

**On the Cover:** Mycorrhizal associations play an important role in determining processes at the plant, community, and ecosystem levels. Thus, characterizing mycorrhizal responses to rising atmospheric carbon dioxide concentration ([CO<sub>2</sub>]) is critical to predicting global change effects across biological scales. Becklin et al. (pages 789–801) assessed mycorrhizal associations in native and invasive *Taraxacum* spp. across a broad [CO<sub>2</sub>] gradient representing glacial (180 μL L<sup>-1</sup>) through future (700–1000 μL L<sup>-1</sup>) conditions. They found that mycorrhizal associations were generally weaker under low [CO<sub>2</sub>] and became more beneficial with rising [CO<sub>2</sub>]. For some plant species, nonlinear effects may limit plant responses to mycorrhizal fungi under future conditions. Differential plant growth rates and vegetative plasticity were also associated with species-specific mycorrhizal-CO<sub>2</sub> responses. Thus, these traits may provide a framework for predicting global change effects on mycorrhizal associations. The cover image shows arbuscular mycorrhizal fungi colonizing the roots of *Taraxacum ceratophorum* (Asteraceae, native dandelion, insert) grown at 1,000 μL L<sup>-1</sup> [CO<sub>2</sub>]. To create this image, *T. ceratophorum* fine roots were stained with Trypan Blue and imaged at 400× magnification with a Nikon AZ100 stereomicroscope. This image was produced by Katie M. Becklin and George W. R. Mullinix, University of Kansas.

## FOCUS ISSUE

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Focus on Ecophysiology. *Elizabeth A. Ainsworth, Carl J. Bernacchi, and Frank G. Dohleman*

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### UPDATES

<sup>[OPEN]</sup>The Quest for Understanding Phenotypic Variation via Integrated Approaches in the Field Environment. *Duke Pauli, Scott C. Chapman, Rebecca Bart, Christopher N. Topp, Carolyn J. Lawrence-Dill, Jesse Poland, and Michael A. Gore*

*Field-based, high-throughput phenotyping enables the detailed characterization of plant populations under relevant conditions, providing valuable biological insight into the life history of plants.*

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<sup>[OPEN]</sup>Examining Plant Physiological Responses to Climate Change through an Evolutionary Lens. *Katie M. Becklin, Jill T. Anderson, Laci M. Gerhart, Susana M. Wadgymar, Carolyn A. Wessinger, and Joy K. Ward*

*Integrating knowledge from physiological ecology, evolutionary biology, phylogenetics, and paleobiology provides novel insights into factors driving plant physiological responses to both past and future climate change.*

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<sup>[OPEN]</sup>Quantitative, Image-Based Phenotyping Methods Provide Insight into Spatial and Temporal Dimensions of Plant Disease. *Andrew M. Mutka, Sarah J. Fentress, Joel W. Sher, Jeffrey C. Berry, Chelsea Pretz, Dmitri A. Nusinow, and Rebecca Bart*

*Novel, image-based phenotyping methods enhance characterization of plant-pathogen interactions.*

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## RESEARCH REPORT

[OPEN]Herbaceous Angiosperms Are Not More Vulnerable to Drought-Induced Embolism Than Angiosperm Trees. *Frederic Lens, Catherine Picon-Cochard, Chloé E.L. Delmas, Constant Signarbieux, Alexandre Buttler, Hervé Cochard, Steven Jansen, Thibaud Chauvin, Larissa Chacon Doria, Marcelino del Arco, and Sylvain Delzon*

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[OPEN]Transcriptomes of Eight *Arabidopsis thaliana* Accessions Reveal Core Conserved, Genotype- and Organ-Specific Responses to Flooding Stress. *Hans van Veen, Divya Vashisht, Melis Akman, Thomas Girke, Angelika Mustroph, Emilie Reinen, Sjon Hartman, Maarten Kooiker, Peter van Tienderen, M. Eric Schranz, Julia Bailey-Serres, Laurentius A.C.J. Voesenek, and Rashmi Sasidharan*

*Eight Arabidopsis accessions highlight early transcriptional and posttranscriptional responses to starvation and flooding stress.*

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[OPEN]Phosphate-Dependent Root System Architecture Responses to Salt Stress. *Dorota Kawa, Magdalena M. Julkowska, Hector Montero Sommerfeld, Anneliek ter Horst, Michel A. Haring, and Christa Testerink*

*Arabidopsis accessions show different patterns of integrating root responses to phosphate starvation and salt stress.*

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[OPEN]Surveying Rubisco Diversity and Temperature Response to Improve Crop Photosynthetic Efficiency. *Douglas J. Orr, André Alcântara, Maxim V. Kapralov, P. John Andralojc, Elizabete Carmo-Silva, and Martin A.J. Parry*

*Species diversity in Rubisco catalysis shows consistencies in temperature response, which can be used to improve crop photosynthetic efficiency.*

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[OPEN]Ethylene- and Shade-Induced Hypocotyl Elongation Share Transcriptome Patterns and Functional Regulators. *Debatosh Das, Kate R. St. Onge, Laurentius A.C.J. Voesenek, Ronald Pierik, and Rashmi Sasidharan*

*Ethylene and shade share a conserved set of molecular regulators to control the plasticity of hypocotyl elongation in Arabidopsis.*

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[OPEN]Promises and Challenges of Eco-Physiological Genomics in the Field: Tests of Drought Responses in Switchgrass. *John T. Lovell, Eugene V. Shakirov, Scott Schwartz, David B. Lowry, Michael J. Aspinwall, Samuel H. Taylor, Jason Bonnette, Juan Diego Palacio-Mejia, Christine V. Hawkes, Philip A. Fay, and Thomas E. Juenger*

*Physiological and gene expression analyses across field and greenhouse experiments highlight diverse gene expression patterns that produce physiologically similar responses to soil water deficits.*

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[OPEN]Genome-Wide Analysis of Yield in Europe: Allelic Effects Vary with Drought and Heat Scenarios. *Emilie J. Millet, Claude Welcker, Willem Kruijer, Sandra Negro, Aude Coupel-Ledru, Stéphane D. Nicolas, Jacques Laborde, Cyril Bauland, Sebastien Praud, Nicolas Ranc, Thomas Presterl, Roberto Tuberosa, Zoltan Bedo, Xavier Draye, Björn Usadel, Alain Charcosset, Fred Van Eeuwijk, and François Tardieu*

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*Huimin Ma and Shui Wang*

*Histidine regulates  $\beta$ -oxidation through abscisic acid in plant seed oil deposition and may serve as an important signal molecule in plant metabolism and development.*

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## RESEARCH ARTICLES

### BIOCHEMISTRY AND METABOLISM

[OPEN] Glutaredoxin GRXS17 Associates with the Cytosolic Iron-Sulfur Cluster Assembly Pathway.  
*Sabrina Iñigo, Astrid Nagels Durand, Andrés Ritter, Sabine Le Gall, Martin Termathe, Roland Klassen, Takayuki Tohge, Barbara De Coninck, Jelle Van Leene, Rebecca De Clercq, Bruno P. A. Cammue, Alisdair R. Fernie, Kris Gevaert, Geert De Jaeger, Sebastian A. Leidel, Raffael Schaffrath, Mieke Van Lijsebettens, Laurens Pauwels, and Alain Goossens*

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[OPEN] ORM Expression Alters Sphingolipid Homeostasis and Differentially Affects Ceramide Synthase Activity. *Athen N. Kimberlin, Gongshe Han, Kyle D. Lutgeharm, Ming Chen, Rebecca E. Cahoon, Julie M. Stone, Jonathan E. Markham, Teresa M. Dunn, and Edgar B. Cahoon*

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D-Lactate Dehydrogenase Links Methylglyoxal Degradation and Electron Transport through Cytochrome *c*. *Elina Welchen, Jessica Schmitz, Philippe Fuchs, Lucila García, Stephan Wagner, Judith Wienstroer, Peter Schertl, Hans-Peter Braun, Markus Schwarzländer, Daniel H. Gonzalez, and Veronica G. Maurino*

*Mitochondrial D-lactate dehydrogenase links the last step of methylglyoxal detoxification to the mitochondrial electron transport chain through cytochrome *c*.*

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[OPEN] In Planta Localization of Stilbenes within *Picea abies* Phloem. *Tuula Jyske, Katsushi Kuroda, Jussi-Petteri Suuronen, Andrey Pranovich, Silvia Roig-Juan, Dan Aoki, and Kazuhiko Fukushima*

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[OPEN]A Distinct Pathway for Polar Exocytosis in Plant Cell Wall Formation. Hao Wang, Xiaohong Zhuang, Xiangfeng Wang, Angus Ho Yin Law, Teng Zhao, Shengwang Du, Michael M.T. Loy, and Liwen Jiang

*A distinct Golgi-derived polar exocytosis pathway occurs in Nicotiana tabacum for pectin methylesterase 1 and contributes to cell wall and cell plate formation during cytokinesis.* 1003

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[OPEN]The Dehydratase ADT3 Affects ROS Homeostasis and Cotyledon Development. Alessia Para, DurreShahwar Muhammad, Danielle A. Orozco-Nunnelly, Ramis Memishi, Sophie Alvarez, Michael J. Naldrett, and Katherine M. Warpeha

*Arabidopsis seedlings mutated in the phenylalanine biosynthetic enzyme ADT3 cannot buffer reactive oxygen species, produce a defective cuticle, and display impaired cotyledon development.* 1045

[OPEN]Glycosylphosphatidylinositol (GPI) Modification Serves as a Primary Plasmodesmal Sorting Signal. Raul Zavaliev, Xinnian Dong, and Bernard L. Epel

*A glycosylphosphatidylinositol modification is a necessary and sufficient signal for enriched protein accumulation in a plasma membrane domain associated with plasmodesmata.* 1061

## ECOPHYSIOLOGY AND SUSTAINABILITY

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*A Proline Dehydrogenase1 promoter:luciferase screen and transcriptome of the proline synthesis mutant p5cs1-4 find coordination between proline and multiple redox-related metabolic pathways.* 1074

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*Full and partial deletion of the DEK1 Linker implicate DEK1 in the three major developmental phases of the moss Physcomitrella patens.* 1089

[OPEN] The Exonuclease Homolog OsRAD1 Promotes Accurate Meiotic Double-Strand Break Repair by Suppressing Nonhomologous End Joining. *Qing Hu, Ding Tang, Hongjun Wang, Yi Shen, Xiaojun Chen, Jianhui Ji, Guijie Du, Yafei Li, and Zhukuan Cheng*

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*SVR9 and its homolog SVR9L1 encode functionally redundant chloroplast translation initiation factors essential for chloroplast and leaf development in Arabidopsis.* 1117

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Dissimilar Manifestation of Heterosis in Superhybrid Rice at Early-Tillering Stage under Nutrient-Deficient and Nutrient-Sufficient Condition. *Longjiang Gu, Ying Wu, Mengmeng Jiang, Weina Si, Xiaohui Zhang, Dacheng Tian, and Sihai Yang*

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[OPEN] Sporophyte Formation and Life Cycle Completion in Moss Requires Heterotrimeric G-Proteins. *Dieter Hackenberg, Pierre-François Perroud, Ralph Quatrano, and Sona Pandey*

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[OPEN]The Heat Stress Factor HSFA6b Connects ABA Signaling and ABA-Mediated Heat Responses.  
*Ya-Chen Huang, Chung-Yen Niu, Chen-Ru Yang, and Tsung-Luo Jinn*

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*Fang Wei Yu, Xiao Fang Zhu, Guang Jie Li, Herbert J. Kronzucker, and Wei Ming Shi*

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[OPEN]Reactive Oxygen Species Tune Root Tropic Responses. *Gat Krieger, Doron Shkolnik, Gad Miller, and Hillel Fromm*

*ROS accelerates gravitropism but attenuates hydrotropism of Arabidopsis roots.* 1209

[OPEN]Class I and II Small Heat Shock Proteins Together with HSP101 Protect Protein Translation Factors during Heat Stress. *Fionn McLoughlin, Eman Basha, Mary E. Fowler, Minsoo Kim, Juliana Bordowitz, Surekha Katiyar-Agarwal, and Elizabeth Vierling*

*Small HSPs are important for heat tolerance, interacting with and protecting an overlapping set of heat-sensitive proteins in protein translation together with HSP101.* 1221

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[OPEN]Cytokinin Response Factor 6 Represses Cytokinin-Associated Genes during Oxidative Stress. *Paul J. Zwack, Inge De Clercq, Timothy C. Howton, H. Tucker Hallmark, Andrej Hurny, Erika A. Keshishian, Alyssa M. Parish, Eva Benkova, M. Shahid Mukhtar, Frank Van Breusegem, and Aaron M. Rashotte*

*Arabidopsis CYTOKININ RESPONSE FACTOR 6 represses a module of cytokinin-associated genes during exposure to oxidative stress.* 1249

[OPEN]Systemic Induction of Photosynthesis via Illumination of the Shoot Apex Is Mediated Sequentially by Phytochrome B, Auxin and Hydrogen Peroxide in Tomato. *Zhixin Guo, Feng Wang, Xun Xiang, Golam Jalal Ahammed, Mengmeng Wang, Eugen Onac, Jie Zhou, Xiaojian Xia, Kai Shi, Xueren Yin, Kunsong Chen, Jingquan Yu, Christine H. Foyer, and Yanhong Zhou*

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[OPEN]SHORT HYPOCOTYL1 Encodes a SMARCA3-like Chromatin Remodeling Factor Regulating Elongation. *Kailiang Bo, Hui Wang, Yupeng Pan, Tusar K. Behera, Sudhakar Pandey, Changlong Wen, Yuhui Wang, Philipp W. Simon, Yuhong Li, Jinfeng Chen, and Yiqun Weng*

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[OPEN] Opposing Control by Transcription Factors MYB61 and MYB3 Increases Freezing Tolerance by Relieving C-Repeat Binding Factor Suppression. *Zhenqian Zhang, Xiaona Hu, Yunqin Zhang, Zhenyan Miao, Can Xie, Xiangzhao Meng, Jie Deng, Jiangqi Wen, Kirankumar S. Mysore, Florian Frugier, Tao Wang, and Jiangli Dong*

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*Correlations of metabolic profiles are reflected in the role of metabolites and describe the state of the entire metabolic network of Arabidopsis thaliana.*

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A Transcriptional and Metabolic Framework for Secondary Wall Formation in Arabidopsis.  
*Zheng Li, Nooshin Omranian, Lutz Neunetzler, Ting Wang, Thomas Herter, Bjoern Usadel, Taku Demura, Patrick Giavalisco, Zoran Nikoloski, and Staffan Persson*

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*Albino Leaf1 That Encodes the Sole Octotricopeptide Repeat Protein Is Responsible for Chloroplast Development.* *Zhang Z., Tan J., Shi Z., Xie Q., Xing Y., Liu C., Chen Q., Zhu H., Wang J., Zhang J., and Zhang G.*

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