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FOCUS ISSUE

EDITORIAL
Cellular Dynamics: Cellular Systems in the Time Domain Dan Szymanski, Diane Bassham, Teun Munnik, and Wataru Sakamoto

UPDATES

Structural and functional roles of cellulose, xyloglucan, and pectins in cell wall enlargement are reappraised with insights from mechanics, atomic force microscopy, and other methods.

[OPEN] Interplay between Ions, the Cytoskeleton, and Cell Wall Properties during Tip Growth. Carlisle S. Bascom Jr., Peter K. Hepler, and Magdalena Bezanilla
Tip growth is a focused and tightly regulated apical explosion that depends on the interconnected activities of ions, the cytoskeleton, and the cell wall.

Mechanical modeling of plant cells using finite element methods serves to simulate the behavior of complex cell shapes with the aim to understand biological functioning.

[OPEN] ROP GTPases Structure-function and Signaling Pathways. Gil Feiguelman, Ying Fu, and Shaul Yalovsky
Interactions between receptor like kinases and guanyl nucleotide exchange factors together with identification of effector proteins reveal putative ROP GTPases signaling cascades.

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Advanced bioimaging uncovers insights into subcellular structures of plants. 80


Cortical microtubules play a critical role in plant morphogenesis by creating array patterns that template the deposition of cellulose microfibrils. 94


Functionally distinct actin filament arrays cluster organelles and define cellular scale flow patterns for secretion. 106

[OPEN] Update on Myosin Motors: Molecular Mechanisms and Physiological Functions. Jennifer M. Ryan and Andreas Nebenfuhr

Recent progress has revealed aspects of the molecular mechanisms that allow myosin motors to carry out their physiological functions. 119


Stromules are plastid stroma-filled tubules that increase the surface area of the envelope and extend the reach of the plastid within the plant cell, affecting biosynthesis, metabolism, and signaling. 128


Recent studies advance understanding of the mechanisms, spatial control, and regulation of chloroplast division, but many questions remain. 138

[OPEN] Fission and Fusion of Plant Mitochondria, and Genome Maintenance. Shin-ichi Arimura

Dynamic changes maintain a multipartite mitochondrial genome meets the changing needs of plant cells. 152

[OPEN] Peroxisome Function, Biogenesis, and Dynamics in Plants. Yun-Ting Kao, Kim L. Gonzalez, and Bonnie Bartel

Recent advances highlight understanding of the diversity of peroxisome contributions to plant biology and the mechanisms through which these essential organelles are generated. 162

[OPEN] Advances in Plant ER Architecture and Dynamics. Giovanni Stefano and Federica Brandizzi

Recent advances highlight mechanisms that enable the morphological integrity of the plant ER in relation to the other organelles and the cytoskeleton. 178

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The trans-Golgi network in plants is a major sorting station of Golgi derived cargo while it also receives recycled material from endocytosis.

Membrane Dynamics and Multiple Functions of Oil Bodies in Seeds and Leaves. Takashi L. Shimada, Makoto Hayashi, and Ikuko Hara-Nishimura

Oil bodies have multiple functions: oleosin-mediated freezing tolerance of seeds, direct interaction with glyoxysomes for lipid degradation in seedlings, and antifungal compound production in leaves.

Inroads into Internalization: Five Years of Endocytic Exploration. Gregory D. Reynolds, Chao Wang, Jianwei Pan, and Sebastian Y. Bednarek

Advances over recent years underlines a growing interest in investigating endocytosis in plants.

Dynamics of Autophagosome Formation. Junmarie Soto-Burgos, Xiaohong Zhuang, Liwen Jiang, and Diane C. Bassham

Environmental stress activates autophagy and leads to autophagosome formation at the endoplasmic reticulum.


The functional organization of the plant nuclear pore, nuclear envelope, and nucleoplasm marks dynamically changing environmental cues and developmental programs.

Emerging Roles of the Nuclear Cap-Binding Complex in Abiotic Stress Responses. Agata Daszkowska-Golec

Plant nuclear CBC consisted of two subunits (CBP20 and CBP80) is involved in both conserved processes related to RNA metabolism and simultaneously in extremely dynamic plant stress response.

Polysomes, Stress Granules and Processing Bodies: A Dynamic Triumvirate Controlling Cytoplasmic mRNA Fate and Function. Thanin Chantarachot and Julia Bailey-Serres

Discoveries illuminate highly regulated dynamics of mRNA translation, sequestration, and degradation within the cytoplasm of plants.

BREAKTHROUGH TECHNOLOGIES

Nuclear Transcriptomes at High Resolution Using Retooled INTACT. Mauricio A. Reynoso, Germain C. Pauzuzzi, Kaisa Kajala, Sean Cabanlit, Joel Velasco, Jeremie Bazin, Roger Deal, Neelima R. Sinha, Siobhan M. Brady, and Julia Bailey-Serres

Improved technology and methodology facilitate affinity purification of nuclei and analysis of nuclear transcriptomes, chromatin, and other nuclear components.
RESEARCH REPORT

Three-Dimensional Analysis of Chloroplast Structures Associated with Virus Infection. Xuejiao Jin, Zhihao Jiang, Kun Zhang, Pengfei Wang, Xiuling Cao, Ning Yue, Xueting Wang, Xuan Zhang, Yunqin Li, Dawei Li, Byung-Ho Kang, and Yongliang Zhang

Three-dimensional visualization identifies structural remodeling in chloroplasts during barley stripe mosaic virus infection.

RESEARCH ARTICLES


Bacterial-like and a eukaryotic-specific FtsZ families have distinct but conserved functions in the division of red- and green-lineage chloroplasts.

Microtubule Array Patterns Have a Common Underlying Architecture in Hypocotyl Cells. Andrew Elliott, and Sidney L. Shaw

Cortical microtubule arrays in the Arabidopsis hypocotyl share a common underlying architecture that identifies their mode of construction.

Pollen Aperture Factor INP1 Acts Late in Aperture Formation by Excluding Specific Membrane Domains from Exine Deposition. Anna A. Dobritsa, Andrew B. Kirkpatrick, Sarah H. Reeder, Peng Li, and Heather A. Owen

Pollen aperture factor INP1 assembles gradually and asynchronously at specific membrane domains and is involved in keeping them adjacent to callose wall.

Kinase MPK17 and the Peroxisome Division Factor PMD1 Influence Salt-induced Peroxisome Proliferation. Elizabeth M. Frick and Lucia C. Strader

MPK17 and PMD1 are required with the actin cytoskeleton for peroxisome proliferation in response to salt treatment.


Quantitative analysis and modeling of vesicle diffusion shows that polarized cell growth rates are sustained by actin-based vesicle clustering at the tip.

Environmental and Genetic Factors Regulating Localization of the Plant Plasma Membrane H+·ATPase. Miyoshi Haruta, Li Xuan Tan, Daniel B. Bushey, Sarah J. Swanson, and Michael R. Sussman

Cellular dynamics and localization of plasma membrane H+·ATPase is determined by cell type, light condition, and a receptor kinase, FERONIA, which regulates cell elongation growth.

Auxin and ROP GTase Signaling of Polar Nuclear Migration in Root Epidermal Hair Cells. Moritaka Nakamura, Andrea R. Clae, Tobias Grebe, Rebecca Hermkes, Corrado Viotti, Yoshihisa Ikeda, and Markus Grebe

Auxin and ROP signaling affect nuclear migration in root epidermal cells.
KinG is a plant-specific kinesin that forms a complex with SHR through binding to SIEL, promotes its intercellular trafficking, and facilitates pausing of SHR-associated endosomes on microtubules.

Efficient ER Fusion Requires a Dimerization and a C-Terminal Tail Mediated Membrane Anchoring of RHD3. Jiaqi Sun and Huanquan Zheng

Efficient ER membrane fusion requires dimerization of RHD3 in different ER membranes and an interaction between membrane lipids and the C-terminal amphipathic helix of RHD3.

Division Plane Orientation Defects Revealed by a Synthetic Double Mutant Phenotype. Ricardo Mir, Victoria H. Morris, Henrik Buschmann, and Carolyn G. Rasmussen

The tangled1air9 double mutant had synthetic division plane orientation and root growth and cell file rotation defects that are rescued by full-length TAN1-YFP and only partially by TAN1-YFP deletion constructs.

Reassessing the Roles of PIN Proteins and Anticlinal Microtubules during Pavement Cell Morphogenesis. Samuel A. Belteton, Megan G. Sawchuk, Bryon S. Donohoe, Enrico Scarpella, and Daniel B. Szymanski

Neither PINs nor stable anticlinal microtubules define the lobing patterns of pavement cells; broader analyses of microtubules and cell wall strain are needed.

Predicting Dynamic Metabolic Demands in the Photosynthetic Eukaryote Chlorella vulgaris. Cristal Zuñiga, Jennifer Levering, Maciek R. Antoniewicz, Michael T. Guarnieri, Michael J. Betenbaugh, and Karsten Zengler

Constraint-based modeling gives insights into dynamic metabolic demands and compartmentalization in a photosynthetic eukaryote.

REGULAR ISSUE

ON THE INSIDE

Peter V. Minorsky

FOUNDERS’ REVIEW

Auxin Signaling. Ottoline Leyser

Auxin triggers diverse responses in plants, and this is reflected in quantitative and qualitative diversity in the auxin signaling machinery.

LETTER TO THE EDITOR

The Arabidopsis E3 Ubiquitin Ligase SP1 Targets to Chloroplasts, Peroxisomes, and Mitochondria. Ronghui Pan and Jianping Hu

COMMENTARIES

Retromer and VSR Recycling: A Red Herring? David G. Robinson

Recently published data on retromer function in animal cells demands a rethink on the mechanism of recycling of vacuolar sorting receptors in plants.

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Stomatal Response to Humidity: Blurring the Boundary between Active and Passive Movement. Florent Pantin and Michael R. Blatt

Two recent publications suggest that VPD drives stomatal conductance independent of ABA and that hydropassive and active stomatal movements are interlocked within a single, mechanistic framework.

SCIENTIFIC CORRESPONDENCE


Reanalysis of published experimental data shows that in dehydrating leaves ABA accumulation is linked with reduction of cell volume rather than turgor, providing clues toward signaling mechanisms.

BREAKTHROUGH TECHNOLOGIES


A modified virus vector facilitates plant gene fragment retention and improves gene-silencing phenotypes in the host.

RESEARCH REPORT


Extracellular ATP signaling, mediated by the P2K1 receptor, changes the stability of JAZ1 protein in JA signaling to boost plant defense response.

RESEARCH ARTICLES

BIOCHEMISTRY AND METABOLISM

[OPEN] Coexpression Analysis Identifies Two Oxidoreductases Involved in the Biosynthesis of the Monoterpene Acid Moiety of Natural Pyrethrin Insecticides in Tanacetum cinerariifolium. Haiyang Xu, Gaurav D. Moghe, Krystle Wiegert-Rininger, Anthony L. Schilmiller, Cornelius S. Barry, Robert L. Last, and Eran Pichersky

A set of dehydrogenases are involved in the synthesis of trans-chrysanthemic acid, the terpene moiety of the natural insecticide pyrethrins.


Glutathione S-transferase class-tau member 13 is essential for the PENETRATION2 myrosinase-mediated preinvasive resistance and callose deposition in Arabidopsis thaliana.
A mucin-like protein in the rice brown planthopper (Nilaparvata lugens) enables insect feeding and induces plant immune responses.


In Arabidopsis leaves, the catalytic C-terminal region of STARCH SYNTHASE 4 promotes starch granule initiation while its noncatalytic N-terminal region determines starch granules morphology.

Gradually Decreasing Starch Branching Enzyme Expression Is Responsible for the Formation of Heterogeneous Starch Granules. Juan Wang, Pan Hu, Lingshang Lin, Zichun Chen, Qiaoquan Liu, and Cunxu Wei

Starch-branching enzyme expression is responsible for the formation of four heterogeneous starch granules distributed regionally from inside to outside in high-amylose rice endosperm.


To adjust to iron limitation, Arabidopsis rosettes coordinately down-regulate expression of abundant Fe proteins and key components of the iron-sulfur cluster assembly system in the chloroplasts.

Regulation of Sucrose Transporters and Phloem Loading in Response to Environmental Cues. Qiyu Xu, Siyuan Chen, Ren Yunjuan, Shaolin Chen, and Johannes Liesche

Sucrose transporter expression in leaves is regulated at the transcriptional and post-transcriptional level to link changes in photosynthesis and sugar status with phloem loading and carbon export.

Vessel-Specific Reintroduction of CINNAMOYL COA REDUCTASE 1 (CCR1) in Dwarfed ccr1 Mutants Restores Vessel and Xylary Fiber Integrity and Increases Biomass. Barbara De Meester, Lisanne de Vries, Merve Özparpucu, Notburga Gierlinger, Sander Corneillie, Andreas Pallidis, Geert Goeminne, Kris Morreel, Michiel De Bruyne, Riet De Rycke, Ruben Vanholme, and Wout Boerjan

Restoring vessel integrity without lowering general ferulic acid levels overcomes dwarfism in ccr1 mutants and reveals monolignol transport from vessels to xylary fibers.

CELL BIOLOGY

The DEAD-box RNA Helicase RH50 Is a 23S-4.5S rRNA Maturation Factor that Functionally Overlaps with the Plastid Signaling Factor GUN1. Francesca Patiri, Luca Tadini, Nikolay Manavski, Tatjana Kleine, Roberto Ferrari, Piero Morandini, Paolo Pesaresi, Jörg Meurer, and Dario Leister

RH50 is required for processing of chloroplast ribosomal RNA and shares several features with the signaling factor GUN1, including intrachloroplast localization, expression profile, and epistatic effects.
Turnip Mosaic Virus Counteracts Selective Autophagy of the Viral Silencing Suppressor HCpro.
Anders Hafren, Suayib Ustun, Anton Hochmuth, Steingrim Sveinsson, Terje Johansen, and Daniel Hofius

Potyviruses antagonize NBR1-mediated antiviral autophagy that targets RNA granules containing the viral RNA silencing suppressor HCpro for degradation.

Prolines in Transit Peptides Are Crucial for Efficient Preprotein Translocation into Chloroplasts.
Dong Wook Lee, Yun-Joo Yoo, Md. Abdur Razzak, and Inhwan Hwang

Prolines in transit peptides are critical for the preprotein translocation through import channels and prevent inappropriate insertion of TMD-containing preproteins into chloroplast envelopes.

ECOPHYSIOLOGY AND SUSTAINABILITY

Reduction in Root Secondary Growth as a Strategy for Phosphorus Acquisition.
Christopher F. Strock, Laurie Morrow de la Riva, and Jonathan P. Lynch

Reduced root secondary growth decreases maintenance and construction costs, allowing greater root elongation and soil exploration, thereby improving P acquisition and plant growth under P stress.

A Model of Leaf Coordination to Scale-up Leaf Expansion from the Organ to the Canopy.
Pierre Martre and Anaelle Dambreville

The coordination of the growth of wheat organs highlights robust functional rules used to model the dynamics of wheat leaf growth at the phytomer and canopy scales in response to abiotic constraints.

GENES, DEVELOPMENT, AND EVOLUTION

GROWTH-REGULATING FACTOR and GRF-INTERACTING FACTOR Specify Meristematic Cells of Gynoecia and Anthers.
Sang-Joo Lee, Byung Ha Lee, Jae-Hak Jung, Soon Ki Park, Jong Tae Song, and Jeong Hoe Kim

Specification of carpel margin meristems and archesporial cells by the GRF-GIF duo is a prerequisite for the female and male reproductive competence of Arabidopsis.

A Role for the F-Box Protein HAWAIIAN SKIRT in Plant microRNA Function.
Patricia L. M. Lang, Michael D. Christie, Ezgi S. Dogan, Rebecca Schwaab, Jörg Hagmann, Anna-Lena van de Weyer, Emanuele Scacchi, and Detlef Weigel

HAWAIIAN SKIRT is a cofactor for Arabidopsis thaliana microRNA function and acts in an F-box-dependent manner.

TsNAC1 Is a Key Transcription Factor in Abiotic Stress Resistance and Growth.
Can Liu, Baomei Wang, Zhaoxia Li, Zhenghua Peng, and Juren Zhang

Continued on next page
TsNAC1 improves abiotic stress resistance of Thelungiella halophil a by regulating ion transport and retards vegetative growth by limiting the expansion of cells.

[CC-BY] SHORTROOT-Mediated Increase in Stomatal Density Has No Impact on Photosynthetic Efficiency.  Mara L. Schuler, Olga V. Sedelnikova, Berkley J. Walker, Peter Westhoff, and Jane A. Langdale

Stomatal density can be increased in rice by expanding the expression domain of SHORTROOT, but contrary to theoretical predictions, enhanced stomatal numbers have no impact on photosynthetic capacity.

[OPEN] Transcription Factors VND1-VND3 Contribute to Cotyledon Xylem Vessel Formation.  Tian Tian Tan, Hitoshi Endo, Ryosuke Sano, Tetsuya Kurata, Masatoshi Yamaguchi, Misato Ohtani, and Taku Demura

VND1, VND2, and VND3 are required for xylem vessel element formation in the secondary veins of Arabidopsis cotyledons grown under continuous dark conditions.

Transcription Factor WRKY75 Interacts with DELLA Proteins to Affect Flowering.  Liping Zhang, Ligang Chen, and Diqiu Yu

WRKY75 functions as a component of the regulatory network in Arabidopsis that modulates the onset and progression of floral initiation through GA signaling.

Balance between Cytosolic and Chloroplast Translation Affects Leaf Variegation.  Ruijuan Wang, Jun Zhao, Min Jia, Ni Xu, Shuang Liang, Jingxia Shao, Yafei Qi, Xiayan Liu, Lijun An, and Fei Yu

Mutations in cytosolic ribosomal protein RPS21 enhance leaf variegation in Arabidopsis by loss of chloroplast VAR2/AtFtsH2 protein, an effect dependent on chloroplast translation.

[OPEN] Transcription factor OsTGA10 is a target of the MADS protein OsMADS8 and is required for tapetum development.  Zhi-Shan Chen, Xiao-Feng Liu, Dong-Hui Wang, Rui Chen, Xiao-Lan Zhang, Zhi-Hong Xu, and Shu-Nong Bai

The transcription factor OsTGA10, a target of OsMADS8, regulates tapetum development via direct binding to other tapetum-regulatory factors and to the regulatory regions of genes involved in tapetum development.

MEMBRANES, TRANSPORT, AND BIOENERGETICS

A Tonoplast Sugar Transporter Underlies a Sugar Accumulation QTL in Watermelon.  Yi Ren, Shaogui Guo, Jie Zhang, Hongju He, Honghe Sun, Shouwei Tian, Guoyi Gong, Haijing Zhang, Amnon Levi, Yaakov Tadmor, and Yong Xu

A tonoplast sugar transporter CITST2 is regulated by a sugar-induced WRKY transcription factor SUSIWM1.

SIGNaling AND RESPONSE

[OPEN] Stomatal VPD Response: There Is More to the Story Than ABA.  Ebe Merilo, Dmitry Yarmolinsky, Pirko Jalakas, Helen Parik, Ingmar Tulva, Bakhtier Rasulov, Kalle Kilk, and Hannes Kollist

ABA level is important for steady-state stomatal conductance, and OST1 is crucial for humidity-induced stomatal closure.


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The Arabidopsis nonhost resistance gene PSS1 encoding an unknown glycine-rich plasma membrane protein has shown to enhance sudden death syndrome resistance in transgenic soybean plants.

Arabidopsis ACTIN-DEPOLYMERIZING FACTOR3 is Required for Controlling Aphid Feeding from the Phloem.  
Hossain A. Mondal, Joe Louis, Lani Archer, Monika Patel, Vamsi J. Nalam, Sujon Sarowar, Vishala Sivapalan, Douglas D. Root, and Jyoti Shah

Green peach aphid feeding from the sieve elements is restricted by ACTIN-DEPOLYMERIZING FACTOR3, implicating an actin-dependent process in controlling insect feeding from the phloem.

The RIN-MC Fusion of MADS-Box Transcription Factors Has Transcriptional Activity and Modulates Expression of Many Ripening Genes.  
Shan Li, Huijinlan Xu, Zheng Ju, Dongyan Cao, Hongliang Zhu, Daqi Fu, Donald Grierson, Guozheng Qin, Yunbo Luo, and Benzhong Zhu

Tomato RIN-MC fusion plays a negative role in ripening and encodes a chimeric transcription factor that modulates the expression of many ripening genes, thereby contributing to the rin mutant phenotype.

Ethylene Receptors Signal via a Noncanonical Pathway to Regulate Abscisic Acid Responses.  
Arkadipta Bakshi, Sarbottam Piya, Jessica C. Fernandez, Christian Chervin, Tarek Hewezi, and Brad M. Binder

The ETHYLENE RESPONSE1 and ETHYLENE RESPONSE2 ethylene receptors signal via a noncanonical pathway to control sensitivity to the hormone abscisic acid during seed germination.

OsmiR396d miRNA affects gibberellin and brassinosteroid signaling to regulate plant architecture.  
Yongyan Tang, Huanhuan Liu, Siyi Guoa, Bo Wang, Zhitao Li, Kang Chong, and Yunyuan Xu

The microRNA396d connects OsBZR1 with OsGRFs to regulate the signal of brassinosteroid and gibberellin for controlling the key agriculture yield traits in rice.

CORRECTION

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