow fluorescent protein, or incubated with the steryl dye FM4-64 to label the plasma membrane. Cover image credits: Adrien S. Chevalier.

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^[W]Activity-Based Profiling of a Physiologic Aglycone Library Reveals Sugar Acceptor Promiscuity of Family 1 UDP-Glucosyltransferases from Grape. *Friedericke Bönisch, Johanna Frotscher, Sarah Stanitzek, Ernst Rühl, Matthias Wüst, Oliver Bitz, and Wilfried Schwab*

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Differential Accumulation of ELONGATED HYPOCOTYL5 Correlates with Hypocotyl Bending to Ultraviolet-B Light. *Filip Vandenbussche and Dominique Van Der Straeten*

During UV-B-specific induction of bending to the light in Arabidopsis etiolated seedlings, the transcription factor HY5 accumulates on the illuminated side and orchestrates the response.

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RESEARCH ARTICLES

BIOCHEMISTRY AND METABOLISM

^{[W][OPEN]}Different Mechanisms Are Responsible for Chlorophyll Dephytylation during Fruit Ripening and Leaf Senescence in Tomato. *Luzia Guyer, Silvia Schelbert Hofstetter, Bastien Christ, Bruno Silvestre Lira, Magdalena Rossi, and Stefan Hörtensteiner*

Phytol hydrolysis during chlorophyll breakdown in tomato leaves is specifically catalyzed by pheophytinase, while during fruit ripening other, so far unknown, hydrolases are active.

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^{[W][OPEN]}Functional Evidence for the Critical Amino-Terminal Conserved Domain and Key Amino Acids of Arabidopsis 4-HYDROXY-3-METHYLBUT-2-ENYL DIPHOSPHATE REDUCTASE. *Wei-Yu Hsieh, Tzu-Ying Sung, Hsin-Tzu Wang, and Ming-Hsiun Hsieh*

Key residues near the N-terminus and around the central active site are critical for the function of Arabidopsis 4-hydroxy-3-methylbut-2-enyl diphosphate reductase.

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^{[C][W][OPEN]}Chlorophyll Degradation: The Tocopherol Biosynthesis-Related Phytol Hydrolase in Arabidopsis Seeds Is Still Missing. *Wei Zhang, Tianqi Liu, Guodong Ren, Stefan Hörtensteiner, Yongming Zhou, Edgar B. Cahoon, and Chunyu Zhang*

Two known chlorophyll-related types of phytol hydrolases may only play limited roles in tocopherol biosynthesis in Arabidopsis seeds, implicating another unknown dephytylase that may exist.

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^[W]Molecular Cloning and Characterization of a Geranyl Diphosphate-Specific Aromatic Prenyltransferase from Lemon. *Ryosuke Munakata, Tsuyoshi Inoue, Takao Koeduka, Fazeelat Karamat, Alexandre Olry, Akifumi Sugiyama, Kojiro Takanashi, Audray Dugrand, Yann Froelicher, Ryo Tanaka, Yoshihiro Uto, Hitoshi Hori, Jun-Ichi Azuma, Alain Hehn, Frédéric Bourgaud, and Kazufumi Yazaki*

A prenyltransferase gene from lemon encodes a membrane-bound geranyl diphosphate-specific prenyltransferase for coumarin, which produces a novel compound, 8-geranylumbelliferone, in citrus species.

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^{[W][OPEN]}Proteins with High Turnover Rate in Barley Leaves Estimated by Proteome Analysis Combined with in Planta Isotope Labeling. *Clark J. Nelson, Ralitza Alexova, Richard P. Jacoby, and A. Harvey Millar*

Proteins turn over at different rates in plant tissues, and these have been quantified using stable isotope labeling of nitrogen and peptide mass spectrometry of leaf tissue from hydroponically grown barley.

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^[W]The Reductase Activity of the Arabidopsis Caleosin RESPONSIVE TO DESSICATION20 Mediates Gibberellin-Dependent Flowering Time, Abscisic Acid Sensitivity, and Tolerance to Oxidative Stress. *Elizabeth Blée, Benoît Boachon, Michel Burcklen, Marina Le Guédard, Abdulsamie Hanano, Dimitri Heintz, Jürgen Ehltling, Cornelia Herrfurth, Ivo Feussner, and Jean-Jacques Bessoule*

A peroxxygenase controls floral transition and tolerance to oxidative stress.

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^{[C][W][OPEN]}Geranylinalool Synthases in Solanaceae and Other Angiosperms Constitute an Ancient Branch of Diterpene Synthases Involved in the Synthesis of Defensive Compounds. *Vasiliki Falara, Juan M. Alba, Merijn R. Kant, Robert C. Schuurink, and Eran Pichersky*

The genes encoding geranylinalool synthases in Solanaceae represent an ancient branch of the terpene synthase gene family that likely diverged from the rest of the family prior to the split between the gymnosperm and angiosperm lineages.

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CELL BIOLOGY

[W][OPEN] A New LxxxA Motif in the Transmembrane Helix3 of Maize Aquaporins Belonging to the Plasma Membrane Intrinsic Protein PIP2 Group Is Required for Their Trafficking to the Plasma Membrane. *Adrien S. Chevalier, Gerd Patrick Bienert, and François Chaumont*

Two amino acids located in a transmembrane helix regulate the trafficking of endoplasmic reticulum- and plasma membrane-localized aquaporins along the secretory pathway. 125

[W][OPEN] The Apical Actin Fringe Contributes to Localized Cell Wall Deposition and Polarized Growth in the Lily Pollen Tube. *Caleb M. Rounds, Peter K. Hepler, and Lawrence J. Winship*

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[C][W] Chloroplast Dysfunction Causes Multiple Defects in Cell Cycle Progression in the Arabidopsis *crumpled leaf* Mutant. *Elodie Hudik, Yasushi Yoshioka, Séverine Domenichini, Mickaël Bourge, Ludivine Soubigout-Taconnat, Christelle Mazubert, Dalong Yi, Sandrine Bujaldon, Hiroyuki Hayashi, Lieven De Veylder, Catherine Bergounioux, Moussa Benhamed, and Cécile Raynaud*

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ECOPHYSIOLOGY AND SUSTAINABILITY

[OPEN] Wettability, Polarity, and Water Absorption of Holm Oak Leaves: Effect of Leaf Side and Age. *Victoria Fernández, Domingo Sancho-Knapik, Paula Guzmán, José Javier Peguero-Pina, Luis Gil, George Karabourniotis, Mohamed Khayet, Costas Fasseas, José Alejandro Heredia-Guerrero, Antonio Heredia, and Eustaquio Gil-Pelegrín*

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[W][OPEN] TRICHOME BIREFRINGENCE-LIKE27 Affects Aluminum Sensitivity by Modulating the O-Acetylation of Xyloglucan and Aluminum-Binding Capacity in Arabidopsis. *Xiao Fang Zhu, Ying Sun, Bao Cai Zhang, Nasim Mansoori, Jiang Xue Wan, Yu Liu, Zhi Wei Wang, Yuan Zhi Shi, Yi Hua Zhou, and Shao Jian Zheng*

O-acetylation of xyloglucan affects aluminum sensitivity in Arabidopsis by modifying the aluminum-binding capacity of xyloglucan in the cell wall. 181

[W][OPEN] Disordered COR15 Proteins Protect Chloroplast Membranes during Freezing through Binding and Folding, But Do Not Stabilize Chloroplast Enzymes in Vivo. *Anja Thalhammer, Gary Bryant, Ronan Sulpice, and Dirk K. Hincha*

Cold-induced, unstructured chloroplast proteins increase plant freezing tolerance by stabilizing membranes, but not enzymes, through folding and binding. 190

[W][OPEN] Dissection of the Control of Anion Homeostasis by Associative Transcriptomics in *Brassica napus*. *Anna Koprivova, Andrea L. Harper, Martin Trick, Ian Bancroft, and Stanislav Kopriva*

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GENES, DEVELOPMENT, AND EVOLUTION

[W][OPEN]AtGEN1 and AtSEND1, Two Paralogs in Arabidopsis, Possess Holliday Junction Resolvase Activity. Markus Bauknecht and Daniela Kobbe

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[C][W]Long-Term Evolution of Nucleotide-Binding Site-Leucine-Rich Repeat Genes: Understanding Gained from and beyond the Legume Family. Zhu-Qing Shao, Yan-Mei Zhang, Yue-Yu Hang, Jia-Yu Xue, Guang-Can Zhou, Ping Wu, Xiao-Yi Wu, Xun-Zong Wu, Qiang Wang, Bin Wang, and Jian-Qun Chen

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Polymorphisms in the leucine-rich-repeat domains of two closely related soybean genes allow them to distinguish between two pathogen effectors detected by a single disease resistance gene in Arabidopsis. 235

[W][OPEN]Dynamic Transcriptome Landscape of Maize Embryo and Endosperm Development. Jian Chen, Biao Zeng, Mei Zhang, Shaojun Xie, Gaokui Wang, Andrew Hauck, and Jinsheng Lai

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[W][OPEN]Intraspecific Arabidopsis Hybrids Show Different Patterns of Heterosis Despite the Close Relatedness of the Parental Genomes. Michael Groszmann, Rebeca Gonzalez-Bayon, Ian K. Greaves, Li Wang, Amanda K. Huen, W. James Peacock, and Elizabeth S. Dennis

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[W][OPEN]Plasma Membrane Localization Is Essential for *Oryza sativa* Pto-Interacting Protein 1a-Mediated Negative Regulation of Immune Signaling in Rice. *Hidenori Matsui, Masayuki Fujiwara, Satoshi Hamada, Ko Shimamoto, Yuko Nomura, Hirofumi Nakagami, Akira Takahashi, and Hirohiko Hirochika*

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[W][OPEN]Ideal Osmotic Spaces for Chlorobionts or Cyanobionts Are Differentially Realized by Lichenized Fungi. *Makiko Kosugi, Ryoko Shizuma, Yufu Moriyama, Hiroyuki Koike, Yuko Fukunaga, Akihisa Takeuchi, Kentaro Uesugi, Yoshio Suzuki, Satoshi Imura, Sakae Kudoh, Atsuo Miyazawa, Yasuhiro Kashino, and Kazuhiko Satoh*

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[W][OPEN]bHLH05 Is an Interaction Partner of MYB51 and a Novel Regulator of Glucosinolate Biosynthesis in Arabidopsis. *Henning Frerigmann, Bettina Berger, and Tamara Gigolashvili*

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[W][OPEN]Auxin and Strigolactone Signaling Are Required for Modulation of Arabidopsis Shoot Branching by Nitrogen Supply. *Maaike de Jong, Gilu George, Veronica Ongaro, Lisa Williamson, Barbara Willetts, Karin Ljung, Hayley McCulloch, and Ottoline Leyser*

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[W][OPEN]Jasmonic Acid and Its Precursor 12-Oxophytodienoic Acid Control Different Aspects of Constitutive and Induced Herbivore Defenses in Tomato. *Marko Bosch, Louwance P. Wright, Jonathan Gershenzon, Claus Wasternack, Bettina Hause, Andreas Schaller, and Annick Stintzi*

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