

On the Cover: Reconstructed metabolic network of *Arabidopsis thaliana* based on AraCyc database version 8.0. Dots (nodes) represent reactions or metabolites, and links (edges) represent the direct association between metabolites and their reactions. Twenty-four currency compound nodes and their edges have been removed. Classified metabolites are color coded by the types of compounds: amino acids (pink), carbohydrates (cyan), cofactors (gray), electron carriers (light purple), fatty acids (peach), plant hormones (red), lipids (green), nucleotides (yellow), and specialized metabolites (blue). For a clearer visual illustration of the metabolic network, we included only the main carbon skeletal compounds of reactions found in pathways from the layout information in AraCyc 8.0. Pajek software was used to visualize the network. Cover image credits: Taehyong Kim and Seung Y. Rhee (Department of Plant Biology, Carnegie Institution for Science, Stanford, CA).

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Peter V. Minorsky

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Interplay of Reactive Oxygen Species and Nitric Oxide: Nitric Oxide Coordinates Reactive Oxygen Species Homeostasis. *Christian Lindermayr and Jörg Durner*

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Multispectral Phloem-Mobile Probes: Properties and Applications. *Michael Knoblauch, Marc Vendrell, Erica de Leau, Andrea Paterlini, Kirsten Knox, Tim Ross-Elliot, Anke Reinders, Stephen A. Brockman, John Ward, and Karl Oparka*

New fluorescent probes allow the study of phloem transport in Arabidopsis.

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^[OPEN]Relative Mass Defect Filtering of Mass Spectra: A Path to Discovery of Plant Specialized Metabolites. *E.A. Prabodha Ekanayaka, Mary Dawn Celiz, and A. Daniel Jones*

Metabolite masses measured using LC-MS can be sorted into structural classes using relative mass defect filtering to accelerate the annotation of novel metabolites.

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Remodeling of the Infection Chamber before Infection Thread Formation Reveals a Two-Step Mechanism for Rhizobial Entry into the Host Legume Root Hair. *Joëlle Fournier, Alice Teillet, Mireille Chabaud, Sergey Ivanov, Andrea Genre, Erik Limpens, Fernanda de Carvalho-Niebel, and David G. Barker*

Legume root hairs remodel the interface with symbiotic rhizobia prior to initiating the tubular-growing infection thread.

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BIOCHEMISTRY AND METABOLISM

Natural Variation in Monoterpene Synthesis in Kiwifruit: Transcriptional Regulation of Terpene Synthases by NAC and ETHYLENE-INSENSITIVE3-Like Transcription Factors. *Niels J. Nieuwenhuizen, Xiuyin Chen, Mindy Y. Wang, Adam J. Matich, Ramon Lopez Perez, Andrew C. Allan, Sol A. Green, and Ross G. Atkinson*

Fruit monoterpene synthesis in kiwifruit is transcriptionally regulated by transcription factors that activate the terpene synthase promoter.

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[OPEN] A Small Phospholipase A₂- α from Castor Catalyzes the Removal of Hydroxy Fatty Acids from Phosphatidylcholine in Transgenic Arabidopsis Seeds. *Shen Bayon, Guanqun Chen, Randall J. Weselake, and John Browse*

A castor phospholipase is involved in editing ricinoleic acid from the membrane lipids in transgenic Arabidopsis seeds. 1259

[OPEN] The Role of the Plant-Specific ALTERED XYLOGLUCAN9 Protein in Arabidopsis Cell Wall Polysaccharide O-Acetylation. *Alex Schultink, Dan Naylor, Murali Dama, and Markus Pauly*

The Arabidopsis AXY9 gene encodes a plant-specific component of a cell wall polysaccharide acetylation pathway. 1271

[OPEN] Tricin, A Flavonoid Monomer in Monocot Lignification. *Wu Lan, Fachuang Lu, Matthew Regner, Yimin Zhu, Jorge Rencoret, Sally A. Ralph, Uzma I. Zakai, Kris Morreel, Wout Boerjan, and John Ralph*

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[OPEN] Establishment of Monitoring Methods for Autophagy in Rice Reveals Autophagic Recycling of Chloroplasts and Root Plastids during Energy Limitation. *Masanori Izumi, Jun Hidema, Shinya Wada, Eri Kondo, Takamitsu Kurusu, Kazuyuki Kuchitsu, Amane Makino, and Hiroyuki Ishida*

Autophagy is responsible for the degradation of leaf chloroplasts and root plastids in rice plants and functions during energy limitation caused by interruption of photosynthesis. 1307

[OPEN] CO₂-Responsive CONSTANS, CONSTANS-Like, and Time of Chlorophyll *a/b* Binding Protein Expression1 Protein Is a Positive Regulator of Starch Synthesis in Vegetative Organs of Rice. *Ryutaro Morita, Miho Sugino, Tomoko Hatanaka, Shuji Misoo, and Hiroshi Fukayama*

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Proteomic Analysis of Lettuce Seed Germination and Thermoinhibition by Sampling of Individual Seeds at Germination and Removal of Storage Proteins by Polyethylene Glycol Fractionation. *Wei-Qing Wang, Bin-Yan Song, Zhi-Jun Deng, Yue Wang, Shu-Jun Liu, Ian Max Møller, and Song-Quan Song*

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[^{OPEN}] A Calcium Sensor-Regulated Protein Kinase, CALCINEURIN B-LIKE PROTEIN-INTERACTING PROTEIN KINASE19, Is Required for Pollen Tube Growth and Polarity. *Liming Zhou, Wenzhi Lan, Binqing Chen, Wei Fang, and Sheng Luan*

A specific protein kinase plays an important role in pollen tube growth and likely participates in Ca²⁺ homeostasis through the modulation of Ca²⁺ influx. 1351

FYVE1 Is Essential for Vacuole Biogenesis and Intracellular Trafficking in Arabidopsis. *Cornelia Kolb, Marie-Kristin Nagel, Kamila Kalinowska, Jörg Hagmann, Mie Ichikawa, Franziska Anzenberger, Angela Alkofer, Masa H. Sato, Pascal Braun, and Erika Isono*

A phospholipid-binding protein regulates intracellular trafficking and vacuole formation. 1361

Turnip mosaic virus Moves Systemically through Both Phloem and Xylem as Membrane-Associated Complexes. *Juan Wan, Daniel Garcia Cabanillas, Huanquan Zheng, and Jean-François Laliberté*

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ECOPHYSIOLOGY AND SUSTAINABILITY

[^{OPEN}] Does Morphological and Anatomical Plasticity during the Vegetative Stage Make Wheat More Tolerant of Water Deficit Stress Than Rice? *Niteen N. Kadam, Xinyou Yin, Prem S. Bindraban, Paul C. Struik, and Krishna S.V. Jagadish*

Shoot and root morphology and root anatomical plasticity facilitate effective water uptake and use, making wheat more tolerant of water deficit stress than rice. 1389

[^{OPEN}] Identification of the Primary Lesion of Toxic Aluminum in Plant Roots. *Peter M. Kopittke, Katie L. Moore, Enzo Lombi, Alessandra Gianoncelli, Brett J. Ferguson, F. Pax C. Blamey, Neal W. Menzies, Timothy M. Nicholson, Brigid A. McKenna, Peng Wang, Peter M. Gresshoff, George Kourousias, Richard I. Webb, Kathryn Green, and Alina Tollenaere*

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[^{OPEN}] Natural Genetic Variation for Acclimation of Photosynthetic Light Use Efficiency to Growth Irradiance in Arabidopsis. *Roxanne van Rooijen, Mark G.M. Aarts, and Jeremy Harbinson*

Natural variations in photosynthetic acclimation to different growth irradiances, and to a step-wise increase in growth irradiance, allows genetic analysis of this complex phenomenon. 1412

[^{OPEN}] Phenetic Synergism between Root Hair Length and Basal Root Growth Angle for Phosphorus Acquisition. *Magalhaes Amade Miguel, Johannes Auke Postma, and Jonathan Paul Lynch*

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Evolution of a Double Amino Acid Substitution in the 5-Enolpyruvylshikimate-3-Phosphate Synthase in *Eleusine indica* Conferring High-Level Glyphosate Resistance. *Qin Yu, Adam Jalaludin, Heping Han, Ming Chen, R. Douglas Sammons, and Stephen B. Powles*

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The Phenylpropanoid Pathway Is Controlled at Different Branches by a Set of R2R3-MYB C2 Repressors in Grapevine. *Erika Cavallini, José Tomás Matus, Laura Finezzo, Sara Zenoni, Rodrigo Loyola, Flavia Guzzo, Rudolf Schlechter, Agnès Ageorges, Patricio Arce-Johnson, and Giovanni Battista Tornielli*

A set of transcriptional repressors negatively regulates the expression of genes involved in different branches of the phenylpropanoid pathway. 1448

[OPEN] *ALTERED MERISTEM PROGRAM1* Suppresses Ectopic Stem Cell Niche Formation in the Shoot Apical Meristem in a Largely Cytokinin-Independent Manner. *Wenzhen Huang, Delphine Pitorre, Olena Poretska, Christine Marizzi, Nikola Winter, Brigitte Poppenberger, and Tobias Sieberer*

Suppression of stem cell niche respecification in the shoot meristem periphery is mediated by a putative carboxypeptidase. 1471

[OPEN] Quantitative Trait Locus Mapping Reveals Regions of the Maize Genome Controlling Root System Architecture. *Paul R. Zurek, Christopher N. Topp, and Philip N. Benfey*

Phenotypic variation of maize root system architecture highlights a genetic trade-off between small compact and large, exploratory root systems. 1487

[OPEN] *Lotus japonicus* Clathrin Heavy Chain1 Is Associated with Rho-Like GTPase ROP6 and Involved in Nodule Formation. *Chao Wang, Maosheng Zhu, Liujiang Duan, Haixiang Yu, Xiaojun Chang, Li Li, Heng Kang, Yong Feng, Hui Zhu, Zonglie Hong, and Zhongming Zhang*

A clathrin heavy chain participates in Nod factor signal transduction and infection thread formation in the leguminous symbiosis with rhizobia. 1497

MEMBRANES, TRANSPORT, AND BIOENERGETICS

[OPEN] Reducing the Genetic Redundancy of Arabidopsis PHOSPHATE TRANSPORTER1 Transporters to Study Phosphate Uptake and Signaling. *Amal Ayadi, Pascale David, Jean-François Arrighi, Serge Chiarenza, Marie-Christine Thibaud, Laurent Nussaume, and Elena Marin*

Disruption of four genes severely reduces the active phosphate transport but does not impact phosphate sensing capacities in Arabidopsis. 1511

A Nucleus-Encoded Chloroplast Protein Regulated by Iron Availability Governs Expression of the Photosystem I Subunit PsaA in *Chlamydomonas reinhardtii*. *Linnka Lefebvre-Legendre, Yves Choquet, Richard Kuras, Sylvain Loubéry, Damien Douchi, and Michel Goldschmidt-Clermont*

A nucleus-encoded chloroplast protein, which controls the stability and translation of the messenger RNA encoding the PsaA subunit of Photosystem I, responds post-transcriptionally to iron availability. 1527

[OPEN] Arabidopsis Type I Proton-Pumping Pyrophosphatase Expresses Strongly in Phloem, Where It Is Required for Pyrophosphate Metabolism and Photosynthate Partitioning. *Gaston A. Pizzio, Julio Paez-Valencia, Aswad S. Khadilkar, Kamesh Regmi, Araceli Patron-Soberano, Shangji Zhang, Jonathan Sanchez-Lares, Tara Furstenu, Jisheng Li, Concepcion Sanchez-Gomez, Pedro Valencia-Mayoral, Umesh P. Yadav, Brian G. Ayre, and Roberto A. Gaxiola*

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Protection of a homiochlorophyllous resurrection plant against oxidative damage during dehydration involves changes in the levels and quaternary organization of photosynthetic proteins.

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PHOTOSYSTEM II SUBUNIT R Is Required for Efficient Binding of LIGHT-HARVESTING COMPLEX STRESS-RELATED PROTEIN3 to Photosystem II-Light-Harvesting Supercomplexes in *Chlamydomonas reinhardtii*. *Huidan Xue, Ryutaro Tokutsu, Sonja Verena Bergner, Martin Scholz, Jun Minagawa, and Michael Hippler*

Efficient light to heat dissipation in Chlamydomonas reinhardtii requires binding of a stress-related light-harvesting complex protein to photosystem II and associated light-harvesting complexes II.

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^[OPEN]WRKY42 Modulates Phosphate Homeostasis through Regulating Phosphate Translocation and Acquisition in Arabidopsis. *Tong Su, Qian Xu, Fei-Cui Zhang, Yun Chen, Li-Qin Li, Wei-Hua Wu, and Yi-Fang Chen*

An Arabidopsis transcription factor modulates phosphate homeostasis by regulating phosphate uptake and translocation.

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SIGNALING AND RESPONSE

2-Cysteine Peroxiredoxins and Thylakoid Ascorbate Peroxidase Create a Water-Water Cycle That Is Essential to Protect the Photosynthetic Apparatus under High Light Stress Conditions. *Jasmin Awad, Henrik U. Stotz, Agnes Fekete, Markus Krischke, Cornelia Engert, Michel Havaux, Susanne Berger, and Martin J. Mueller*

2-Cys peroxiredoxins and thylakoid ascorbate peroxidase act together to protect plants against high light damage by creating a water-water cycle and restricting light-induced redox signaling.

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S-Nitrosylation Positively Regulates Ascorbate Peroxidase Activity during Plant Stress Responses. *Huanjie Yang, Jinye Mu, Lichao Chen, Jian Feng, Jiliang Hu, Lei Li, Jian-Min Zhou, and Jianru Zuo*

Nitric oxide positively regulates a key Arabidopsis peroxidase through S-nitrosylation and enhances resistance to oxidative stresses.

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^[OPEN]The Greening after Extended Darkness1 Is an N-End Rule Pathway Mutant with High Tolerance to Submergence and Starvation. *Willi Riber, Jana T. Müller, Eric J.W. Visser, Rashmi Sasidharan, Laurentius A.C.J. Voesenek, and Angelika Mustroph*

An E3 ligase PRT6 mutant with constitutive expression of hypoxic genes confers tolerance against submergence via sugar conservation as well as resistance to starvation.

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^[OPEN]Arabidopsis Glutamate Receptor Homolog3.5 Modulates Cytosolic Ca²⁺ Level to Counteract Effect of Abscisic Acid in Seed Germination. *Dongdong Kong, Chuanli Ju, Aisha Parihar, So Kim, Daeshik Cho, and June M. Kwak*

A Ca²⁺ signal mediated by a glutamate receptor homolog promotes seed germination, opposing the effect of abscisic acid.

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Arabidopsis Glutaredoxin S17 and Its Partner, the Nuclear Factor Y Subunit C11/Negative Cofactor 2 α , Contribute to Maintenance of the Shoot Apical Meristem under Long-Day Photoperiod. *Johannes Knuesting, Christophe Riondet, Carlos Maria, Inga Kruse, Noëlle Bécuwe, Nicolas König, Carsten Berndt, Sébastien Tourrette, Jocelyne Guillemot-Montoya, Enrique Herrero, Frédéric Gaymard, Janneke Balk, Gemma Belli, Renate Scheibe, Jean-Philippe Reichheld, Nicolas Rouhier, and Pascal Rey*

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[OPEN]UDP-Glucosyltransferase71C5, a Major Glucosyltransferase, Mediates Abscisic Acid Homeostasis in Arabidopsis. *Zhen Liu, Jin-Ping Yan, De-Kuan Li, Qin Luo, Qiujie Yan, Zhi-Bin Liu, Li-Ming Ye, Jian-Mei Wang, Xu-Feng Li, and Yi Yang*

A unique UDP-glucosyltransferase plays an important role in ABA homeostasis by glucosylating ABA to ABA-glucose ester.

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Priming of Wheat with the Green Leaf Volatile Z-3-Hexenyl Acetate Enhances Defense against *Fusarium graminearum* But Boosts Deoxynivalenol Production. *Maarten Ameye, Kris Audenaert, Nathalie De Zutter, Kathy Steppe, Lieven Van Meulebroek, Lynn Vanhaecke, David De Vleeschauwer, Geert Haesaert, and Guy Smagghe*

A green leaf volatile primes wheat for enhanced defense against the hemibiotrophic fungus F. graminearum by boosting jasmonate-related defenses.

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SYSTEMS AND SYNTHETIC BIOLOGY

[OPEN]Patterns of Metabolite Changes Identified from Large-Scale Gene Perturbations in Arabidopsis Using a Genome-Scale Metabolic Network. *Taehyong Kim, Kate Dreher, Ricardo Nilo-Poyanco, Insuk Lee, Oliver Fiehn, Bernd Markus Lange, Basil J. Nikolau, Lloyd Sumner, Ruth Welti, Eve S. Wurtele, and Seung Y. Rhee*

Global patterns of metabolic responses upon single gene perturbations are specific to gene functions, but they are coordinated with characteristics of the perturbed genes.

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[OPEN]Integrated Metabolomics and Transcriptomics Reveal Enhanced Specialized Metabolism in *Medicago truncatula* Root Border Cells. *Bonnie S. Watson, Mohamed F. Bedair, Ewa Urbanczyk-Wochniak, David V. Huhman, Dong Sik Yang, Stacy N. Allen, Wensheng Li, Yuhong Tang, and Lloyd W. Sumner*

Medicago truncatula border cells contain elevated levels of specialized metabolites that are important in plant-microbe signaling and defense.

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[OPEN]FlowerNet: A Gene Expression Correlation Network for Anther and Pollen Development. *Simon Pearce, Alison Ferguson, John King, and Zoe A. Wilson*

A network model of global transcriptional interactions, based on clustering of transcriptionally correlated genes using publicly available floral gene expression data sets, provides a community resource for studies of reproductive gene expression.

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Site-Specific Nitrosoproteomic Identification of Endogenously S-Nitrosylated Proteins in Arabidopsis. *Jiliang Hu, Xiahe Huang, Lichao Chen, Xuwu Sun, Congming Lu, Lixin Zhang, Yingchun Wang, and Jianru Zuo*

Proteome-wide identification of S-nitrosylated proteins in Arabidopsis by nitrosoproteomic analysis reveals the involvement of S-nitrosylation in diverse signaling pathways.

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