On the Cover: In dicot leaves, epidermal pavement cells morph from a simple polyhedron to an interdigitated and highly lobed shape. Given the importance of pavement cells for the growth and mechanical stability of leaves, a quantitative analysis of their morphogenesis is critical. Wu et al. (pages 2331–2342) describe a convex hull-based algorithm termed LobeFinder, which uses the XY coordinates of the cell perimeter to locate cell lobes. This new phenotyping tool provides a standardized method to quantify and track lobe formation events. LobeFinder also creates a graphical output to map cell geometry over time. The cover image shows a field of epidermal cells, and the XY coordinates of the center cell were analyzed using LobeFinder. The artwork was created by Samuel A. Belteton. The confocal image was captured by Russell S. Julian.

ON THE INSIDE

Peter V. Minorsky

COMMENTARY

Moving toward Light in Response to a Gas: A Novel Cyanobacterial Ethylene Receptor. 
Bram Van de Poel and Caren Chang

TOPICAL REVIEWS

Chloroplast Proteases: Updates on Proteolysis within and across Suborganellar Compartments. 
Kenji Nishimura, Yusuke Kato, and Wataru Sakamoto

Homeostasis and remodeling of the chloroplast proteome involve various “processing” and “processive” proteases.

Evolution of Gene Duplication in Plants. 
Nicholas Panchy, Melissa Lehti-Shiu, and Shin-Han Shiu

Gene duplicates are prevalent in plants and in some cases contribute to evolutionary novelty.

BREAKTHROUGH TECHNOLOGIES

Chloroplast-Specific in Vivo Ca\(^{2+}\) Imaging Using Yellow Cameleon Fluorescent Protein Sensors Reveals Organelle-Autonomous Ca\(^{2+}\) Signatures in the Stroma. 
Giovanna Loro, Stephan Wagner, Fabrizio Gandolfo Doccula, Smrutisanjita Behera, Stefan Weintr, Joerg Kudla, Markus Schwarzländer, Alex Costa, and Michela Zottini

Plants expressing a chloroplast-localized Cameleon Ca\(^{2+}\) probe allow single-organelle analysis of chloroplast Ca\(^{2+}\) dynamics.

Tzu-Ching Wu, Samuel A. Belteton, Jessica Pack, Daniel B. Szymanski, and David M. Umulis

LobeFinder, a new convex hull-based cell phenotyping tool, creates a coordinate system for cell boundary changes and detects lobe positions in epidermal pavement cells.

Expression Pattern Similarities Support the Prediction of Orthologs Retaining Common Functions after Gene Duplication Events. 
Malay Das, Georg Haberer, Arup Panda, Shayani Das Laha, Tapas Chandra Ghosh, and Anton R. Schöffner

Expressologs identify functional orthologs and will be a powerful tool in future orthology assignment.

Continued on next page
SCIENTIFIC CORRESPONDENCE

The Developmental Basis of Stomatal Density and Flux. Lawren Sack and Thomas N. Buckley

Equations for stomatal density and maximum theoretical stomatal conductance as functions of stomatal initiation rate, epidermal cell size, and stomatal size enable scaling from development to flux.

Inositol Polyphosphate Binding Specificity of the Jasmonate Receptor Complex. Debabrata Laha, Nargis Parvin, Marek Dynowski, Philipp Johnen, Haibin Mao, Sven T. Bitters, Ning Zheng, and Gabriel Schaaf

Inositol polyphosphate binding specificity of the jasmonate receptor is largely determined by the F-box protein COII.

RESEARCH REPORT


Idioblasts from Catharanthus roseus leaves specifically accumulate alkaloids and show autofluorescence that enabled the fluorescence-activated cell sorting of a population of idioblast protoplasts.

UPDATE

FERONIA and Her Pals: Functions and Mechanisms. Chao Li, H.-M. Wu, and Alice Y. Cheung

Current research into the FERONIA family of receptor kinases highlights both questions and opportunities for understanding signaling strategies in plant growth and survival.

RESEARCH ARTICLES

BIOCHEMISTRY AND METABOLISM

Microalgae Synthesize Hydrocarbons from Long-Chain Fatty Acids via a Light-Dependent Pathway. Damien Sorigué, Bertrand Légeret, Stéphan Cuiné, Pablo Morales, Boris Mirabella, Geneviève Guédencay, Yonghua Li-Beisson, Reinhard Jetter, Gilles Peltier, and Fred Beisson

A pathway converting C16 and C18 fatty acids to alkanes or alkenes, involving the light-dependent transformation of cis-vaccenic acid into 7-heptadecene, is present in various microalgae.

Saturating Light Induces Sustained Accumulation of Oil in Plastidal Lipid Droplets in Chlamydomonas reinhardtii. Hugh Douglas Goold, Stéphan Cuiné, Bertrand Légeret, Yuanxue Liang, Sabine Brugière, Pascaline Auroy, Hélène Javot, Marianne Tardif, Brian Jones, Fred Beisson, Gilles Peltier, and Yonghua Li-Beisson

Saturating light induces oil storage in Chlamydomonas reinhardtii, and the newly formed oil accumulates in lipid droplets distinct in protein and lipid compositions from those induced by nitrogen starvation.

Evolution of Xylan Substitution Patterns in Gymnosperms and Angiosperms: Implications for Xylan Interaction with Cellulose. Marta Busse-Wicher, An Li, Rodrigo L. Silveira, Caroline S. Pereira, Theodora Tryfona, Thiago C. F. Gomes, Munir S. Skaf, and Paul Dupree

The xylan decoration pattern in all lineages of gymnosperms permits hydrogen bonding of xylan to cellulose.
Molecular Evolution and Functional Characterization of a Bifunctional Decarboxylase Involved in Lycopodium Alkaloid Biosynthesis. Somnuk Bunsupa, Kousuke Hanada, Akira Maruyama, Kaori Aoyagi, Kana Komatsu, Hideki Ueno, Madoka Yamashita, Ryosuke Sasaki, Akira Oikawa, Kazuki Saito, and Mami Yamazaki

Production of plant lysine-derived alkaloids originates with the convergent evolution of lysine decarboxylase.

The Relationship of Triacylglycerol and Starch Accumulation to Carbon and Energy Flows during Nutrient Deprivation in Chlamydomonas reinhardtii. Matthew T. Juergens, Bradley Disbrow, and Yair Shachar-Hill

Overflow in triacylglycerol is insufficient to explain carbon storage during nutrient deprivation.


Silencing two cytochrome P450 genes reduces steroidal glycoalkaloid content and stops tuber sprouting.

Light Remodels Lipid Biosynthesis in Nannochloropsis gaditana by Modulating Carbon Partitioning between Organelles. Alessandro Alboresi, Giorgio Perin, Nicola Vitalo, Gianfranco Diretto, Maryse Block, Juliette Jouhet, Andrea Meneghesso, Giorgio Valle, Giovanni Giuliano, Eric Maréchal, and Tomas Morosinotto

Light availability remodels carbon partitioning between organelles toward a greater TAG accumulation in Nannochloropsis gaditana.

A Stilbenoid-Specific Prenyltransferase Utilizes Dimethylallyl Pyrophosphate from the Plastidic Terpenoid Pathway. Tianhong Yang, Lingling Fang, Agnes M. Rimando, Victor Sobolev, Keithanne Mockaitis, and Fabricio Medina-Bolivar

Stilbene prenyltransferase that utilizes DMAPP from the plastidic terpenoid pathway shows a high substrate specificity.

Coordinate Regulation of Metabolite Glycosylation and Stress Hormone Biosynthesis by TT8 in Arabidopsis. Amit Rai, Shioshankar Umashankar, Megha Rai, Lim Boon Kiat, Johanan Aow Shao Bing, and Sanjay Swarup

Processes that generate metabolite diversity and reprogram hormone biosynthesis are coordinately regulated to impart stress tolerance in Arabidopsis.

CELL BIOLOGY

Lack of FTSH4 Protease Affects Protein Carbonylation, Mitochondrial Morphology, and Phospholipid Content in Mitochondria of Arabidopsis: New Insights into a Complex Interplay. Elwira Smakowska, Renata Skibior-Blaszczyk, Malgorzata Czarna, Marta Kolodziejczak, Malgorzata Kwasiński-Oweczarek, Katarzyna Pars, Christiane Funk, and Hanna Janska

Plants devoid of FTSH4, one of the ATP-dependent metalloproteases in mitochondria, reveal an increased number of abnormal mitochondria, decreased respiratory complexes, and lower amounts of cardiolipins, which is suggested to cause the observed accumulation of oxidative damage.


C-terminally encoded peptides together with the CRA2 receptor regulate nodulation and lateral root development through ethylene-dependent and ethylene-independent pathways, respectively, in Medicago truncatula.
ECOPHYSIOLOGY AND SUSTAINABILITY

Rubisco Catalytic Properties and Temperature Response in Crops. Carmen Hermida-Carrera, Maxim V. Kapralov, and Jeroni Galmés

Variability in Rubisco kinetic parameters and their temperature dependency demonstrate differences in photosynthetic efficiency in the most important crops worldwide.

Rice Root Architectural Plasticity Traits and Genetic Regions for Adaptability to Variable Cultivation and Stress Conditions. Nitika Sandhu, K. Anitha Raman, Rolando O. Torres, Alain Audebert, Audrey Dardou, Arvind Kumar, and Amelia Henry

Rice root genetic regions determining root architectural plasticity can be used for selection of improved adaptability to variable conditions.

Alarm Photosynthesis: Calcium Oxalate Crystals as an Internal CO₂ Source in Plants. Georgia Tooulakou, Andreas Giannopoulos, Dimosthenis Nikolopoulos, Panagiota Bresta, Elissavet Dotsika, Malvina G. Orkoula, Christos G. Kontoyannis, Costas Fasseas, Georgios Liakopoulos, Maria I. Klapa, and George Karabourniotis

A new photosynthetic path named “alarm photosynthesis” uses mesophyll calcium oxalate crystals as the CO₂ source when stomata are closed, providing adaptive advantages under drought conditions.

GENES, DEVELOPMENT, AND EVOLUTION

A Collection of Conserved Noncoding Sequences to Study Gene Regulation in Flowering Plants. Jan Van de Velde, Michiel Van Bel, Dries Vaneechoutte, and Klaas Vandepoele

Comparative sequence analysis delineates conserved noncoding sequences that are functionally relevant, a subset of which are conserved throughout green plants.

Functional Promiscuity of Two Divergent Paralogs of Type III Plant Polyketide Synthases. Shahnaz A. Pandith, Niha Dhar, Satinder Rana, Wajid Waheed Bhat, Manoj Kushwaha, Ajai P. Gupta, Manzoor A. Shah, Ram Vishwakarma, and Surinder K. Tattoo

Evolutionary and functional divergence of gene paralogs expressing polyketide synthases from Rheum emodi play into secondary metabolism and substrate selectivities.

mRNA Decay of Most Arabidopsis miRNA Targets Requires Slicer Activity of AGO1. Laura Arribas-Hernández, Lukasz Jan Kielpinski, and Peter Brodersen

The majority of miRNA targets require slicer activity of ARGONALITE1 for repression at the mRNA level.

nana plant2 Encodes a Maize Ortholog of the Arabidopsis Brassinosteroid Biosynthesis Gene DWARF1, Identifying Developmental Interactions between Brassinosteroids and Gibberellins. Norman B. Best, Thomas Hartwig, Josh Budka, Shozo Fujikawa, Gurumukh Johal, Burkhard Schulz, and Brian P. Dilkes

nana plant2 encodes an enzyme in the brassinosteroid biosynthetic pathway, and brassinosteroid and gibberellin interact in a developmentally specific manner to control maize architecture.


The juvenile phase of maize is correlated with elevated expression of stress-related genes.
Sequence Polymorphisms at the REDUCED DORMANCY5 Pseudophosphatase Underlie Natural Variation in Arabidopsis Dormancy. Yong Xiang, Baoping Song, Guillaume Née, Katharina Kramer, Iris Finkemeier, and Wim J.J. Soppe

DELAY OF GERMINATION18 QTL encodes a pseudophosphatase, involved in seed dormancy regulation.

Different Alleles of a Gene Encoding Leuochantocyanidin Reductase (PaLAR3) Influence Resistance against the Fungus Heterobasidion parviporum in Picea abies. Miguel Nemesio-Gorriz, Almuth Hammerbacher, Katarina Ihrmark, Thomas Källman, Åke Olson, Martin Lascoux, Jan Stenlid, Jonathan Gershenzon, and Malin Elfstrand

Two alleles contributing to phenolic secondary metabolism provide markers for pathogen resistance in Norway spruce and have differential effects on resistance.

Protocorms and Protocorm-Like Bodies Are Molecularly Distinct from Zygotic Embryonic Tissues in Phalaenopsis aphrodite. Su-Chiung Fang, Jhun-Chen Chen, and Miao-Ju Wei

Protocorm-like body development does not utilize the somatic embryogenesis program in Phalaenopsis aphrodite.

SUPPRESSOR OF PHYTOCHROME B4-3 Represses Genes Associated with Auxin Signaling to Modulate Hypocotyl Growth. David S. Favero, Caitlin N. Jacques, Akira Iwase, Kimberly Ngan Le, Jianfei Zhao, Keiko Sugimoto, and Michael M. Neff

SOB3 modulates seedling elongation by repressing the expression of genes associated with auxin signaling.

MEMBRANES, TRANSPORT, AND BIOENERGETICS

Chlamydomonas reinhardtii PsbS Protein is Functional and Accumulates Rapidly and Transiently under High Light. Tania Tibiletti, Pascaline Auroy, Gilles Peltier, and Stefano Caffarri

Photoprotective proteins PsbS and LhcSR3 accumulate rapidly in the photosynthetic membrane of Chlamydomonas during high light stress with PsbS activating nonphotochemical quenching.

The Plasma Membrane H+-ATPase AHA1 Plays a Major Role in Stomatal Opening in Response to Blue Light. Shota Yamauchi, Aitsushi Takemiyagi, Tomoaki Sakamoto, Tetsuya Kuratani, Toshifumi Tsutsumi, Toshinori Kinoshita, and Ken-ichiro Shimazaki

Mutation of the gene for AHA1, an H+-ATPase isoform, provides new insights into the stomatal regulation of Arabidopsis in response to blue light.

SIGNALING AND RESPONSE

Mutational Evidence for the Critical Role of CBF Transcription Factors in Cold Acclimation in Arabidopsis. Chunzhao Zhao, Zhengjing Zhang, Shaojun Xie, Tong Si, Yuanya Li, and Jian-Kang Zhu

The three CBF genes are essential for freezing tolerance and affect seedling development and salt tolerance.

The ERF11 Transcription Factor Promotes Internode Elongation by Activating Gibberellin Biosynthesis and Signaling. Xin Zhou, Zhong-Lin Zhang, Jeongmoo Park, Ludmila Tyler, Jikumaru Yusuke, Kai Qiu, Edward A. Nam, Shelley Lumba, Darrell Desveaux, Peter McCourt, Yuji Kamiya, and Tai-ping Sun

The transcription factor AtERF11 promotes stem growth by increasing GA biosynthesis and GA response in Arabidopsis.
The WRKY57 Transcription Factor Affects the Expression of Jasmonate ZIM-Domain Genes Transcriptionally to Compromise Botrytis cinerea Resistance. Yanjuan Jiang and Diqiu Yu

The negative role of AtWRKY57 in Botrytis infection results from transcriptional competition between transcription factors WRKY57 and WRKY33 and their actions on downstream target JAZ1 and JAZ5 genes.

Maize and Arabidopsis ARGOS Proteins Interact with Ethylene Receptor Signaling Complex, Supporting a Regulatory Role for ARGOS in Ethylene Signal Transduction. Jinrui Shi, Bruce J. Drummond, Hongyu Wang, Rayeann L. Archibald, and Jeffrey E. Habben


Ethylene Regulates the Physiology of the Cyanobacterium Synechocystis sp. PCC 6803 via an Ethylene Receptor. Randy F. Lacey and Brad M. Binder

Ethylene modulates the physiology of Synechocystis sp. PCC 6803 via the SynEtr1 ethylene receptor.

Feedback Regulation of ABA Signaling and Biosynthesis by a bZIP Transcription Factor Targets Drought-Resistance-Related Genes. Wei Zong, Ning Tang, Jun Yang, Lei Peng, Siqi Ma, Yan Xu, Guoliang Li, and Lisheng Xiong

Abscisic acid signaling and biosynthesis are feedback-regulated by transcription factor OsbZIP23 that targets diverse genes involved in drought resilience.

New Constitutively Active Phytochromes Exhibit Light-Independent Signaling Activity. A-Reum Jeong, Si-Seok Lee, Yun-Jeong Han, Ah-Young Shin, Ayoung Baek, Taeho Ahn, Min-Gon Kim, Young Soon Kim, Keum Woo Lee, Akira Nagatani, and Jeong-Il Kim

Characterization of new constitutively active mutants of phytochromes reveals that both biologically active structure and nuclear localization are crucial for the light-independent function in plants.

The THO/TREX Complex Active in miRNA Biogenesis Negatively Regulates Root-Associated Acid Phosphatase Activity Induced by Phosphate Starvation. Sibo Tao, Ye Zhang, Xiaoyue Wang, Le Xu, Xiaofeng Fang, Zhi John Lu, and Dong Liu

The THO/TREX complex negatively regulates phosphate starvation-induced root-associated acid phosphatase activity by suppressing ethylene signaling in Arabidopsis.

A NAP-Family Histone Chaperone Functions in Abiotic Stress Response and Adaptation. Amit K. Tripathi, Ashaani Pareek, and Sneh Lata Singla-Pareek


Articles can be viewed without a subscription.