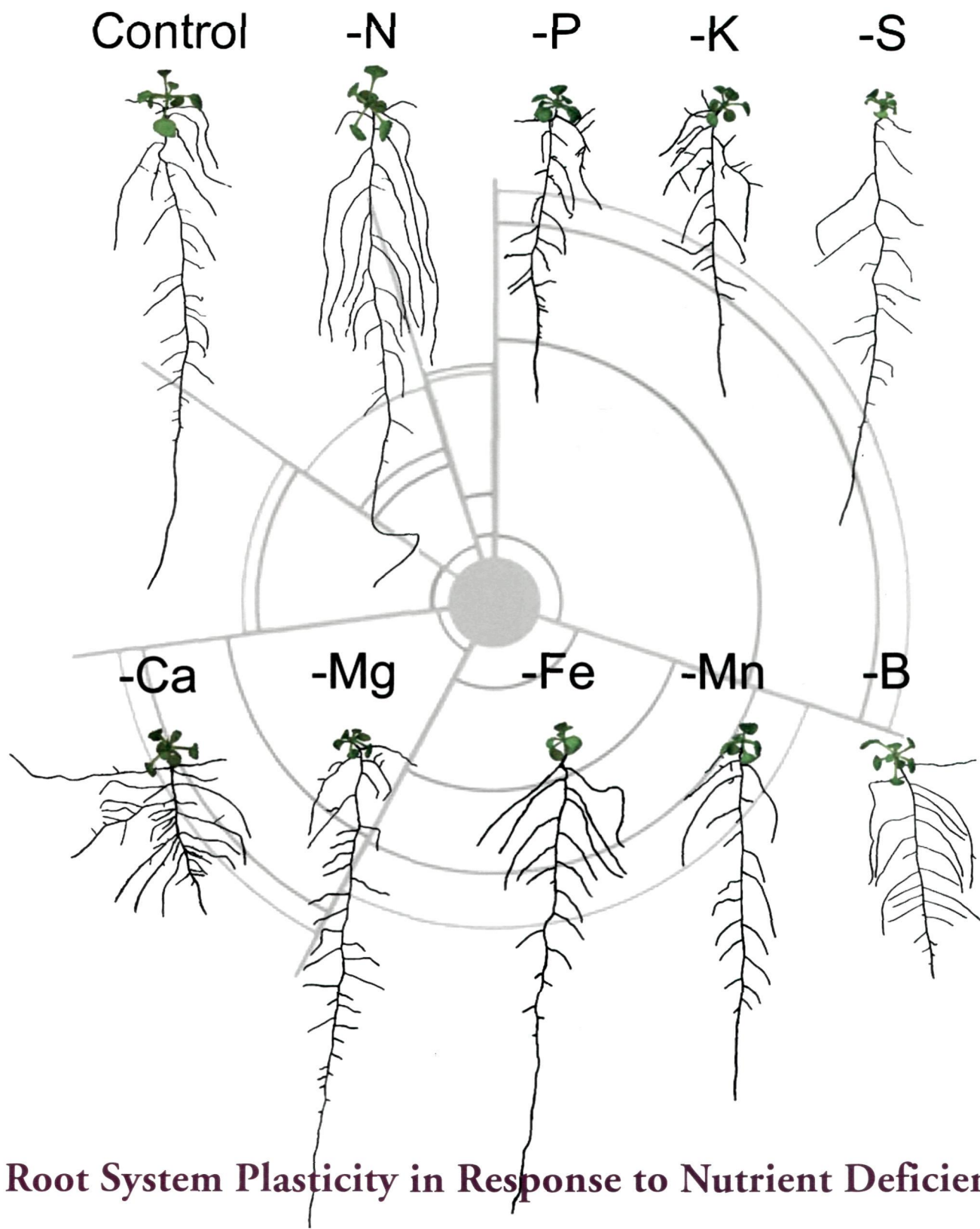


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On the Cover: Roots have the challenging task of sourcing nutrients from the environment to fulfill the needs of a developing plant. This occurs in an environment where the supply of nutrients is both spatially and temporally variable. The root system responds to conditions of nutrient deficiency at both physiological and morphological levels. In this issue, Gruber et al. (pp. 161–179) have characterised the response of the root system architecture to 12 different nutrient deficiencies. The authors found a diverse response of plant roots to the deficiency of single nutrients, with individual root traits behaving differently. Nutrient-dependent changes in root system architecture were then visualised and quantified using novel root plasticity charts, an example of which is shown in the background of the cover image. Such plasticity charts allow the degree of root plasticity from all measured root traits to be compared across the nutrient deficiencies. Cover design and images: Ricardo F.H. Giehl and Benjamin D. Gruber.

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Manipulation and Misconduct in the Handling of Image Data. *Mike Blatt and Cathie Martin*

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The Formation and Function of Plant Cuticles. *Trevor H. Yeats and Jocelyn K.C. Rose*

Recent progress in the biochemistry and molecular biology of cuticle synthesis and function highlights major questions that will drive future research in this field.

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BREAKTHROUGH TECHNOLOGIES

[^{OPEN}]Insertional Mutagenesis Using *Tnt1* Retrotransposon in Potato. *Saowapa Duangpan, Wenli Zhang, Yufang Wu, Shelley H. Jansky, and Jiming Jiang*

A transposon-based insertional mutagenesis system potentially enables mutation of every potato gene.

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RESEARCH ARTICLES

BIOCHEMISTRY AND METABOLISM

[^W][^{OPEN}]Identification and Functional Analysis of Tomato BRI1 and BAK1 Receptor Kinase Phosphorylation Sites. *Vikramjit S. Bajwa, Xiaofeng Wang, R. Kevin Blackburn, Michael B. Goshe, Srijeet K. Mitra, Elisabeth L. Williams, Gerard J. Bishop, Sergei Krasnyanski, George Allen, Steven C. Huber, and Steven D. Clouse*

Phosphorylation of a membrane-bound receptor kinase is essential for brassinosteroid signaling and normal plant growth and development in tomato.

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[^W]Metabolic Interaction between Anthocyanin and Lignin Biosynthesis Is Associated with Peroxidase FaPRX27 in Strawberry Fruit. *Ludwig Ring, Su-Ying Yeh, Stephanie Hücherig, Thomas Hoffmann, Rosario Blanco-Portales, Mathieu Fouché, Carmen Villatoro, Béatrice Denoyes, Amparo Monfort, José Luis Caballero, Juan Muñoz-Blanco, Jonathan Gershenson, and Wilfried Schwab*

Metabolite profiling and quantitative genetics analyses uncover a strawberry peroxidase gene as an important factor controlling the flux to soluble (flavonoids) and insoluble (lignin) polyphenols in fruits.

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[^C][^W][^{OPEN}]Probing Arabidopsis Chloroplast Diacylglycerol Pools by Selectively Targeting Bacterial Diacylglycerol Kinase to Suborganellar Membranes. *Bagyalakshmi Muthan, Rebecca L. Roston, John E. Froehlich, and Christoph Benning*

Specific targeting of bacterial diacylglycerol kinase within the chloroplast determines whether or not it impairs the growth of Arabidopsis.

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^[W]Loss of Starch Granule Initiation Has a Deleterious Effect on the Growth of Arabidopsis Plants Due to an Accumulation of ADP-Glucose. *Paula Ragel, Sebastian Streb, Regina Feil, Mariam Sahrawy, Maria Grazia Annunziata, John E. Lunn, Samuel Zeeman, and Ángel Mérida*

ADP-Glc in the starch-deficient mutant ss3/ss4 sequesters adenine nucleotides, which limits photophosphorylation, leads to photooxidative stress, and causes the chlorotic and stunted phenotypes.

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^{[W][OPEN]}The Identification of Two Arabinosyltransferases from Tomato Reveals Functional Equivalency of Xyloglucan Side Chain Substituents. *Alex Schultink, Kun Cheng, Yong Bum Park, Daniel J. Cosgrove, and Markus Pauly*

Expression of xyloglucan arabinofuranosyltransferases, identified from tomato using a comparative genomics approach, rescues growth and mechanical defects of an Arabidopsis mutant deficient for xyloglucan galactosylation.

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^{[C][W][OPEN]}RNA Interference Suppression of Genes in Glycosyl Transferase Families 43 and 47 in Wheat Starchy Endosperm Causes Large Decreases in Arabinoxylan Content. *Alison Lovegrove, Mark D. Wilkinson, Jackie Freeman, Till K. Pellny, Paola Tosi, Luc Saulnier, Peter R. Shewry, and Rowan A.C. Mitchell*

Suppression of either of two wheat genes decreases the amount of arabinoxylan, the major cell wall polymer in wheat flour, by 50%.

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^{[C][W][OPEN]}Distinct Detoxification Mechanisms Confer Resistance to Mesotrione and Atrazine in a Population of Waterhemp. *Rong Ma, Shiv S. Kaundun, Patrick J. Tranel, Chance W. Riggins, Daniel L. McGinness, Aaron G. Hager, Tim Hawkes, Eddie McIndoe, and Dean E. Riechers*

Multiple herbicide resistance in waterhemp is due to distinct biochemical mechanisms for herbicide detoxification.

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CELL BIOLOGY

^{[W][OPEN]}Complementation of *Hyponastic Leaves1* by Double-Strand RNA-Binding Domains of Dicer-Like1 in Nuclear Dicing Bodies. *Qi Liu, Qingqing Yan, Yin Liu, Fang Hong, Zhenfei Sun, Leilei Shi, Ying Huang, and Yuda Fang*

Distinct double-strand RNA binding domains of Dicer-like1 are important in binding of primary microRNAs and protein-protein interactions.

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^{[W][OPEN]}Abscisic Acid- and Stress-Induced Highly Proline-Rich Glycoproteins Regulate Root Growth in Rice. *I-Chieh Tseng, Chwan-Yang Hong, Su-May Yu, and Tuan-Hua David Ho*

A class of plasma membrane-localized and highly Pro-rich glycoproteins are essential for abscisic acid- and stress-mediated repression of rice root elongation.

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^{[C][W][OPEN]}ML3 Is a NEDD8- and Ubiquitin-Modified Protein. *Jana P. Hakenjos, Sarosh Bejai, Quirin Ranftl, Carina Behringer, A. Corina Vlot, Birgit Absmanner, Ulrich Hammes, Stephanie Heinzlmeir, Bernhard Kuster, and Claus Schwechheimer*

A previously uncharacterized lipid-binding protein is modified by the ubiquitin-like protein NEDD8 and by ubiquitin.

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^{[W][OPEN]}The Endocytosis of Cellulose Synthase in Arabidopsis Is Dependent on $\mu 2$, a Clathrin-Mediated Endocytosis Adaptin. *Logan Bashline, Shundai Li, Charles T. Anderson, Lei Lei, and Ying Gu*

The abundance of primary cellulose synthases at the plasma membrane is dependent on clathrin-mediated endocytosis through the $\mu 2$ adaptin protein.

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^{[C][W][OPEN]}New Evidence for Differential Roles of L10 Ribosomal Proteins from Arabidopsis. *María Lorena Falcone Ferreyra, Romina Casadevall, Marianela Dana Luciani, Alejandro Pezza, and Paula Casati*

Arabidopsis RIBOSOMAL PROTEIN L10 family members are nonredundant and contribute differentially to male gametophyte functionality and UV-B stress responses.

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Structural Changes in Senescing Oilseed Rape Leaves at Tissue and Subcellular Levels Monitored by Nuclear Magnetic Resonance Relaxometry through Water Status. *Maja Musse, Loriane De Franceschi, Mireille Cambert, Clément Sorin, Françoise Le Caherec, Agnès Burel, Alain Bouchereau, François Mariette, and Laurent Leport*

Changes in cell water distribution during leaf senescence in oilseed rape plants are uncovered using NMR relaxometry combined with micrographs and physiological characterization.

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ECOPHYSIOLOGY AND SUSTAINABILITY

[C][W][OPEN]Plasticity of the Arabidopsis Root System under Nutrient Deficiencies. *Benjamin D. Gruber, Ricardo F.H. Giehl, Svetlana Friedel, and Nicolaus von Wirén*

A systematic characterization of root system architecture and quantification of multiple root traits describes changes in overall root plasticity in response to nutrient deficiencies.

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[W][OPEN]Molecular and Physiological Analysis of Al³⁺ and H⁺ Rhizotoxicities at Moderately Acidic Conditions. *Yasufumi Kobayashi, Yuriko Kobayashi, Toshihiro Watanabe, Jon E. Shaff, Hiroyuki Ohta, Leon V. Kochian, Tadao Wagatsuma, Thomas B. Kinraide, and Hiroyuki Koyama*

Rhizotoxicities of Al³⁺ and H⁺ occur at moderately acidic soil conditions (pH [water] = 5–5.5), especially under conditions of low Ca supply.

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[C][W]In Situ Speciation and Distribution of Toxic Selenium in Hydrated Roots of Cowpea. *Peng Wang, Neal W. Menzies, Enzo Lombi, Brigid A. McKenna, Martin D. de Jonge, David J. Paterson, Daryl L. Howard, Chris J. Glover, Simon James, Peter Kappen, Bernt Johannessen, and Peter M. Kopittke*

In situ speciation and distribution of selenium in hydrated roots guide an understanding of selenium uptake, transport, and toxicity in plants.

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GENES, DEVELOPMENT, AND EVOLUTION

[C][W]Nuclear Trapping Controls the Position-Dependent Localization of CAPRICE in the Root Epidermis of Arabidopsis. *Yeon Hee Kang, Sang-Kee Song, John Schiefelbein, and Myeong Min Lee*

Differential nuclear trapping of a transcription factor between root epidermal cells at distinct positions causes differential accumulation of the protein and affects cell fate decision.

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[W][OPEN]Transcriptional Dynamics of Two Seed Compartments with Opposing Roles in Arabidopsis Seed Germination. *Bas J.W. Dekkers, Simon Pearce, R.P. van Bolderen-Veldkamp, Alex Marshall, Paweł Widera, James Gilbert, Hajk-Georg Drost, George W. Bassel, Kerstin Müller, John R. King, Andrew T.A. Wood, Ivo Grosse, Marcel Quint, Natalio Krasnogor, Gerhard Leubner-Metzger, Michael J. Holdsworth, and Leónie Bentsink*

Gene expression profiling in two seed compartments uncovers two transcriptional phases during seed germination that are separated by testa rupture.

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[W][OPEN]Enlarging Cells Initiating Apomixis in *Hieracium praealtum* Transition to an Embryo Sac Program prior to Entering Mitosis. *Takashi Okada, Yingkao Hu, Matthew R. Tucker, Jennifer M. Taylor, Susan D. Johnson, Andrew Spriggs, Tohru Tsuchiya, Karsten Oelkers, Julio C.M. Rodrigues, and Anna M.G. Koltunow*

Transcriptomic analyses show that apomixis-initiating cells embark on an embryo sac program prior to nuclear division.

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Citrus MAF1, a Repressor of RNA Polymerase III, Binds the *Xanthomonas citri* Canker Elicitor PthA4 and Suppresses Citrus Canker Development. *Adriana Santos Soprano, Valeria Yukari Abe, Juliana Helena Costa Smetana, and Celso Eduardo Benedetti*

The citrus CsMAF1 protein, an interacting partner of the transcription activator-like effector and citrus canker elicitor PthA4, functions as a suppressor of canker development in sweet orange.

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[C][W][OPEN] *FLOWERING LOCUS C* EXPRESSOR Family Proteins Regulate *FLOWERING LOCUS C* Expression in Both Winter-Annual and Rapid-Cycling Arabidopsis. *Lei Ding, Sang Yeol Kim, and Scott D. Michaels*

FLX4 physically interacts with FLX to form a transcription activation module in the FRIGIDA complex, which is required for the activation of FLC expression in winter-annual Arabidopsis.

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[C][W][OPEN] Comparative Transcriptome Profiling of Maize Coleoptilar Nodes during Shoot-Borne Root Initiation. *Nils Muthreich, Christine Majer, Mary Beatty, Anja Paschold, André Schützenmeister, Yan Fu, Waqas Ahmed Malik, Patrick S. Schnable, Hans-Peter Piepho, Hajime Sakai, and Frank Hochholdinger*

A microarray analysis reveals 828 unique transcripts with expression related to crown root initiation during coleoptilar node development.

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[C][W][OPEN] Histone Deacetylase AtHDA7 Is Required for Female Gametophyte and Embryo Development in Arabidopsis. *Riccardo Aiese Cigliano, Gaetana Cremona, Rosa Paparo, Pasquale Termolino, Giorgio Perrella, Ruben Gutzat, Maria Federica Consiglio, and Clara Conicella*

AtHDA7 is essential for female gametophyte development and embryogenesis in Arabidopsis.

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[W][OPEN] Salinity-Induced Calcium Signaling and Root Adaptation in Arabidopsis Require the Calcium Regulatory Protein Annexin1. *Anuphon Laohavisit, Siân L. Richards, Lana Shabala, Chen Chen, Renato D.D.R. Colaço, Stéphanie M. Swarbreck, Emma Shaw, Adeeba Dark, Sergey Shabala, Zhonglin Shang, and Julia M. Davies*

Arabidopsis root response to salinity requires the calcium regulatory protein annexin1.

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SIGNALING AND RESPONSE

[C][W] Cryptogein-Induced Transcriptional Reprogramming in Tobacco Is Light Dependent. *Frank A. Hoeberichts, Céline Davoine, Michaël Vandorpe, Stijn Morsa, Brigitte Ksas, Catherine Stassen, Christian Triantaphylidès, and Frank Van Breusegem*

Light alters the physiological and transcriptional responses of tobacco plants to the fungal elicitor cryptogein through modified antioxidant availability and increased photooxidative damage caused by singlet oxygen.

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[W][OPEN] Common and Distinct Functions of Arabidopsis Class A1 and A2 Heat Shock Factors in Diverse Abiotic Stress Responses and Development. *Hsiang-chin Liu and Yee-yung Charng*

Class A1 and A2 heat shock factors possess overlapping and distinct functions in diverse abiotic stress responses and development.

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[W][OPEN] Basic Helix-Loop-Helix Transcription Factors JASMONATE-ASSOCIATED MYC2-LIKE1 (JAM1), JAM2, and JAM3 Are Negative Regulators of Jasmonate Responses in Arabidopsis. *Yuko Sasaki-Sekimoto, Yusuke Jikumaru, Takeshi Obayashi, Hikaru Saito, Shinji Masuda, Yuji Kamiya, Hiroyuki Ohta, and Ken Shirasu*

Three bHLH-type transcription factors negatively regulate jasmonate responses.

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[W] DELLA-Interacting SWI3C Core Subunit of Switch/Sucrose Nonfermenting Chromatin Remodeling Complex Modulates Gibberellin Responses and Hormonal Cross Talk in Arabidopsis. *Elzbieta A. Sarnowska, Anna T. Rolicka, Ernest Bucior, Pawel Cwiek, Takayuki Tohge, Alisdair R. Fernie, Yusuke Jikumaru, Yuji Kamiya, Rainer Franzen, Elmon Schmelzer, Aimone Porri, Sebastian Sacharowski, Dominika M. Gratkowska, Dorota L. Zugaj, Aleksandra Taff, Anna Zalewska, Rafal Archacki, Seth J. Davis, George Coupland, Csaba Koncz, Andrzej Jerzmanowski, and Tomasz J. Sarnowski*

A chromatin remodeling complex subunit physically interacts with DELLA proteins and is involved in control of gibberellin biosynthesis and hormonal cross talk.

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[W][OPEN] *SUPPRESSOR OF MORE AXILLARY GROWTH2 1* Controls Seed Germination and Seedling Development in Arabidopsis. John P. Stanga, Steven M. Smith, Winslow R. Briggs, and David C. Nelson

A screen for suppressors of the karrikin- and strigolactone-insensitive mutant max2 identifies a regulator of seed germination and seedling growth. 318

[W] Dynamics of the Shade-Avoidance Response in Arabidopsis. Andrea Cioffi, Giovanna Sessa, Massimiliano Sassi, Marco Possenti, Samanta Salvucci, Monica Carabelli, Giorgio Morelli, and Ida Ruberti

Light signaling genes are dynamically regulated during shade avoidance with adaptation to a low red/far-red light environment mediated by enhancing the activity of HY5, a master regulator of seedling deetiolation. 331

[C][W][OPEN] The PYL4 A194T Mutant Uncovers a Key Role of PYR1-LIKE4/PROTEIN PHOSPHATASE 2CA Interaction for Abscisic Acid Signaling and Plant Drought Resistance. Gaston A. Pizzio, Lesia Rodriguez, Regina Antoni, Miguel Gonzalez-Guzman, Cristina Yunta, Ebe Merilo, Hannes Kollist, Armando Albert, and Pedro L. Rodriguez

Enhanced drought resistance through mutagenesis of an ABA receptor is associated with enhanced interaction with its protein phosphatase binding partner. 441

SYSTEMS AND SYNTHETIC BIOLOGY

[OPEN] CrusView: A Java-Based Visualization Platform for Comparative Genomics Analyses in Brassicaceae Species. Hao Chen and Xiangfeng Wang

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