

## G. ERIC SCHALLER

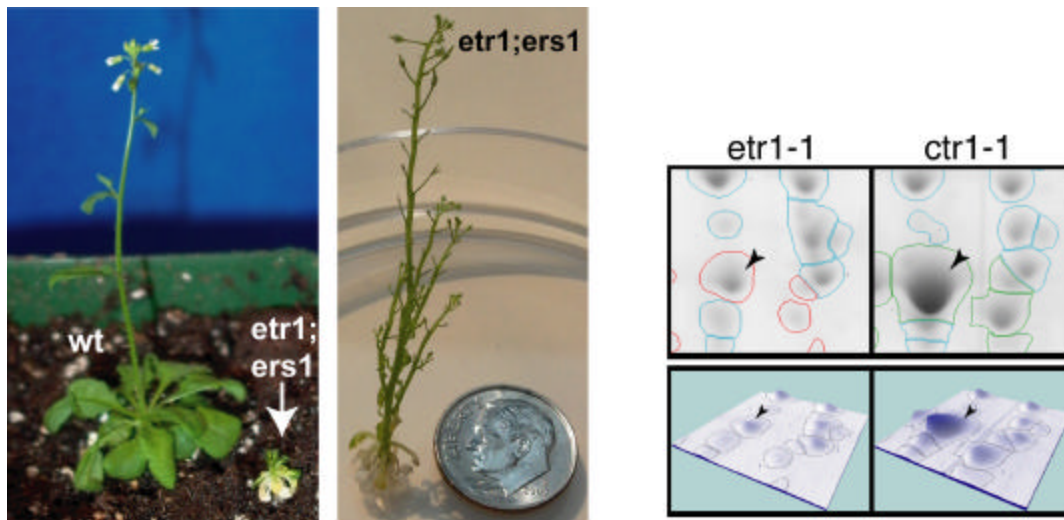
### Plant Hormones: Perception and Signal Transduction

We are interested in the mechanisms by which plants grow and respond to changes in their environment. Plants make use of a diverse group of signaling compounds to regulate growth and development. Although some of these compounds were identified almost a century ago, only recently has significant progress been made in identifying the proteins involved in sensing and transducing these signals. Much of this work has been accomplished by using the plant *Arabidopsis*, which serves as a model organism for addressing basic questions in plant biology. My laboratory uses a combination of biochemical, molecular, and genetic strategies to analyze signaling pathways in *Arabidopsis*.

#### RESEARCH PROJECTS:

##### 1. Mechanism of ethylene signal transduction.

One of our focuses is on the pathway of ethylene signal transduction. Ethylene serves as a gaseous hormone in plants, and is perhaps most widely known for its role in the ripening of such fruit as tomatoes, bananas, and apples. Ethylene receptors have been identified and my laboratory is determining how these transduce the ethylene signal. For this purpose we are characterizing the receptors in terms of localization, regulation, interactions, and the effects of mutations upon downstream signaling. We are also taking proteomic approaches to identify protein complexes that function early in the signal transduction pathway and to analyze the effects of ethylene upon the plant. These studies will help build a mechanistic model for how ethylene is perceived and the signal transduced in the plant.

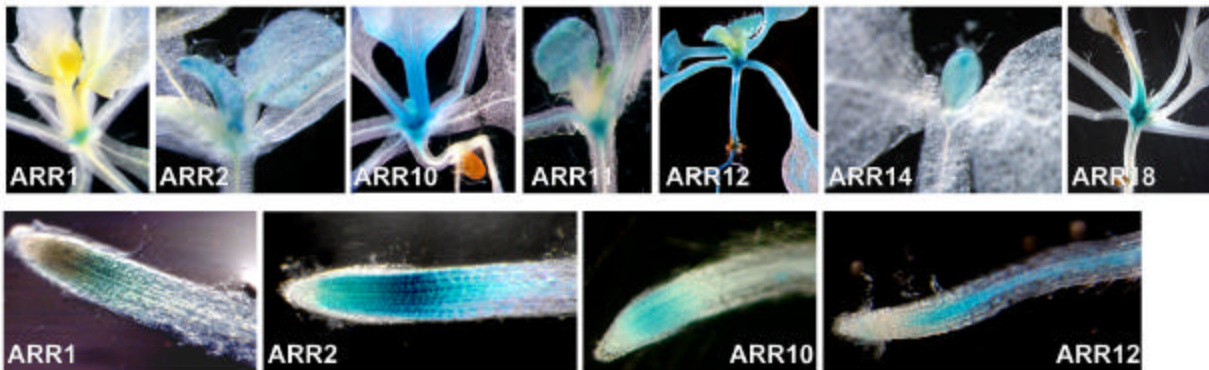


Phenotype of ethylene receptor double mutant *etr1;ers1*. Left, Comparison of *etr1;ers1* to a wildtype plant (wt). Right, Close-up of *etr1;ers1* plant that has bolted. The double mutant has a growth phenotype consistent with a constitutive ethylene response.

Proteomic analysis of ethylene regulated expression. The ethylene insensitive mutant *etr1-1* was compared to the constitutive ethylene response mutant *ctr1-1* by 2-D gel analysis. The arrow indicates ACC-oxidase, a protein involved in ethylene biosynthesis.

## 2. Mechanism of cytokinin signal transduction

Cytokinins are adenine derivatives that play essential roles in regulating plant growth and development. Cytokinins regulate cell division and metabolism, stimulate chloroplast development, modulate shoot and root development, and delay senescence. The cytokinin signal is relayed from membrane to nucleus via a phosphorelay making use of receptors, phospho-transfer proteins, and type-B response regulators. Our research is primarily focused on the type-B response regulators which act as transcription factors to regulate the initial response of plants to cytokinin. We have taken a mutant-based approach using a gene knockouts to assess the roles of these genes in plant growth and development. We are also determining where in the plant these genes are expressed. We are also purifying and analyzing protein complexes from *Arabidopsis* to determine the interactions among these elements and to identify novel interacting proteins. These studies will illuminate the signaling pathways in which the type-B response regulators function and how they interact to control plant growth and development.



Histochemical localization of type-B response regulators (ARRs) in *Arabidopsis* based on GUS reporter gene expression. The top panels show localization of the *Arabidopsis* members in the region around the shoot apical meristem and/or young developing leaves. The bottom panels show localization at the primary root tip. These localizations are consistent with a role in the regulation of plant cell division by cytokinins.

### SELECTED PUBLICATIONS:

- Gamble, R.L., X. Qu and G.E. Schaller. (2002) Mutational analysis of the ethylene receptor ETR1. Role of the histidine kinase domain in dominant ethylene insensitivity. *Plant Physiol.* 128:1428-1438
- Chen, Y.-F., M.D. Randlett, J.L. Findell and G.E. Schaller. Localization of the ethylene receptor ETR1 to the endoplasmic reticulum of *Arabidopsis*. *J. Biol. Chem.* 277:19861-19866 (2002).
- Zhao, X.-C., X. Qu, D.E. Mathews and G.E. Schaller (2002) Effect of ethylene pathway mutations upon expression of the ethylene receptor ETR1 from *Arabidopsis*. *Plant Physiol.* 130:1983-1991
- Schaller, G.E. and J.J. Kieber. (2002) Ethylene. in *The Arabidopsis Book* (Somerville, C., and Meyerowitz, E., eds.) American Society of Plant Biologists. Rockville, MD, DOI/10.1199/tab.0071 <http://www.aspb.org/publications/arabidopsis/>
- Gao, Z., Y.-F. Chen, M.D. Randlett, X.-C. Zhao, J.L. Findell, J.J. Kieber, and G.E. Schaller (2003) Localization of the Raf-like kinase CTR1 to the endoplasmic reticulum of *Arabidopsis* through participation in ethylene receptor signaling complexes. *J. Biol. Chem.* 278: 34725-34732
- Zhao, X.-C., and G.E. Schaller (2004) Effect of salt and osmotic stress upon expression of the ethylene receptor ETR1 in *Arabidopsis thaliana*. *FEBS Lett.* 562:189-192
- Mason, M.G., J. Li, D.M. Mathews, J.J. Kieber, and G.E. Schaller (2004) Type-B response regulators display overlapping expression patterns in *Arabidopsis*. *Plant Physiol.* 135: 927-937.