ON THE COVER: The formation of nanoridges on the surface of epidermal cells of petals requires the cuticular polyester cutin and its main component 10,16-dihydroxy C16:0 in Arabidopsis thaliana. Research gave new insights into the relationships between composition and spectroscopic features of cutin and the ultrastructure and surface structure of the cuticle. The studies furthermore suggested that nanoridges that are present on floral organs of many species might have important functions in floral development by diminishing adhesion forces between different organs and thus facilitating the gliding of petals during their fast outgrowth of the floral bud. The image shows the nanoridge-covered petal epidermal surface of Arabidopsis wild type. Cryoscanning electron micrograph taken by Antonio Mucciolo.

ON THE INSIDE

Peter V. Minorsky

BREAKTHROUGH TECHNOLOGIES

Validating Genome-Wide Association Candidates Controlling Quantitative Variation in Nodulation. Shaun J. Curtin, Peter Tiffin, Joseph Gahlin, Diana I. Trujillo, Liana T. Burghardt, Paul Atkins, Nicholas J. Baltes, Roxanne Denny, Daniel F. Voytas, Robert M. Stupar, and Nevin D. Young

GWA studies combined with multiple mutagenesis technologies, including CRISPR/Cas9, functionally validate novel candidate genes contributing to phenotypic variation in symbiosis between legume plants and rhizobial bacteria.

RESEARCH REPORT

The Plastid Genome of Polytona uvella Is the Largest Known among Colorless Algae and Plants and Reflects Contrasting Evolutionary Paths to Nonphotosynthetic Lifestyles. Francisco Figueroa-Martinez, Aurora M. Nedelcu, David R. Smith, and Adrian Reyes-Prieto

The plastid genome of the nonphotosynthetic green alga Polytona uvella has a reduced coding capacity but is bloated with repeats. This is in striking contrast with its colorless relative, Polytomella, that lost its plastid genome.

RESEARCH ARTICLES

BIOCHEMISTRY AND METABOLISM

A β-Ketoacyl-CoA Synthase Is Involved in Rice Leaf Cuticular Wax Synthesis and Requires a CER2-LIKE Protein as a Cofactor. Xiaochen Wang, Yuanyuan Guan, Du Zhang, Xiangbai Dong, Lihong Tian, and Le Qing Qu

WSL4 physically interacts with CER2-like protein, catalyzing the elongation of very-long-chain fatty acids longer than 24 carbons, and is involved in the synthesis of cuticular wax in rice leaf.

Activation of Mitochondrial Protein Phosphatase SLP2 by MIA40 Regulates Seed Germination. R. Glen Uhrig, Anne-Marie Labandera, Lay-Yin Tang, Nicolas A. Sieben, Marilyn Goudreault, Edward Yeung, Anne-Claude Gingras, Marcus A. Samuel, and Greg B.G. Moorhead

The serine/threonine protein phosphatase SLP2 is mitochondrial intermembrane space localized and redox activated by the oxidoreductase Mia40.

Functional Analysis of Cellulose Synthase (CESA) Protein Class Specificity. Manoj Kumar, Ivan Atanassov, and Simon Turner

Reciprocal swap experiments suggest that the class specificity of CESA proteins extends throughout the protein and the degree of specificity differs greatly between different classes of CESA.
Metabolic Control of Tobacco Pollination by Sugars and Invertases. Marc Goetz, Anne Guivarč, Jörg Hirsche, Martin Andreas Bauerfeind, María-Cruz González, Tae Kyung Hyun, Seung Hee Eom, Dominique Chiriquí, Thomas Engelke, Dominik K. Großkinsky, and Thomas Roitsch

Invertases and hexose transporters, as essential components of carbohydrate supply, are regulated in a spatiotemporally coordinated manner to maintain functionality of tobacco pollination.

Silencing CHALCONE SYNTHASE in Maize Impedes the Incorporation of Tricin into Lignin and Increases Lignin Content. Nubia B. Eloy, Wannes Voorend, Wu Lan, Marina de Lyra Soriano Saleme, Igor Cesarino, Ruben Vanholme, Rebecca A. Smith, Geert Goeminne, Andreas Pallidis, Kris Morreel, José Nacmedes Jr., John Ralph, and Wout Boerjan

The maize C2-Idf mutant has reduced levels of soluble flavonoids, reduced incorporation of tricin into the lignin polymer, and higher total lignin that is enriched in β-β and β-5 interunit linkages.

Soluble and Membrane-Bound β-Glucosidases Are Involved in Trimming the Xyloglucan Backbone. Javier Sampedro, Elene R. Valdivia, Patricia Fraga, Natalia Iglesias, Gloria Revilla, and Ignacio Zarra

Two Arabidopsis glucosidases, soluble BGLC1 and GPI-anchored BGLC3, are involved in xyloglucan metabolism and could differentially affect wall-bound and soluble fractions.

Structural and Biochemical Characterization of Cinnamoyl-CoA Reductases. Steven A. Sattler, Alexander M. Walker, Wilfred Vermerris, Scott E. Sattler, and ChulHee Kang

In-depth investigation for CCRs from Sorghum bicolor provides information about the critical residues for substrate preference among CCRs.

The MYB107 Transcription Factor Positively Regulates Suberin Biosynthesis. Mingyue Gou, Guichuan Hou, Huijun Yang, Xuebin Zhang, Yuanheng Cai, Guoyin Kai, and Chang-Jun Liu

The Arabidopsis MYB107 transcription factor regulates the expression of suberin biosynthetic genes in developing seeds, thereby controlling the synthesis and assembly of seed coat suberin.

Identification and Characterization of Arabidopsis Seed Coat Mucilage Proteins. Allen Yi-Lun Tsai, Tadashi Kunieda, Jason Rogalski, Leonard J. Foster, Brian E. Ellis, and George W. Haughn

Arabidopsis seed coat mucilage, an extracellular matrix composed of cell wall carbohydrates, contains a proteome functionally similar to that of cell wall, but also includes proteins unique to mucilage.

Combined Experimental and Computational Approaches Reveal Distinct pH Dependence of Pectin Methylesterase Inhibitors. Ludivine Hocq, Fabien Sénéchal, Valérie Lefebvre, Arnaud Lehner, Jean-Marc Domon, Jean-Claude Mollet, Jérémy Dehors, Karine Pageau, Paulo Marcelo, François Guérineau, Katra Kolsek, Davide Mercadante, and Jérôme Pelloux

The pH dependence of PMEI proteins that fine-tune the activity of pectin methylesterases, can be predicted by molecular dynamics simulation and validated in vitro and on pollen tube development.

SDH6 and SDH7 Contribute to Anchoring Succinate Dehydrogenase to the Inner Mitochondrial Membrane in Arabidopsis thaliana. Christine Schikowsky, Jennifer Senkler, and Hans-Peter Braun

Solving the complex II puzzle: SDH6 and SDH7 contribute to anchoring succinate dehydrogenase to the inner mitochondrial membrane in Arabidopsis thaliana.
The Acyl Desaturase CER17 Is Involved in Producing Wax Unsaturated Primary Alcohols and Cutin Monomers. Xianpeng Yang, Huayan Zhao, Dylan K. Kosma, Pernell Tomasi, John M. Dyer, Rongjun Li, Xiulin Liu, Zhouya Wang, Eugene P. Parsons, Matthew A. Jenks, and Shiyou Lu

CER17/ADS4 is involved in unsaturated wax and cutin monomer production in Arabidopsis.

CELL BIOLOGY

Capping Protein Modulates Actin Remodeling in Response to Reactive Oxygen Species during Plant Innate Immunity. Jiejie Li, Lingyan Cao, and Christopher J. Staiger

Actin filament capping protein transduces ROS signaling into changes of actin dynamics during plant innate immunity.

The GET System Inserts the Tail-Anchored Protein, SYP72, into Endoplasmic Reticulum Membranes. Renu Srivastava, Benjamin E. Zalisko, Robert J. Keenan, and Stephen H. Howell

The GET protein insertion system inserts the model tail-anchored protein SYP72 into endoplasmic reticulum membranes in Arabidopsis.

Connecting the Molecular Structure of Cutin to Ultrastructure and Physical Properties of the Cuticle in Petals of Arabidopsis. Sylvester Mazurek, Imène Garroum, Jean Daraspe, Damien De Bellis, Vilde Olsson, Antonio Mucciolo, Melinka A. Butenko, Bruno M. Humbel, and Christiane Nawrath

GPAT6 and DCR play different roles in structuring the cell wall-cuticle continuum.


Binding of the pentatricopeptide repeat protein EMB2654 to one-half of the plastid rps12 intron is essential for trans-splicing, production of plastid ribosomes, and embryogenesis in Arabidopsis.

ECOPHYSIOLOGY AND SUSTAINABILITY

Xylem Surfactants Introduce a New Element to the Cohesion-Tension Theory. H. Jochen Schenk, Susana Espino, David M. Romo, Neda Nima, Aïssa Y.T. Do, Joseph M. Michaud, Brigitte Papahadjopoulos-Sternberg, Jinlong Yang, Yi Y. Zuo, Kathy Steppe, and Steven Jansen

Lipid-based xylem surfactants affect water transport under negative pressure by coating hydrophobic surfaces and nanobubbles and are hypothesized to reduce embolism under normal pressure conditions.

Outside-Xylem Vulnerability, Not Xylem Embolism, Controls Leaf Hydraulic Decline during Dehydration. Christine Scoffoni, Caetano Albuquerque, Craig R. Brodersen, Shatara V. Toumes, Grace P. John, Megan K. Bartlett, Thomas N. Buckley, Andrew J. McElrone, and Lawren Sack

Changes in leaf outside-xylem properties drive leaf and whole-plant hydraulic decline with dehydration, protecting plants from catastrophic embolism in xylem conduits.
GENES, DEVELOPMENT, AND EVOLUTION

[OPEN] MYB89 Transcription Factor Represses Seed Oil Accumulation. Dong Li, Changyu Jin, Shaowei Duan, Yana Zhu, Shuanghui Qi, Kaige Liu, Chenhao Gao, Haoli Ma, Meng Zhang, Yuncheng Liao, and Mingxun Chen

An Arabidopsis transcription factor negatively regulates the accumulation of seed oil by targeting WRI1 and several other genes involved in the seed oil biosynthetic pathway.


Fluorescence in situ hybridization maps a cluster of EPSPS genes to the pericentromeric region on one pair of homologous chromosomes of glyphosate-resistant Amaranthus tuberculatus.

[OPEN] EXTRA-LARGE G PROTEINs Interact with E3 Ligases PUB4 and PUB2 and Function in Cytokinin and Developmental Processes. Yiping Wang, Yingying Wu, Boying Yu, Zhao Yin, and Yiji Xia

Arabidopsis EXTRA-LARGE G PROTEINs interact with two PUB proteins in mediating the cytokinin response and multiple developmental processes.


Single-parent expression genes are nonsyntenic and stable throughout fluctuating water availability, underscoring their role in the early developmental manifestation of heterosis in maize.


Vernalization-induced VIN3 enhances the PRC2 activity through its histone binding motif, PHD-finger domain, to mediate proper vernalization response in Arabidopsis.


The role of DA1 in restricting cell proliferation is conserved in different genetic backgrounds. In addition, DA1 and BB restrict leaf growth and longevity through converging and different mechanisms.

[OPEN] Atypical Protein Phosphatase 2A Gene Families Do Not Expand via Paleopolyploidization. Matthew A. Booker and Alison DeLong

Whole-genome duplications have driven expansion of PP2A gene families; however, distinct subclades exhibit reduced rates of expansion and may perform specialized functions.
A Flowering Locus C Homolog Is a Vernalization-Regulated Repressor in *Brachypodium* and Is Cold Regulated in Wheat. Neha Sharma, Philip Ruelens, Mariella D’hauwe, Thomas Maggen, Niklas Dochy, Sanne Torfs, Kerstin Kaufmann, Antje Rohde, and Koen Geuten

ODDSOC2/TaAGL33 functions in vernalization-responsive flowering of Poaceae in a similar but unique manner compared to its Arabidopsis homolog, FLOWERING LOCUS C. 1301

Resolvase OsGEN1 Mediates DNA Repair by Homologous Recombination. Chong Wang, James D. Higgins, Yi He, Pingli Lu, Dabing Zhang, and Wanqi Liang

The canonical Holliday junction resolvase OsGEN1 plays an important role in rice pollen development via influence interference-insensitive crossover formation and DNA repair during pollen mitosis processes. 1316

MEMBRANES, TRANSPORT, AND BIOENERGETICS

Sucrose Transporter Localization and Function in Phloem Unloading in Developing Stems. Ricky J. Milne, Jai M. Perroux, Anne L. Rae, Anke Reinders, John M. Ward, Christina E. Offler, John W. Patrick, and Christopher P.L. Grof

Sorghum sucrose transporters may function to efflux sucrose from the phloem during early internode development and retrieve leaked sucrose to the phloem as internodes mature. 1330

CNGC2 Is a Ca^{2+} Influx Channel That Prevents Accumulation of Apoplastic Ca^{2+} in the Leaf. Yan Wang, Yan Kang, Chunli Ma, Ruiying Miao, Caili Wu, Yu Long, Ting Ge, Zinian Wu, Xiangyang Hou, Junxia Zhang, and Zhi Qi

Arabidopsis CNGC2 is a Ca^{2+}-permeable channel that mediates Ca^{2+} influx into mesophyll cells near minor veins but has no direct role in the hypersensitive response or leaf senescence. 1342

Physiological Characterization of a Plant Mitochondrial Calcium Uniporter in Vitro and in Vivo. Enrico Teardo, Luca Carraretto, Stephan Wagner, Elide Formentin, Smrutisanjita Behera, Sara De Bortoli, Véronique Larosa, Philippe Fuchs, Fiorella Lo Schiavo, Anna Raffaello, Rosario Rizzuto, Alex Costa, Markus Schwarzländer, and Ildiko Szabó

An Arabidopsis homolog of the mammalian mitochondrial calcium uniporter MCL1 acts as Ca^{2+} channel, and its absence impacts mitochondrial function and morphology. 1355

SIGNALING AND RESPONSE


The tomato genome encodes 40 ubiquitin-conjugating enzymes (E2), among which members of group III are required for the suppression of host immunity by the AvrPtoB effector and for plant pattern-triggered immunity. 1371

AIK1, A Mitogen-Activated Protein Kinase, Modulates Abscisic Acid Responses through the MKK5-MPK6 Kinase Cascade. Kun Li, Fengbo Yang, Guozeng Zhang, Shufei Song, Yuan Li, Dongtao Ren, Yuchen Miao, and Chun-Peng Song

An Arabidopsis MAPK kinase kinase (MAPKKK), AIK1, modulates ABA signaling by sequentially relaying and amplifying intracellular signals through the AIK1-MKK5-MPK6 cascade. 1391
Defense Responses in Aspen with Altered Pectin Methylesterase Activity Reveal the Hormonal Inducers of Tyloses. Joanna Leśniewska, David Öhman, Małgorzata Krzesłowska, Sunita Kushwah, Maria Barciszewska-Pucak, Leszek A. Kleczkowski, Björn Sundberg, Thomas Moritz, and Ewa J. Mellerowicz

Suppression of pectin methyl esterase, and jasmonates in synergy with 1-aminocyclopropane-1-carboxylic acid acting via the ethylene signaling pathway, induces tyloses in intact, healthy aspen plants. 1409

Jasmonic Acid Enhances Al-Induced Root Growth Inhibition. Zhong-Bao Yang, Chunmei He, Yanqi Ma, Marco Herde, and Zhaojun Ding

Jasmonate mediates aluminum-induced root growth inhibition through regulation of microtubule polymerization and ALMT1-regulated malate exudation in an auxin-independent manner in Arabidopsis. 1420

Nitric Oxide Modulates Histone Acetylation at Stress Genes by Inhibition of Histone Deacetylases. Alexander Mengel, Alexandra Ageeva, Elisabeth Georgii, Jörg Bernhardt, Keqiang Wu, Jörg Durner, and Christian Lindermayr

Nitric oxide may regulate histone acetylation at stress-related genes by inhibiting histone deacetylases. 1434


Constitutive expression of SAUR genes increases cell wall extensibility and promotes auxin-independent elongation growth in Arabidopsis and tomato. 1453

Gibberellin Signaling Requires Chromatin Remodeler PICKLE to Promote Vegetative Growth and Phase Transitions. Jeongmoo Park, Dong-Ha Oh, Maheshi Dassanayake, Khoa Thi Nguyen, Joe Ogas, Giltsu Choi, and Tai-ping Sun

GA induction of genes involved in cell elongation, cell division, and phase transitions requires chromatin-remodeler PICKLE function. 1463

The OsMYB30 Transcription Factor Suppresses Cold Tolerance by Interacting with a JAZ Protein and Suppressing \( b \)-Amylase Expression. Yan Lv, Mei Yang, Dan Hu, Zeyu Yang, Siqui Ma, Xianghua Li, and Lihong Xiong

OsMYB30 confers cold sensitivity through interaction with OsJAZ9 to down-regulate the expression \( \beta \)-amylase genes and the production of maltose in rice. 1475

SYSTEMS AND SYNTHETIC BIOLOGY

Detainment of Tam3 Transposase at Plasma Membrane by Its BED-Zinc Finger Domain. Hua Zhou, Megumi Hirata, Ryo Oosawa, Kaizen Fujino, and Yuji Kishima

To silence transposition of the DNA transposon Tam3, the BED-zinc finger domain of Tam3 transposase in Antirrhinum retains function at the plasma membrane. 1492

Integrating Omics and Alternative Splicing Reveals Insights into Grape Response to High Temperature. Jianfu Jiang, Xinna Liu, Chonghua Liu, Guotian Liu, Shaohua Li, and Lijun Wang

Integration of transcriptomic and proteomic data provides complementary evidence for grape responses to high temperature at transcriptional, posttranscriptional, and translational levels. 1502

Continued on next page
CORRECTIONS


The Pentratricopeptide Repeat Protein DELAYED GREENING1 Is Involved in the Regulation of Early Chloroplast Development and Chloroplast Gene Expression in Arabidopsis. Chi W., Ma J., Zhang D., Guo J., Chen F., Lu C., and Zhang L. 1521


DAC Is Involved in the Accumulation of the Cytochrome b_{6}/f Complex in Arabidopsis. Xiao J., Li J., Ouyang M., Yun T., He B., Ji D., Ma J., Chi W., Lu C., and Zhang L. 1524

RETRACTION

Cooperation of LPA3 and LPA2 Is Essential for Photosystem II Assembly in Arabidopsis. Cai W., Ma J., Chi W., Zou M., Guo J., Lu C., and Zhang L. 1526

[CC-BY] Article free via Creative Commons CC-BY 4.0 license. [OPEN] Articles can be viewed without a subscription.