On the Cover: The composite image shows the submergence response found in flood-tolerant *Rumex* spp. and a ribbon model of the receiver domain from the ETHYLENE RESPONSE1 (ETR1) ethylene receptor of Arabidopsis (*Arabidopsis thaliana*). *Rumex* spp. escape from submerged conditions by fast elongation of petioles. This cell elongation process is initiated by the accumulation of ethylene inside the submerged plant tissues, related to the slow diffusion of gases in water. Subsequently, other plant hormones, along with regulators of photomorphogenesis, mediate this growth response, leading to the stimulation of target processes such as cell wall loosening. After the leaf tips emerge into the atmosphere, oxygen can diffuse into the plant to ensure survival. In the ribbon model of the ETR1 receiver domain, amino acids that are important for various traits described by Bakshi et al. (pp. 219–232) are shown in space-filling structures. Mutation of three amino acid residues (gray carbons) results in a receptor that cannot stimulate nutational bending in response to ethylene. Mutation of two residues in the γ loop (white carbons) results in a receptor that inhibits germination on salt more effectively than wild-type ETR1, whereas mutation of two residues just prior to the γ loop (black carbons) results in a receptor that cannot inhibit germination on salt. The model of the ETR1 receiver domain was generated by Molecular Operating Environment (version 2012.10) based on the receiver domain crystal structure (Protein Data Bank 1DCF). Cover image credits: Ole Pedersen, Freshwater Biological Laboratory, University of Copenhagen (*Rumex* spp. submergence response); and Brad M. Binder, Department of Biochemistry, Cellular, and Molecular Biology, University of Tennessee, Knoxville (ETR1 receiver domain). Cover layout by Diane McCauley.

FOCUS ON ETHYLENE

EDITORIAL

Focus on Ethylene  
*G. Eric Schaller and Laurentius A.C.J. Voesenek*

UPDATES

Ethylene-Mediated Acclimations to Flooding Stress.  
*Rashmi Sasidharan and Laurentius A.C.J. Voesenek*

*The volatile hormone ethylene is an important regulator of plant-adaptive responses to flooding stress.*

Bacterial Modulation of Plant Ethylene Levels.  
*Elisa Gamalero and Bernard R. Glick*

*Bacterial ACC deaminase affects ethylene production and plant growth under stress.*

Group VII Ethylene Response Factors Coordinate Oxygen and Nitric Oxide Signal Transduction and Stress Responses in Plants.  
*Daniel J. Gibbs, Jorge Vicente Conde, Sophie Berckhan, Geeta Prasad, Guillermina M. Mendiondo, and Michael J. Holdsworth*

*Group VII ethylene response factors are key regulators of signal transduction at the interface of ethylene, oxygen, and nitric oxide signaling.*

Ethylene Response Factors: A Key Regulatory Hub in Hormone and Stress Signaling.  
*Maren Müller and Sergi Munné-Bosch*

*Ethylene Response Factors are transcription factors that act as a key regulatory hub in plant response to abiotic stresses, integrating ethylene, ABA, jasmonate, and redox signaling.*

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Producing the Ethylene Signal: Regulation and Diversification of Ethylene Biosynthetic Enzymes.  Mathew A. Booker and Alison DeLong

Posttranslational modifications control the stability of a key family of biosynthetic enzymes, and phylogenetic analysis indicates recent specialization of this enzyme family in seed plants.

Ethylene and the Regulation of Physiological and Morphological Responses to Nutrient Deficiencies.  María José García, Francisco Javier Romera, Carlos Lucena, Esteban Alcántara, and Rafael Pérez-Vicente

Physiological and morphological responses to increase the mobilization and uptake of nutrients from the soil are subject to regulation by ethylene.

Ethylene and Hormonal Cross Talk in Vegetative Growth and Development.  Bram Van de Poel, Dajo Smet, and Dominique Van Der Straeten

Recent insights into the role of ethylene in regulating plant growth and development highlight interactions with other hormones.

Role of Ethylene and Its Cross Talk with Other Signaling Molecules in Plant Responses to Heavy Metal Stress.  Nguyễn Phuong Thảo, M. Isbal R. Khan, Nguyễn Binh Anh Thu, Xuan Lan Thi Hoang, Mohd Asgher, Nafees A. Khan, and Lam-Son Phan Tran

Ethylene regulates plant responses to heavy metal stress through the interaction with other signaling molecules.

Mechanistic Insights in Ethylene Perception and Signal Transduction.  Chuanli Ju and Caren Chang

New insights into the ethylene signaling pathway, including dynamic regulatory mechanisms, provide a more comprehensive view of ethylene perception and signal transduction.

RESEARCH ARTICLES

[OPEN] Tobacco Translationally Controlled Tumor Protein Interacts with Ethylene Receptor Tobacco Histidine Kinase1 and Enhances Plant Growth through Promotion of Cell Proliferation.  Jian-Jun Tao, Yang-Rong Cao, Hao-Wei Chen, Wei Wei, Qing-Tian Li, Biao Ma, Wan-Ke Zhang, Shou-Yi Chen, and Jin-Song Zhang

Translationally-controlled tumor protein binds with a class of ethylene receptors at the endoplasmic reticulum and affects protein degradation.


A mutation that impairs ethylene response in pea reveals an interaction of light and ethylene signaling in the control of leaf expansion during deetiolation.

[OPEN] Roles of Ethylene Production and Ethylene Receptor Expression in Regulating Apple Fruitlet Abscission.  Giulia Eccher, Maura Begheldo, Andrea Boschetti, Benedetto Ruperti, and Alessandro Botton

The balance between the ethylene produced by the fruit and cell-specific expression of ethylene receptor genes in the seed affects the determinism of apple fruitlet abscission.

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Strigolactone Regulates Leaf Senescence in Concert with Ethylene in Arabidopsis. Hiroaki Ueda and Makoto Kusaba

Prolonged dark treatment induces ethylene synthesis and consequent induction of strigolactone synthesis in the leaf to promote leaf senescence.

[OPEN] MAOHUZI6/ETHYLENE INSENSITIVE3-LIKE1 and ETHYLENE INSENSITIVE3-LIKE2 Regulate Ethylene Response of Roots and Coleoptiles and Negatively Affect Salt Tolerance in Rice. Chao Yang, Biao Ma, Si-Jie He, Qing Xiong, Kai-Xuan Duan, Cui-Cui Yin, Hui Chen, Xiang Lu, Shou-Yi Chen, and Jin-Song Zhang

Two transcriptional regulators of ethylene signaling play differential roles in ethylene and salt stress responses, distinct from their orthologs in Arabidopsis.


A negative feedback loop involving two Ethylene Response Factors fine-tunes growth inhibition and stress tolerance activation under mannitol-induced stress.


Long-chain fatty acids enhance the expression of an ethylene biosynthesis gene, production of ethylene, and promote ethylene-induced aerenchyma formation.


Ethylene and cell proliferation confine the amplitude of Arabidopsis hyponastic leaf movement.

[OPEN] Disruption of Ethylene Responses by Turnip mosaic virus Mediates Suppression of Plant Defense against the Green Peach Aphid Vector. Clare L. Casteel, Manori De Alwis, Aurélie Bak, Haili Dong, Steven A. Whitham, and Georg Jander

A plant virus suppresses plant defense against insect vectors by modulating ethylene responses.

[OPEN] Identification of Regions in the Receiver Domain of the ETHYLENE RESPONSE1 Ethylene Receptor of Arabidopsis Important for Functional Divergence. Arkadipta Bakshi, Rebecca L. Wilson, Randy F. Lacey, Heejung Kim, Sai Keerthana Wuppalapati, and Brad M. Binder

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Overexpression of ARGOS Genes Modifies Plant Sensitivity to Ethylene, Leading to Improved Drought Tolerance in Both Arabidopsis and Maize. Jinrui Shi, Jeffrey E. Habben, Rayeann L. Archibald, Bruce J. Drummond, Mark A. Chamberlin, Robert W. Williams, H. Renee Lafitte, and Ben P. Weers

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UPDATE

The VQ Motif-Containing Protein Family of Plant-Specific Transcriptional Regulators. Yanjun Jing and Rongcheng Lin

Recent advances highlight the roles and mechanisms of the plant-specific VQ-motif-containing protein family in regulating stress and developmental processes.

RESEARCH ARTICLES

BIOCHEMISTRY AND METABOLISM

(OPEN) Transcription Factor Arabidopsis Activating Factor1 Integrates Carbon Starvation Responses with Trehalose Metabolism. Prashanth Garapati, Regina Feil, John Edward Lunn, Patrick Van Dijck, Salma Balazadeh, and Bernd Mueller-Roeber

A transcription factor regulates trehalase expression and induces a carbon starvation transcriptome and metabolome.

(OPEN) TRANSPARENT TESTA GLABRA1 Regulates the Accumulation of Seed Storage Reserves in Arabidopsis. Mingxun Chen, Bin Zhang, Chengxiang Li, Harikrishna Kulaveerasingam, Fook Tim Chew, and Hao Yu

An Arabidopsis transcription factor regulates the accumulation of seed storage reserves, including storage proteins and fatty acids.

(OPEN) MUCILAGE-RELATED10 Produces Galactoglucomannan That Maintains Pectin and Cellulose Architecture in Arabidopsis Seed Mucilage. Cătălin Voiniciuc, Maximilian Heinrich-Wilhelm Schmidt, Adeline Berger, Bo Yang, Berit Ebert, Henrik V. Scheller, Helen M. North, Björn Usadel, and Markus Günl

A highly branched polymer defines the distribution of pectin and the structure of cellulose in Arabidopsis mucilage.
A Single Amino Acid Substitution in an ORANGE Protein Promotes Carotenoid Overaccumulation in Arabidopsis. Hui Yuan, Katherine Owsiany, T.E. Sheeja, Xiangjun Zhou, Caroline Rodriguez, Yongxi Li, Ralf Welsch, Noam Chayut, Yong Yang, Theodore W. Thannhauser, Mandayam V. Parthasarathy, Qiang Xu, Xiaxin Deng, Zhangjun Fei, Ari Schaffer, Nurit Katzir, Joseph Burger, Yaakov Tadmor, and Li Li

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Half-of-the-Sites Reactivity of the Castor Δ9-18:0-Acyl Carrier Protein Desaturase. Qin Liu, Jin Chai, Martin Moche, Jodie Guy, Ylva Lindqvist, and John Shanklin

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Mutations in the Prokaryotic Pathway Rescue the fatty acid biosynthesis1 Mutant in the Cold. Jinpeng Gao, James G. Wallis, and John Browse

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Bioinformatics Reveal Five Lineages of Oleosins and the Mechanism of Lineage Evolution Related to Structure/Function from Green Algae to Seed Plants. Ming-Der Huang and Anthony H.C. Huang

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Sequence Motifs in Transit Peptides Act as Independent Functional Units and Can Be Transferred to New Sequence Contexts. Dong Wook Lee, Seunjeong Woo, Kyoung Rok Geem, and Inhwan Hwang

Various sequence motifs in diverse transit peptides act as independent functional units and can be transferred to new sequence contexts with the possibility of a change in their functionality.


Pollen tube arrival at a synergid cell promotes its degeneration, and cytoplasmic discharge from the tube completes the process.

A Critical Role of Lyst-Interacting Protein5, a Positive Regulator of Multivesicular Body Biogenesis, in Plant Responses to Heat and Salt Stresses. Fei Wang, Yan Yang, Zhe Wang, Jie Zhou, Baofang Fan, and Zhixiang Chen

The multivesicular body pathway is positively regulated by two protein kinases through phosphorylation of an ATPase required for multivesicular body formation and plays a critical role in plant responses to abiotic stresses.

Extra-Large G Proteins Expand the Repertoire of Subunits in Arabidopsis Heterotrimeric G Protein Signaling. David Chakravorty, Timothy E. Gookin, Matthew J. Milner, Yunqing Yu, and Sarah M. Assmann

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ECOPHYSIOLOGY AND SUSTAINABILITY

CATION EXCHANGER1 Cosegregates with Cadmium Tolerance in the Metal Hyperaccumulator Arabidopsis halleri and Plays a Role in Limiting Oxidative Stress in Arabidopsis Spp. Cecilia Baliardini, Claire-Lise Meyer, Pietrino Salls, Pierre Saumitou-Laprade, and Nathalie Verbruggen

A gene encoding a calcium/proton antiporter is involved in cadmium tolerance and acts to limit oxidative stress.

Facing the Future: Effects of Short-Term Climate Extremes on Isoprene-Emitting and Nonemitting Poplar. Elisa Vanzo, Werner Jud, Ziru Li, Andreas Albert, Malgorzata A. Domagalska, Andrea Ghirardo, Bishu Niederbacher, Juliane Frenzel, Gerrit T.S. Beemster, Han Asard, Heinz Rennenberg, Thomas D. Sharkey, Armin Hansel, and Jörg-Peter Schmitzler

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constitutive expression of rice microRNA528 alters plant development and enhances tolerance to salinity stress and nitrogen starvation in creeping bentgrass. Shuangrong Yuan, Zhigang Li, Dayong Li, Ning Yuan, Qian Hu, and Hong Luo

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GENES, DEVELOPMENT, AND EVOLUTION

Novel and Recently Evolved MicroRNA Clusters Regulate Expansive F-BOX Gene Networks through Phased Small Interfering RNAs in Wild Diploid Strawberry. Rui Xia, Songqing Ye, Zongrang Liu, Blake C. Meyers, and Zhongchi Liu

Identification and analysis of novel miRNAs in diploid strawberry revealed mechanisms of miRNA evolution and miRNA-mediated regulation of large gene families.

Abscisic Acid Is a General Negative Regulator of Arabidopsis Axillary Bud Growth. Chi Yao and Scott A. Finlayson

The plant hormone abscisic acid functions as a general negative regulator of branching and may contribute to the effects of other hormones and proteins that control the process.

A Member of the Arabidopsis Mitochondrial Transcription Termination Factor Family Is Required for Maturation of Chloroplast Transfer RNA/Ile(GAU). Isidora Romani, Nikolay Manavski, Arianna Morosetti, Luca Tadini, Svetlana Maier, Kristina Kühn, Hannes Ruwe, Christian Schmitz-Linneweber, Gerhard Wanner, Dario Leister, and Tatjana Kleine

The product of a termination factor promotes maturation of a transfer RNA in Arabidopsis plastids.
Allelic variation in a blue-light photoreceptor modulates temperature sensitivity.

Elevation of Pollen Mitochondrial DNA Copy Number by WHIRLY2: Altered Respiration and Pollen Tube Growth in Arabidopsis. Qiang Cai, Liang Guo, Zhao-Rui Shen, Dan-Yang Wang, Quan Zhang, and Sodmergen

A DNA-binding protein affects mitochondrial DNA copy number in pollen vegetative cells, resulting in decreased mitochondrial respiration and pollen tube growth.

Evolution of an alpine genome involved an unusually high number of pericentric inversions, plausibly facilitating the evolution of heavy metal-related traits.

Auxin regulates a progressive cell cycle during adult maize lateral root formation.

A gibberellin oxidase exposes the regulatory association between gibberellic acid and cellulose biosynthesis during cell expansion.

Membranes, Transport, and Bioenergetics

An Antarctic alga exhibits differential phosphorylation of thylakoid membrane proteins, which are part of a photosystem I supercomplex involved in cyclic electron flow.

For photoprotection in cyanobacteria, the N-terminal arm of the orange carotenoid protein is important for both the regulation of its photoactivation and its interaction with the phycobilisome antenna.

Mutations in vacuolar iron transporters modify both tissue specific and subcellular localization of seed iron stores.

Abscisic acid-activated protein kinases interact with each other and with protein phosphatases that modulate abscisic acid responses.


A cytoplasmic calcineurin-like-dependent protein kinase affects salt and osmotic stress responses by preferentially localizing to the vacuolar membrane under stress.

Pseudomonas syringae Effector Avirulence Protein E Localizes to the Host Plasma Membrane and Down-Regulates the Expression of the NONRACE-SPECIFIC DISEASE RESISTANCE1/HARPIN-INDUCED1-LIKE13 Gene Required for Antibacterial Immunity in Arabidopsis. Xiu-Fang Xin, Kinya Nomura, Xinhua Ding, Xujun Chen, Kun Wang, Kyaw Aung, Francisco Uribe, Bruce Rosa, Jian Yao, Jìn Chen, and Sheng Yang He

A major plant plasma membrane-targeted bacterial virulence protein is linked to reduced expression of an Arabidopsis gene required for innate immunity.

SIGNALLING AND RESPONSE


Sequences flanking the degron accelerate or decelerate the rate of auxin-induced degradation of repressor proteins.

A Constitutively Active Allele of Phytochrome B Maintains Circadian Robustness in the Absence of Light. Matthew Alan Jones, Wei Hu, Suzanne Litthauer, J. Clark Lagarias, and Stacey Lynn Harmer

Activated phytochrome is sufficient to sustain robust circadian rhythms in the dark even in the absence of exogenous sugars, revealing the importance of light-signaling pathways in clock function.


Brassinosteroid signaling is central to controlling auricle development and establishing the blade-sheath boundary in maize leaf.

The Responses of Arabidopsis Early Light-Induced Protein2 to Ultraviolet B, High Light, and Cold Stress Are Regulated by a Transcriptional Regulatory Unit Composed of Two Elements. Natsuki Hayami, Yusaku Sakai, Mitsuhiro Kimura, Tatsunori Saito, Mutsutomo Tokizawa, Satoshi Iuchi, Yukio Kurihara, Minami Matsui, Mika Nomoto, Yasuomi Tada, and Yoshiharu Y. Yamamoto

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The Arabidopsis Mediator Complex Subunit16 Is a Key Component of Basal Resistance against the Necrotrophic Fungal Pathogen Sclerotinia sclerotiorum. Chenggang Wang, Jin Yao, Xuezhu Du, Yanping Zhang, Yijun Sun, Jeffrey A. Rollins, and Zhonglin Mou

An evolutionarily conserved gene regulates resistance to a devastating necrotrophic fungal crop plant pathogen by controlling major antifungal defense pathways.

A Novel Gene, OZONE-RESPONSIVE APOPLASTIC PROTEIN1, Enhances Cell Death in Ozone Stress in Rice. Yoshiaki Ueda, Shahid Siddique, and Michael Frei

Polymorphisms in the promoter sequence are a novel, ozon-responsive protein suggested to affect ozone tolerance in contrasting cultivars.

Development of the Poplar-Laccaria bicolor Ectomycorrhiza Modifies Root Auxin Metabolism, Signaling, and Response. Alice Vayssières, Ales Pěnčík, Judith Felten, Annegret Kohler, Karin Ljung, Francis Martin, and Valérie Legué

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