

**On the Cover:** Cone thermogenesis is a widespread phenomenon in cycads, and the intense and durable heat-producing abilities of cycad species makes these plants important for comprehensive studies on plant thermogenesis. The cover shows a thermographic image of a male cone in the cycad species *Cycas revoluta*. The prevalent cool weather conditions during the rainy season assisted in the capturing of thermal images of the cycad cones. Credit: Yasuko Ito-Inaba.

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**LETTER**

<sup>[OPEN]</sup>Characterization of Soybean *STAY-GREEN* GENES in Susceptibility to Foliar Chlorosis of Sudden Death Syndrome. *Hao-Xun Chang, Ruijuan Tan, Glen L. Hartman, Zixiang Wen, Hyunkyung Sang, Leslie L. Domier, Steven A. Whitham, Dechun Wang, and Martin I. Chilvers*

*Genetic mappings for soybean sudden death syndrome foliar chlorosis suggested that STAY-GREEN genes with loss-of-susceptibility mechanism may have different breeding merits for disease resistance.* 711

**BREAKTHROUGH TECHNOLOGIES**

<sup>[CC-BY]</sup>Tandem Fluorescent Protein Timers for Noninvasive Relative Protein Lifetime Measurement in Plants. *Hongtao Zhang, Eric Linster, Lucy Gannon, Wiebke Leemhuis, Chelsea A. Rundle, Frederica L. Theodoulou, and Markus Wirtz*

*Tandem fluorescent protein timers enable non-invasive analysis of protein turnover in intact plant cells, allowing tests of how different genetic backgrounds and treatments affect protein stability.* 718

<sup>[OPEN]</sup>Gcorn Plant: A Database for Retrieving Functional and Evolutionary Traits of Plant Genes. *Yoshiyuki Ogata, Naohiro Kimura, and Ryosuke Sano*

*The Gcorn plant database was designed for the retrieval of information on homology and evolution of a plant gene of interest based on 2,682,261 amino acid sequences of 73 species.* 732

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## RESEARCH REPORTS

<sup>[OPEN]</sup>Alternative Oxidase Capacity of Mitochondria in Microsporophylls May Function in Cycad Thermogenesis. Yasuko Ito-Inaba, Mayuko Sato, Mitsuhiro P. Sato, Yuya Kurayama, Haruna Yamamoto, Mizuki Ohata, Yoshitoshi Ogura, Tetsuya Hayashi, Kiminori Toyooka, and Takehito Inaba

*Enlarged mitochondria with increased rates of alternative respiration may account for the striking heat-producing ability of male cones in the gymnosperm *Cycas revoluta*.*

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<sup>[OPEN]</sup>A Mobile Auxin Signal Connects Temperature Sensing in Cotyledons with Growth Responses in Hypocotyls. Julia Bellstaedt, Jana Trenner, Rebecca Lippmann, Yvonne Poeschl, Xixi Zhang, Jiri Friml, Marcel Quint, and Carolin Delker

*Seedling organs show autonomy as well as interdependency in their ability to respond to elevated temperatures.*

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## RESEARCH ARTICLES

### BIOCHEMISTRY AND METABOLISM

<sup>[OPEN]</sup>Separate Pathways Contribute to the Herbivore-Induced Formation of 2-Phenylethanol in Poplar. Jan Günther, Nathalie D. Lackus, Axel Schmidt, Meret Huber, Heike-Jana Stöttler, Michael Reichelt, Jonathan Gershenzon, and Tobias G. Köllner

*Biochemical analysis of the aromatic amino acid decarboxylase family in poplar revealed two enzymes involved in the herbivore induced formation of 2-phenylethanol and 2-phenylethylamine.*

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<sup>[OPEN]</sup>A Cytosolic Bypass and G6P Shunt in Plants Lacking Peroxisomal Hydroxypyruvate Reductase. Jiyiing Li, Sarathi M. Weraduwage, Alyssa L. Preiser, Stefanie Tietz, Sean E. Weise, Deserah D. Strand, John E. Froehlich, David M. Kramer, Jianping Hu, and Thomas D. Sharkey

*Triose phosphate isomerase inhibition in plants lacking peroxisomal hydroxypyruvate reductase is overcome by exporting triose phosphate and importing Glc 6 P, but this stimulates a Glc 6 P shunt and cyclic electron flow.*

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The Hydrogen Isotope Composition  $\delta^2\text{H}$  Reflects Plant Performance. Rut Sanchez-Bragado, Maria Dolors Serret, Rosa Maria Marimon, Jordi Bort, and José Luis Araus

*The hydrogen isotope composition ( $\delta^2\text{H}$ ) exhibits specific features that report the water conditions of a wheat crop, as well as the photosynthetic characteristics of the plant part considered.*

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### CELL BIOLOGY

<sup>[OPEN]</sup>3D Imaging of Tapetal Mitochondria Suggests the Importance of Mitochondrial Fission in Pollen Growth. Pei-Ying Chen, Chia-Chen Wu, Chung-Chih Lin, Wann-Neng Jane, and Der-Fen Suen

*Mitochondrial fission is involved in regulating mitochondrial status in the tapetum and is critical for pollen development.*

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<sup>[OPEN]</sup>Genome Editing-Based Engineering of CESA3 Dual Cellulose-Inhibitor-Resistant Plants. Zhubing Hu, Teng Zhang, Debbie Rombaut, Ward Decaestecker, Aiming Xing, Sam D'Haeyer, Rene Höfer, Ilse Vercauteren, Mansour Karimi, Thomas Jacobs, and Lieven De Veylder

*Functional analysis of a previously identified C17 cellulose-inhibitor-revealed that it operates differently from other known inhibitors, enabling the development of a dual herbicide-resistant line.*

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<sup>[OPEN]</sup>Unusual Roles of Secretory SNARE SYP132 in Plasma Membrane  $\text{H}^+$ -ATPase Traffic and Vegetative Plant Growth. Lingfeng Xia, Maria Mar Marquès-Bueno, Craig Graham Bruce, and Rucha Karnik

*The secretory SNARE SYP132 affects auxin-regulated traffic of plasma membrane  $\text{H}^+$ -ATPase proteins influencing plant growth and homeostasis.*

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[OPEN]The Golgi Localization of GnTI Requires a Polar Amino Acid Residue within Its Transmembrane Domain. Jennifer Schoberer, Eva Liebming, Ulrike Vavra, Christiane Veit, Clemens Grünwald-Gruber, Friedrich Altmann, Stanley W. Botchway, and Richard Strasser

*An amino acid sequence motif in the N-acetylglucosaminyltransferase I transmembrane domain governs its Golgi localization and glycan processing function in plants.*

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## ECOPHYSIOLOGY AND SUSTAINABILITY

[OPEN]Visualizing Embolism Propagation in Gas-Injected Leaves. Uri Hochberg, Alexandre Ponomarenko, Yong-Jiang Zhang, Fulton E. Rockwell, and N. Michele Holbrook

*A rapid method based on optical light transmission tracks embolism in the xylem of gas injected leaves.*

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## GENES, DEVELOPMENT AND EVOLUTION

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*A rice MADS-box transcription factor, OsMADS57, plays a major role in nitrate translocation from roots to shoots in low-nitrate supplied rice plants.*

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[OPEN]Mitochondrial Pyruvate Dehydrogenase Contributes to Auxin-Regulated Organ Development. Iwai Ohbayashi, Shaobai Huang, Hidehiro Fukaki, Xiaomin Song, Song Sun, Miyo Terao Morita, Masao Tasaka, A. Harvey Millar, and Masahiko Furutani

*The mitochondrial PDC E1 component contributes to respiratory metabolism and PIN-driven polar auxin transport in Arabidopsis organ development.*

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[OPEN]Mesophyll Abscisic Acid Restrains Early Growth and Flowering But Does Not Directly Suppress Photosynthesis. Boaz Negin, Adi Yaaran, Gilor Kelly, Yotam Zait, and Menachem Moshelion

*Basal green tissue ABA widely affects plant morphology, water relations, and growth, inhibiting early growth and flowering, and does not directly suppress photosynthesis in the short term.*

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[OPEN]PINOID Is Required for Formation of the Stigma and Style in Rice. Yubing He, Lang Yan, Chennan Ge, Xue-Feng Yao, Xiang Han, Rongchen Wang, Lihong Xiong, Liwen Jiang, Chun-Ming Liu, and Yunde Zhao

*Disruption of PINOID in rice abolishes the formation of stigmas without affecting flower initiation, a phenotype that differs from the Arabidopsis and maize pinoid mutants.*

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[OPEN]Clade I TGACG-Motif Binding Basic Leucine Zipper Transcription Factors Mediate BLADE-ON-PETIOLE-Dependent Regulation of Development. Ying Wang, Brenda C. Salasini, Madiha Khan, Bhaswati Devi, Michael Bush, Rajagopal Subramaniam, and Shelley R. Hepworth

*Clade I TGAs interact with BLADE-ON-PETIOLE co-activators, contributing to expression of homeobox gene ATH1, which is important for boundary establishment and plant development.*

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OsPINOID Regulates Stigma and Ovule Initiation through Maintenance of the Floral Meristem by Auxin Signaling. Meng Xu, Ding Tang, Xinjie Cheng, Jianxiang Zhang, Yujie Tang, Quandan Tao, Wenqing Shi, Aiqing You, Minghong Gu, Zhukuan Cheng, and Hengxiu Yu

*The OsPID-mediated auxin signaling pathway maintains the floral meristem and thereby regulates stigma and ovule initiation in rice.*

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Characterization and Cloning of Grape Circular RNAs Identified the Cold Resistance-Related Vv-circATS1. Zhen Gao, Jing Li, Meng Luo, Hui Li, Qiuju Chen, Lei Wang, Shiren Song, Liping Zhao, Wenping Xu, Caixi Zhang, Shiping Wang, and Chao Ma

*Identification of circular RNAs and development of an overexpression method in grape revealed that Vv-circATS1 positively regulates cold tolerance*

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[<sup>OPEN</sup>] Down-regulation of the Sucrose Transporter CsSUT1 Causes Male Sterility by Altering Carbohydrate Supply. Lulu Sun, Xiaolei Sui, William J. Lucas, Yaxin Li, Sheng Feng, Si Ma, Jingwei Fan, Lihong Gao, and Zhenxian Zhang

CsSUT1 downregulation induces male sterility in cucumber by altering carbohydrate supply, and potentially auxin signaling, suggesting a strategy for bioengineering male sterility in crop plants. 986

Gibberellic Acid-Stimulated Transcript Proteins Evolved through Successive Conjugation of Novel Motifs and Their Subfunctionalization. Ashutosh Kumar, Alka Singh, Pramod Kumar, and Ananda K. Sarkar

Exploration of GAST-like genes across the plant kingdom for their structure and evolution through acquisition of novel motifs and functional conservation uncovers possible roles in hormone signaling. 998

[<sup>OPEN</sup>] CENTRORADIALIS Interacts with FLOWERING LOCUS T-Like Genes to Control Floret Development and Grain Number. Xiaojing Bi, Wilma van Esse, Mohamed Aman Mulki, Gwendolyn Kirschner, Jinshun Zhong, Rüdiger Simon, and Maria von Korff

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OsAAP5 might mediate basic amino acids (Lys and Arg) and neutral amino acids (Val and Ala) transport to affect cytokinin pathway. 1031

[<sup>OPEN</sup>] A Critical Role of Sodium Flux via the Plasma Membrane Na<sup>+</sup>/H<sup>+</sup> Exchanger SOS1 in the Salt Tolerance of Rice. Houda El Mahi, Javier Pérez-Hormaeche, Anna De Luca, Irene Villalta, Joaquín Espartero, Francisco Gámez-Arjona, José Luis Fernández, Mireia Bundó, Imelda Mendoza, Delphine Mieulet, Eric Lalanne, Sang-Yeol Lee, Dae-Jin Yun, Emmanuel Guiderdoni, Manuel Aguilar, Eduardo O. Leidi, José M. Pardo, and Francisco J. Quintero

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## SIGNALLING AND RESPONSE

[<sup>OPEN</sup>] Abscisic Acid Receptors and Coreceptors Modulate Plant Water Use Efficiency and Water Productivity. Zhenyu Yang, Jinghui Liu, Fabien Poree, Rudi Schaeufele, Hendrik Helmke, Jens Frackenhohl, Stefan Lehr, Pascal von Koskull-Döring, Alexander Christmann, Hans Schnyder, Urs Schmidhalter, and Erwin Grill

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Glucose-Regulated HLP1 Acts as a Key Molecule in Governing Thermomemory. Mohan Sharma, Zeeshan Zahoor Bandy, Brihaspati N. Shukla, and Ashverya Laxmi

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[<sup>OPEN</sup>] CALMODULIN-BINDING TRANSCRIPTION ACTIVATOR 6: A Key Regulator of Na<sup>+</sup> Homeostasis during Germination. Doron Shkolnik, Aliza Finkler, Metsada Pasmank-Chor, and Hillel Fromm

The transcription factor CAMTA6 substantially affects the transcriptome of salt-stressed germinating seeds, including genes encoding Na<sup>+</sup> transporters, such as AtHKT1, to maintain Na<sup>+</sup> homeostasis. 1101

[<sup>OPEN</sup>] Deetiolation Enhances Phototropism by Modulating NON-PHOTOTROPIC HYPOCOTYL3 Phosphorylation Status. Stuart Sullivan, Eros Kharshiing, Janet Laird, Tatsuya Sakai, and John M. Christie

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Xu Zheng, Jihong Xing, Kang Zhang, Xi Pang, Yating Zhao, Guanyu Wang, Jinping Zang, Rongfeng Huang, and Jingao Dong

*ERF11 directly activates BT4 in Arabidopsis response to Pst DC3000 infection and depends on the salicylic acid and ethylene signaling pathways* 1132

[OPEN] Pinstatic Acid Promotes Auxin Transport by Inhibiting PIN Internalization. Akihiko Oochi, Jakub Hajny, Kosuke Fukui, Yukio Nakao, Michelle Gallei, Mussa Quareshy, Koji Takahashi, Toshinori Kinoshita, Sigurd Ramans Harborough, Stefan Kepinski, Hiroyuki Kasahara, Richard Napier, Jiří Friml, and Ken-ichiro Hayashi

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BRASSINOSTEROID-SIGNALING KINASE5 Associates with Immune Receptors and Is Required for Immune Responses. Bharat Bhusan Majhi, Shivakumar Sreeramulu, and Guido Sessa

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*The developmentally programmed polarity of the auxin response underlies thermo-induced leaf hyponasty* 1185

Multi-omics Analysis Reveals Sequential Roles for ABA during Seed Maturation. Frédéric Chauffour, Marlène Bailly, François Perreau, Gwendal Cueff, Hiromi Suzuki, Boris Collet, Anne Frey, Gilles Clément, Ludivine Soubigou-Taconnat, Thierry Balliau, Anja Krieger-Liszky, Loïc Rajjou, and Annie Marion-Poll

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Hypermorphic *SERK1* Mutations Function via a *SOBIR1* Pathway to Activate Floral Abscission Signaling. Isaiah Taylor, John Baer, Ryan Calcutt, and John C. Walker

*Gain of function mutations in SERK1 suppress the abscission defect of the haesa/haesa-like 2-mutant by activating a SOBIR1 signaling pathway* 1219

## SYSTEMS AND SYNTHETIC BIOLOGY

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*The inverse correlation between MPSR1 and AtHSP90.1 via miR414 may adjust the set-point of the HSP90-mediated protein quality control process in response to increasing stress intensity in Arabidopsis.* 1230

## CORRECTIONS

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Decreasing Electron Flux through the Cytochrome and/or Alternative Respiratory Pathways Triggers Common and Distinct Cellular Responses Dependent on Growth Conditions. Kühn K., Yin G., Duncan O., Law S.R., Kubiszewski-Jakubiak S., Kaur P., Meyer E., Wang Y., Colas des Francs Small C., Giraud E., Narsai R., and Whelan J. 1242

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