**On the Cover:** The kaleidoscopic design was created from a confocal image of stress granule foci in the cytoplasm of Arabidopsis hypocotyl cells. The linear structures are the cell cytoplasm, voids are vacuoles, and small dots are assemblies of the intrinsically disordered domain-containing RNA binding protein OLIGOURIDYLYATE BINDING PROTEIN 1C (UBP1C) and mRNA. UBP1C foci form in the cell nucleus and cytoplasm in response to hypoxia, heat and other stresses. The z-projection micrograph of briefly submerged tissue was captured by Reed Sorenson on a Leica SP2 confocal microscope at the University of California, Riverside and used by Julia Bailey-Serres to create an abstract design. Colors indicate z-position of the pixel origin.

### FOCUS ISSUE

**EDITORIAL**

The Dynamic Kaleidoscope of RNA Biology in Plants. Julia Bailey-Serres, Jixian Zhai, and Motoaki Seki

**NEWS AND VIEWS**

Adapting to High Light: At a Different Time and Place? Charlotte M. M. Gommers

**LETTER**

Unparalleled Variation in RNA Editing among Selaginella Plastomes. David Roy Smith

The number and position of C-to-U RNA editing sites in Selaginella plastomes can be extremely variable, to a degree that is currently unparalleled in any other photosynthetic genus.

**UPDATES**

Histone Modifications Form Epigenetic Regulatory Networks to Regulate Abiotic Stress Response. Minoru Ueda and Motoaki Seki

Epigenetic modifiers such as erasers, readers, writers, and recruiters control abiotic stress response in flowering plants.

Autonomous Pathway: FLOWERING LOCUS C Repression through an Antisense-Mediated Chromatin-Silencing Mechanism. Zhe Wu, Xiaofeng Fang, Danling Zhu, and Caroline Dean

Cotranscriptional regulation occurs through antisense-mediated chromatin silencing.


The latest advances in the field exogenous application of RNA molecules in plants help to protect and modify them through RNA interference (RNAi).

Exchange of Small Regulatory RNAs between Plants and Their Pests. Collin Hudzik, Yingnan Hou, Wenbo Ma, and Michael J. Axtell

Regulatory small RNAs are found to exchange between plants and their pests.

Nucleotide Metabolism in Plants. Claus-Peter Witte and Marco Herde

Nucleotide metabolism is an essential function in plants.

Occurrence and Functions of m^6^A and Other Covalent Modifications in Plant mRNA. Laura Arribas-Hernández and Peter Brodersen

Covalent mRNA modifications play crucial roles in gene regulation and are required for plant embryonic and postembryonic development.

Continued on next page
mRNA localization is an essential mechanism for protein targeting and the formation of multiple-protein complexes.

Ribosomes translate the mRNA code into protein, and this process can be controlled by metabolites that bind to the translating ribosome in interaction with the nascent protein.

Artificial, ligand-responsive RNA aptazymes are an efficient tool for dose- and time-dependent external control of nuclear gene expression in plants.

Tools and approaches for plant small RNA and mRNA data visualization and analysis were developed, taking advantage of numerous sequenced genomes, and integrating tools for RNA analysis with these genomes.

RNA fluorescence in situ hybridization on sections can be used to investigate the tissue/subcellular localization of coding and noncoding RNAs, or for double labeling RNAs, or RNAs and proteins.

Light down-regulates photomorphogenic repressor PHYTOCHROME-INTERACTING FACTOR3 by multiple mechanisms, including phytochrome B-induced alternative splicing that inhibits PIF3 protein translation.

Histone Deacetylase Complex1 is specifically expressed in meristematic tissues and recruits histone deacetylase complexes to regulate multiple phytohormone pathway genes, regulating cell proliferation.

Cross talk between histone modifiers regulates miRNA156 and alters hormonal response during aerial tuber formation in potato under short-day conditions.

Flowering time in Arabidopsis is affected by a circadian clock-regulating feedback loop involving miR397b and its target gene CASEIN KINASE II SUBUNIT B3.

Nitrogen nutrient can trigger changes in chromatin modifications, thus affecting RNA processing, metabolism, and growth in plants.

PlantAPAdb: A Comprehensive Database for Alternative Polyadenylation Sites in Plants. Sheng Zhu, Wenbin Ye, Lishan Ye, Hongjuan Fu, Congting Ye, Xuesong Xiao, Yuanhaowei Ji, Weixu Lin, Guoli Ji, and Xiaohui Wu

PlantAPAdb is a user-friendly database of alternative polyadenylation (APA) sites in plants, which will promote the elucidation of APA mechanisms, conservation, and gene expression regulation.


Light-activated phytochrome influences alternative splicing by promoting the association of a heterogeneous nuclear ribonucleoprotein with a regulatory cis element on pre-mRNA.

DEAD-Box RNA Helicase 42 Plays a Critical Role in Pre-mRNA Splicing under Cold Stress. Chung-An Lu, Chun-Kai Huang, Wen-Shan Huang, Tian-Sheng Huang, Hsin-Yi Liu, and Yu-Fu Chen

A DEAD-box RNA helicase, OsRH42, plays an essential role in ensuring accurate pre-mRNA splicing to support normal rice plant growth under low ambient temperature.

circRNAs Are Involved in the Rice-Magnaporthe oryzae Interaction. Jing Fan, Weili Quan, Guo-Bang Li, Xiao-Hong Hu, Qi Wang, He Wang, Xu-Pu Li, Xiaotian Luo, Qin Feng, Zi-Jin Hu, Hui Feng, Mei Pu, Ji-Qun Zhao, Yan-Yan Huang, Yan Li, Yi Zhang, and Wen-Ming Wang

Rice circRNAs regulate rice immunity against the blast fungus Magnaporthe oryzae.

ARGONAUTE1 and ARGONAUTE4 Regulate Gene Expression and Hypoxia Tolerance. Elena Loreti, Federico Betti, Maria Jose Ladera-Carmona, Fabrizia Fontana, Giacomo Novi, Maria Cristina Valeri, and Pierdomenico Perata

RNA-silencing pathways contribute to low-oxygen signaling in Arabidopsis.

Conservation and Divergence in the Meiocyte sRNAomes of Arabidopsis, Soybean, and Cucumber. Jiyue Huang, Cong Wang, Xiang Li, Xiaolong Fang, Ning Huang, Ying Wang, Hong Ma, Yingxiang Wang, and Gregory P. Copenhaver

Soybean meiocyte-specific small RNAs display a positive association with the coding region of genes that are transcriptionally upregulated during meiosis.


Characterizing different small RNA populations reveals the roles of development and genotype in expression variation in maize inbreds and their hybrids.


Multifaceted effects of N^6-methyladenosine modification of messenger RNA on translational status in maize.

Evolution of the RNA N^6-Methyladenosine Methylyome Mediated by Genomic Duplication. Zhenyan Miao, Ting Zhang, Yuhong Qi, Jie Song, Zhaoxue Han, and Chuang Ma

RNA N^6-methyladenosine-modified genes exhibit biased subgenome fractionation, and their coevolutionary relationship with transposable elements is mediated by genomic duplication in maize (Zea mays).

Salinity stress shapes root development through control of mRNA stability and requires the partially redundant function of SnRK2 protein kinases to modulate transcript levels.

Seed-Stored mRNAs that Are Specifically Associated to Monosomes Are Translationally Regulated during Germination. Bing Bai, Sjors van der Horst, Jan H.G. Cordewener, Twan A.H.P. America, Johannes Hanson, and Leenke Bentsink

Dry seeds contain monosome-associated mRNAs that are translationally up-regulated during early seed germination, suggesting that their translational fate is determined at seed maturation.

Upstream Open Reading Frame and Phosphate-Regulated Expression of Rice OsNLA1 Controls Phosphate Transport and Reproduction. Shu-Yi Yang, Wen-Chien Lu, Swee-Suak Ko, Ching-Mei Sun, Jo-Chi Hung, and Tzyy-Jen Chio

An upstream open reading frame participates in phosphate-responsive gene expression to control phosphate acquisition, phosphate translocation, and reproductive success in rice.

mTERF8, a Member of the Mitochondrial Transcription Termination Factor Family, Is Involved in the Transcription Termination of Chloroplast Gene psbJ. Hai-Bo Xiong, Jing Wang, Chao Huang, Jean-David Rochaix, Fei-Min Lin, Jia-Xing Zhang, Lin-Shan Ye, Xiao-He Shi, Qing-Bo Yu, and Zhong-Nan Yang

mTERF8 functions as a transcription terminator of chloroplast gene psbJ in Arabidopsis.

Limited Responsiveness of Chloroplast Gene Expression during Acclimation to High Light in Tobacco. Maja Schuster, Yang Gao, Mark Aurel Schöttler, Ralph Bock, and Reimo Zoschke

Short-, medium-, and long-term acclimation of tobacco seedlings to increased light intensities involves only minor adjustments of the chloroplast transcriptome and protein translation.

REGULAR ISSUE

THANK YOU TO REVIEWERS AND EDITORS

An acknowledgment of Plant Physiology reviewers and editors.

ON THE INSIDE

Peter V. Minorsky

EDITORIAL

Plant Physiology Welcomes 26 New Assistant Features Editors. Mike Blatt and Mary Williams

NEWS AND VIEWS

Rapid Changes: Abscisic Acid-Independent SnRK2s Target mRNA Decay. Magda Julkowska

Variation in Xylem Resistance to Cavitation Explains Why Some Leaves Within a Canopy Are More Likely to Die under Water Stress. Meisha Holloway-Phillips

Paving the Way for C₄ Evolution: Study of C₃-C₄ Intermediate Species in Grasses. Yunqing Yu

LETTERS

NRC4 Gene Cluster Is Not Essential for Bacterial Flagellin-Triggered Immunity. Chih-Hang Wu, Hiroaki Adachi, Juan Carlos De la Concepcion, Roger Castells-Graells, Vladimir Nekrasov, and Sophien Kamoun

CRISPR/Cas9-mediated mutation of NRC2, NRC3, and NRC4 genes did not affect bacterial flagellin-triggered immunity.

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Mutant Muddle: Some Arabidopsis eds5 Mutant Lines Have a Previously Unnoticed Second-Site Mutation in FAH1.  
Sravani Ram Veeragoni, Birgit Lange, Mario Serrano, Christiane Nawrath, Sibylle Bauer, Anton Rudolf Schaffner, Hans Thordal-Christensen, Jörg Durner, and Frank Gaupels

Some of the salicylic acid-deficient Arabidopsis eds5 mutants have an unnoticed fah1-2 background mutation, which could cause salicylic acid- and EDS5-independent mutant phenotypes.

RESEARCH REPORTS

A Select and Resequence Approach Reveals Strain-Specific Effects of Medicago Nodule-Specific PLAT-Domain Genes.  
Liana T. Burghardt, Diana I. Trujillo, Brendan Epstein, Peter Tiffin, and Nevin D. Young

A mixed-inoculum, “select and resequence” approach efficiently assays for strain-specific effects of host mutations in nodule-specific genes.

Chlamydomonas reinhardtii Exhibits De Facto Constitutive NPQ Capacity in Physiologically Relevant Conditions.  
Wojciech J. Naurocki, Xin Liu, and Roberta Croce

Under simulated high light, diel growth conditions, the photosynthetic apparatus of Chlamydomonas reinhardtii exhibits an almost constitutive photoprotection capacity through non-photochemical quenching.

RESEARCH ARTICLES

BIOCHEMISTRY AND METABOLISM

Combinatorial Evolution of a Terpene Synthase Gene Cluster Explains Terpene Variations in Oryza.  
Hao Chen, Tobias G. Köllner, Guanglin Li, Guo Wei, Xintu Chen, Dali Zeng, Qian Qian, and Feng Chen

A terpene synthase gene cluster in Oryza has undergone dynamic evolution through a combination of mechanisms that underlie the diversity of volatile terpenes made by individual species.

High Flux Through the Oxidative Pentose Phosphate Pathway Lowers Efficiency in Developing Camelina Seeds.  
Lisa M. Carey, Teresa J. Clark, Rahul R. Deshpande, Jean-Christophe Cocuron, Emily K. Rustad, and Yair Shachar-Hill

The low efficiency of maternally-supplied substrate conversion into growth and storage compounds in Camelina sativa embryos is due to high flux through the oxidative pentose phosphate pathway.

Glycogen Metabolism Supports Photosynthesis Start through the Oxidative Pentose Phosphate Pathway in Cyanobacteria.  
Shrameeta Shinde, Xiaohui Zhang, Sonali P. Singapuri, Isha Kalra, Xianhua Liu, Rachael M. Morgan-Kiss, and Xin Wang

Glycogen metabolism kick-starts photosynthesis during cyanobacterial diurnal growth.

CELL BIOLOGY

E2FB Interacts with RETINOBLASTOMA RELATED and Regulates Cell Proliferation during Leaf Development.  
Erika Ösi, Csaba Papdi, Binish Mohammed, Aladár Petkó-Szandtner, Tünde Leviczky, Eszter Molnár, Carlos Galvan-Ampudia, Safina Khan, Enrique Lopez Juez, Beatrix Horváth, László Bögre, and Zoltán Magyar

The main function of the E2FB transcription factor is to restrict cell proliferation and establish quiescence during Arabidopsis leaf development; it acts in complex with RETINOBLASTOMA-RELATED.

ECOPHYSIOLOGY AND SUSTAINABILITY

Diverse Traits Contribute to Salinity Tolerance of Wild Tomato Seedlings from the Galapagos Islands.  
Yveline Paillès, Mariam Awlia, Magdalena Julkowska, Luca Passone, Khadija Zemmouri, Sónia Negrão, Sandra M. Schmöckel, and Mark Tester

Seedlings of salt-tolerant Galapagos tomatoes display a wide variation of combined responses to salinity.
Xylem Embolism Resistance Determines Leaf Mortality during Drought in *Persea americana*. Amanda A. Cardoso, Timothy A. Batz, and Scott A. M. McAdam

Leaf death in avocado during drought is strongly associated with embolism in the xylem.

**GENES, DEVELOPMENT AND EVOLUTION**

**HISTONE DEACETYLASE 9 Functions with Polycomb Silencing to Repress FLOWERING LOCUS C Expression.** Xiaolin Zeng, Zheng Gao, Chuan Jiang, Yupeng Yang, Renyi Liu, and Yuehui He

Histone deacetylase, Polycomb repressive complex, and epigenome readers through a cis-element mediate histone deacetylation and methylation to repress FLOWERING LOCUS C in rapid-cycling accessions.

**The Evolutionary Origin of C4 Photosynthesis in the Grass Subtribe Neurachninae.** Roxana Khoshravesh, Matt Stata, Florian A. Busch, Montserrat Saladié, Joanne M. Castelli, Nicole Dakin, Paul W. Hattersley, Terry D. Macfarlane, Rowan F. Sage, Martha Ludwig, and Tammy L. Sage

In multiple Neurachne species, organelles and glycine decarboxylase show varying enhancement in the mestome sheath, suggesting that C4 photosynthesis gradually evolved from ancestral C3 plants.

**MEMBRANES, TRANSPORT AND BIOENERGETICS**

**The HKT Transporter HvHKT1;5 Negatively Regulates Salt Tolerance.** Lu Huang, Lichun Kuang, Liyuan Wu, Qiufang Shen, Yong Han, Lixi Jiang, Dezhi Wu, and Guoping Zhang

A high-affinity K⁺ transporter (HKT) facilitates Na⁺ loading from roots to shoots in barley and its lower expression can enhance salt tolerance, which shows a potential way to improve salt tolerance of barley as well as other cereal crops.

**Low Temperature Enhances Plant Immunity via Salicylic Acid Pathway Genes That Are Repressed by Ethylene.** Zhan Li, Huimin Liu, Zehong Ding, Jiapei Yan, Huiyun Yu, Ronghui Pan, Jin Hu, Yajing Guan, and Jian Hua

Disease resistance to the pathogen *Pseudomonas syringae* in Arabidopsis is enhanced by a lower temperature via up-regulating multiple genes in the salicylic acid pathway that are repressed by ethylene.

**H2Bub1 Regulates RbohD-Dependent Hydrogen Peroxide Signal Pathway in the Defense Responses to *Verticillium dahliae* Toxins.** Jun Zhao, Qihong Chen, Sa Zhou, Yuhui Sun, Xinyue Li, and Yingzhang Li

HUB-mediated H2Bub1 regulates the NADPH oxidase RbohD-dependent H₂O₂ signaling pathway, which plays an important role in the defense response to Vd-toxins.

**H2Bub1 Regulates RbohD-Dependent Hydrogen Peroxide Signal Pathway in the Defense Responses to *Verticillium dahliae* Toxins.** Jun Zhao, Qihong Chen, Sa Zhou, Yuhui Sun, Xinyue Li, and Yingzhang Li

**Gibberellin Signaling Is Required for Far-Red Light-Induced Shoot Elongation in *Pinus tabuliformis* Seedlings.** Wei Li, Shuang-Wei Liu, Jing-Jing Ma, Hong-Mei Liu, Fang-Xu Han, Yue Li, and Shi-Hui Niu

GA signaling is required for FR-induced shoot elongation in *P. tabuliformis* seedlings, and there are different regulatory targets for FR-mediated GA biosynthesis between conifers and angiosperms.
A Mutant Allele Uncouples the brassinosteroid-dependent and Independent Functions of BRASSINOSTEROID INSENSITIVE 1. Eleonore Holzwart, Friederike Wanke, Nina Glückner, Herman Höffte, Klaus Harter, and Sebastian Wolf

A mutant allows dissection of brassinosteroid signaling-related and noncanonical functions of the receptor-like kinase BRASSINOSTEROID INSENSITIVE 1.