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. Matthew 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 Phượng Thảo, M. Iqbal R. Khan, Nguyễn Bình 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.

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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.

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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[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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Reducing ethylene sensitivity by modifying the expression of a negative regulator of ethylene signal transduction improves grain yield in maize under drought stress environments.

An Ancestral Role for CONSTITUTIVE TRIPLE RESPONSE1 Proteins in Both Ethylene and Abscisic Acid Signaling. Yuki Yasumura, Ronald Pierik, Steven Kelly, Masaaki Sakuta, Laurentius A.C.J. Voesenek, and Nicholas P. Harberd

A Physcomitrella patens protein regulates both ethylene and abscisic acid signaling, and this dual function was subsequently lost during evolution.

Multilayered Regulation of Ethylene Induction Plays a Positive Role in Arabidopsis Resistance against Pseudomonas syringae. Rongxia Guan, Jianbin Su, Xiangzong Meng, Sen Li, Yidong Liu, Juan Xu, and Shuqun Zhang

Plant sensing of bacterial pathogens induces ethylene, which is potentiated by salicylic acid and actively suppressed by effector(s) delivered to plant cells via the type III secretion system.

Ethylene Contributes to maize insect resistance1-Mediated Maize Defense against the Phloem Sap-Sucking Corn Leaf Aphid. Joe Louis, Saumik Basu, Suresh Varsani, Lina Castano-Duque, Victoria Jiang, W. Paul Williams, Gary W. Felton, and Dawn S. Luthe

An endogenous defensive protein in maize that encodes a Cys protease, provides enhanced resistance to phloem sap-consuming pests through the action of an ethylene-signaling pathway.

Ethylene Regulates the Arabidopsis Microtubule-Associated Protein WAVE-DAMPENED2-LIKE5 in Etiolated Hypocotyl Elongation. Jingbo Sun, Qianqian Ma, and Tonglin Mao

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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 Kalaveerasingam, Fook Tim Chew, and Hao Yu

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[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

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Genetic Architecture of Natural Variation in Thermal Responses of Arabidopsis.  
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Cell Type-Specific Gene Expression Analyses by RNA Sequencing Reveal Local High Nitrate-Triggered Lateral Root Initiation in Shoot-Borne Roots of Maize by Modulating Auxin-Related Cell Cycle Regulation.  
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MEMBRANES, TRANSPORT, AND BIOENERGETICS

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Regulation of Orange Carotenoid Protein Activity in Cyanobacterial Photoprotection.  
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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, Jin Chen, and Sheng Yang He

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SIGNALING AND RESPONSE


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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

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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

Prediction-oriented functional analysis uncovers a transcriptional regulatory unit composed of two unique elements for UV-B, high light, and cold stress responses.
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

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

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