On the Cover: The cover photo, taken by Drs. Yong-Ling Ruan and Eric Hines, shows rapidly elongating cotton (Gossypium hirsutum) fiber cells from the outer seed coat epidermis using a confocal microscope for preloaded fluorescent dye, carboxyfluorescein. Each cotton fiber is a single cell that undergoes rapid and synchronized unidirectional expansion to several centimeters long by approximately 18 d after anthesis before it switches to cell wall cellulose synthesis. Thus, cotton fiber represents an excellent cell model to study regulation of cell expansion. In this issue, Wang et al. (pp. 744–756) explore the roles and mechanisms of vacuolar invertase (VIN) in controlling plant cell expansion. They discovered that VIN regulates cotton fiber and Arabidopsis (Arabidopsis thaliana) root elongation in osmotic-dependent and -independent pathways, respectively. The study provides an example that a given protein (e.g. VIN) could control similar developmental processes such as cell expansion through different mechanisms in different cell types.

EDITORIAL

Plant Physiology Celebrates Its 25,000th Article!  Rick Amasino, Bonnie Bartel, and Don Ort

FUTURE PERSPECTIVES IN PLANT BIOLOGY

Early Evolution of Photosynthesis.  Robert E. Blankenship
Basal Signaling Regulates Plant Growth and Development.  Wendy F. Boss, Heike Winter Sederoff, Yang Ju Im, Nava Moran, Amy M. Grunden, and Imara Y. Perera
Emerging Complexity in Reactive Oxygen Species Production and Signaling during the Response of Plants to Pathogens.  Tamara Vellolillo, Jorge Vicente, Satish Kulasekaran, Mats Hamberg, and Carmen Castresana
Understanding Lignification: Challenges Beyond Monolignol Biosynthesis.  Xu Li and Clint Chapple
Flavonoids and Isoflavonoids: From Plant Biology to Agriculture and Neuroscience.  Richard A. Dixon and Giulio M. Pasinetti
Endoplasmic Reticulum: The Rising Compartment in Auxin Biology.  Jiří Friml and Angharad R. Jones
Opportunities to Explore Plant Membrane Organization with Super-Resolution Microscopy.  Ryan Gutierrez, Guido Grossmann, Wolf B. Frommer, and David W. Ehrhardt
Plant Biology in the Fourth Dimension.  Stacey Harmer
Ubiquitin Ligase-Coupled Receptors Extend Their Reach to Jasmonate.  Gregg A. Howe
Abscisic Acid Receptors.  Kelli G. Kline, Michael R. Sussman, and Alan M. Jones
Plant Cell Walls.  Kenneth Keegstra
Climbing the Branches of the Strigolactones Pathway One Discovery at a Time.  Charles Goulet and Harry J. Klee
Twenty-First Century Plant Biology: Impacts of the Arabidopsis Genome on Plant Biology and Agriculture.  C. Robin Buell and Robert L. Last
The Power of Auxin in Plants.  Ottoline Leyser
Do Transcription Factors Play Special Roles in Adaptive Variation?  Cathie Martin, Noel Ellis, and Fred Rook
The Elements of Plant Micronutrients.  Sabeeha S. Merchant
The Timing of Flowering.  Richard M. Amasino and Scott D. Michaels
Oxidative Stress: Antagonistic Signaling for Acclimation or Cell Death?  Philip M. Mullineaux and Neil R. Baker

Continued on next page
How Do We Improve Crop Production in a Warming World?  
**Elizabeth A. Ainsworth and Donald R. Ort**  
526

Gene Clusters for Secondary Metabolic Pathways: An Emerging Theme in Plant Biology.  
**Anne Osbourn**  
531

Plant Immunity: It’s the Hormones Talking, But What Do They Say?  
**Adriaan Verhage, Saskia C.M. van Wees, and Corné M.J. Pieterse**  
536

The Past, Present, and Future of Vegetative Phase Change.  
**R. Scott Poethig**  
541

Understanding Plant Vacuolar Trafficking from a Systems Biology Perspective.  
**Abel Rosado and Natasha V. Raikhel**  
545

Pathogen-Associated Molecular Pattern-Triggered Immunity: Veni, Vidi…?  
**Cyril Zipfel and Silke Robatzek**  
551

Lignin and Biomass: A Negative Correlation for Wood Formation and Lignin Content in Trees.  
**Evandro Novaes, Matias Kirst, Vincent Chiang, Heike Winter-Sederoff, and Ronald Sederoff**  
555

Discover and Connect Cellular Signaling.  
**Jen Sheen**  
562

Gibberellin-GID1-DELLA: A Pivotal Regulatory Module for Plant Growth and Development.  
**Tai-ping Sun**  
567

Molecular Basis of Plant Cold Acclimation: Insights Gained from Studying the CBF Cold Response Pathway.  
**Michael F. Thomashow**  
571

The Puzzle of Phloem Pressure.  
**Robert Turgeon**  
578

Quantitative Trait Loci, Epigenetics, Sugars, and MicroRNAs: Quaternaries in Phosphate Acquisition and Use.  
**Carroll P. Vance**  
582

Enhancing C₃ Photosynthesis.  
**Susanne von Caemmerer and John R. Evans**  
589

From Endosymbiosis to Synthetic Photosynthetic Life.  
**Andreas P.M. Weber and Katherine W. Osteryoung**  
593

Evolution of C₄ Photosynthesis—Looking for the Master Switch.  
**Peter Westhoff and Udo Gowik**  
598

ON THE INSIDE

**Peter V. Minorsky**  
602

BREAKTHROUGH TECHNOLOGIES

**Ina Weissflog, Nadine Vogler, Denis Akimov, Andrea Dellith, Doreen Schachtschabel, Ales Svatos, Wilhelm Boland, Benjamin Dietzek, and Jürgen Popp**  
604

**Jeongsik Kim and David E. Somers**  
611

[OA] Stacking Multiple Transgenes at a Selected Genomic Site via Repeated Recombinase-Mediated DNA Cassette Exchanges.  
**Zhongsen Li, Bryan P. Moon, Ai Qiu Xing, Zhan-Bin Liu, Richard P. McCordell, Howard G. Damude, and S. Carl Falco**  
622

RESEARCH ARTICLES

BIOCHEMICAL PROCESSES AND MACROMOLECULAR STRUCTURES

**Yan Liang, Ahmed Faik, Marcia Kieliszewski, Li Tan, Wen-Liang Xu, and Allan M. Showalter**  
632

**Cécile Vriet, Tracey Welham, Andreas Brachmann, Marilyn Pike, Jodie Pike, Jillian Perry, Martin Parniske, Shusei Sato, Satoshi Tabata, Alison M. Smith, and Trevor L. Wang**  
643

**Raymond Campbell, Laurence J.M. Ducreux, Wayne L. Morris, Jenny A. Morris, Jeffrey C. Suttle, Gavin Ramsay, Glenn J. Bryan, Pete E. Hedley, and Mark A. Taylor**  
656

Continued on next page


Analysis of the Rice Mitochondrial Carrier Family Reveals Anaerobic Accumulation of a Basic Amino Acid Carrier Involved in Arginine Metabolism during Seed Germination. Nicolas L. Taylor, Katharine A. Howell, Joshua L. Heazlewood, Tzu Yien W. Tan, Reena Narasi, Shaobai Huang, James Whelan, and A. Harvey Millar

Extracellular Nucleotides Elicit Cytosolic Free Calcium Oscillations in Arabidopsis. Kiwamu Tanaka, Sarah J. Swanson, Simon Gilroy, and Gary Stacey

Tethering Factors Required for Cytokinesis in Arabidopsis. Martha Thellmann, Katarzyna Rybak, Knut Thiele, Gerhard Wanner, and Farhah F. Assaad

Leaf Senescence Signaling: The Ca^{2+}-Conducting Arabidopsis Cyclic Nucleotide Gated Channel2 Acts through Nitric Oxide to Repress Senescence Programming. Wei Ma, Andries Smigel, Robin K. Walker, Wolfgang Moeder, Keiko Yoshioka, and Gerald A. Berkowitz

Evidence That High Activity of Vacuolar Invertase Is Required for Cotton Fiber and Arabidopsis Root Elongation through Osmotic Dependent and Independent Pathways, Respectively. Lu Wang, Xiao-Rong Li, Heng Lian, Di-An Ni, Yu-ke He, Xiao-Ya Chen, and Yong-Ling Ruan


The Plant-Specific SR45 Protein Negatively Regulates Glucose and ABA Signaling during Early Seedling Development in Arabidopsis. Raquel Fonseca Carvalho, Sofia Domingues Carvalho, and Paula Duque


A Gain-of-Function Mutation in the Arabidopsis Disease Resistance Gene RPP4 Confers Sensitivity to Low Temperature. Xiaozen Huang, Jianyong Li, Fei Bao, Xiaoyan Zhang, and Shuhua Yang


Proper Levels of the Arabidopsis Cohesion Establishment Factor CTF7 Are Essential for Embryo and Megagametophyte, But Not Endosperm, Development. Ling Jiang, Li Yuan, Ming Xia, and Christopher A. Makaroff
PLANTS INTERACTING WITH OTHER ORGANISMS

The glabra1 Mutation Affects Cuticle Formation and Plant Responses to Microbes. Ye Xia, Keshun Yu, Duroy Navarre, Kenneth Seebold, Aardra Kachroo, and Pradeep Kachroo 833

Abscisic Acid Deficiency Causes Changes in Cuticle Permeability and Pectin Composition That Influence Tomato Resistance to Botrytis cinerea. Katrien Curvers, Hamed Seifi, Grégory Mouille, Riet de Rycke, Bob Asselbergh, Annelies Van Hecke, Dieter Vanderscaeghe, Herman Höfte, Nico Callewaert, Frank Van Breusegem, and Monica Höfte 847


WHOLE PLANT AND ECOPHYSIOLOGY


Tyloses and Phenolic Deposits in Xylem Vessels Impede Water Transport in Low-Lignin Transgenic Poplars: A Study by Cryo-Fluorescence Microscopy. Peter Kitin, Steven L. Voelker, Frederick C. Meinzer, Hans Beeckman, Steven H. Strauss, and Barbara Lachenbruch 887

Endogenous Abscisic Acid as a Key Switch for Natural Variation in Flooding-Induced Shoot Elongation. Xin Chen, Ronald Pierik, Anton J.M. Peeters, Hendrik Poorter, Eric J.W. Visser, Heidrun Huber, Hans de Kroon, and Laurentius A.C.J. Voesenek 969


Nonreductive Iron Uptake Mechanism in the Marine Alveolate Chromera velia. Robert Sutak, Jan Šlapeta, Mabel San Roman, Jean-Michel Camadro, and Emmanuel Lesuisse 991

SYSTEMS BIOLOGY, MOLECULAR BIOLOGY, AND GENE REGULATION


The Seed Composition of Arabidopsis Mutants for the Group 3 Sulfate Transporters Indicates a Role in Sulfate Translocation within Developing Seeds. Hélène Zuber, Jean-Claude Davidian, Grégoire Aubert, Delphine Aimé, Maya Belghazi, Raphaël Lagan, Dimitri Heintz, Markus Wirtz, Rüdiger Hell, Richard Thompson, and Karine Gallardo 913

Coexpression Analysis Identifies Rice Starch Regulator1, a Rice AP2/EREBP Family Transcription Factor, as a Novel Rice Starch Biosynthesis Regulator. Fang-Fang Fu and Hong-Wei Xue 927


13C-Tracer and Gas Chromatography-Mass Spectrometry Analyses Reveal Metabolic Flux Distribution in the Oleaginous Microalga Chlorella protothecoides. Wei Xiong, Lixia Liu, Chao Wu, Chen Yang, and Qingyu Wu 1001

CORRECTIONS

Phosphatidic Acid Inhibits Blue Light-Induced Stomatal Opening via Inhibition of Protein Phosphatase 1. A. Takemiya and K.-i. Shimazaki 1012

Arabinogalactan-Proteins: Key Regulators at the Cell Surface? M. Ellis, J. Egelund, C.J. Schultz, and A. Bacic 1012

RETRACTION


Some figures in this article are displayed in color online but in black and white in the print edition.

Indicates Web-only data.

Open Access articles can be viewed online without a subscription.