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IN BRIEF

Supply Route: ABCG Transporters Act in the Construction of Suberin Barriers

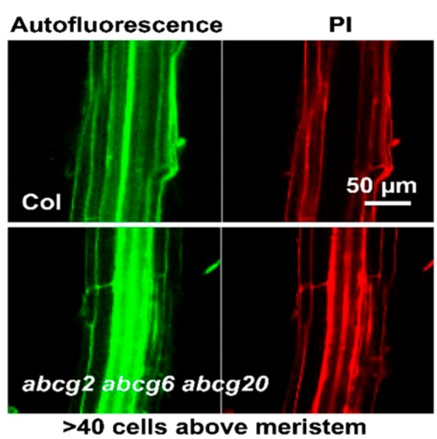
Plants need to regulate the flow of water and solutes between themselves and their environment, both above and below the ground. To enable this, plants form diffusion barriers of hydrophobic components within the cell wall matrix (Nawrath et al., 2013). Such apoplastic barriers include the cuticle in vegetative tissues, the Casparian strip in roots, and suberin-containing layers in vegetative and root tissues. Diffusion barriers also form at wound sites and during abscission. Among the many questions surrounding the formation of diffusion barriers is how the necessary hydrophobic components are transported outside the cell (Beisson et al., 2012).

The ATP binding cassette (ABC) superfamily includes transmembrane transporters involved in a remarkable range of processes and is particularly expanded in plants. *Arabidopsis thaliana* has >40 members in the ABCG subfamily alone (Verrier et al., 2008). Although high genetic redundancy and functional divergence hinder determination of ABC protein functions, some *Arabidopsis* ABCG family members are known to be involved in the export of cuticle components. Now, **Yadav et al. (2014)** report that a clade of ABCG proteins in *Arabidopsis* functions in suberin layer formation.

Yadav et al. focused on a clade in which all members are coexpressed with suberin biosynthesis genes. They found that the promoters of all five genes were active in anthers/pollen and the root endodermis (where the suberin barrier is formed) and were responsive to wounding as well as abscisic acid. Fusion proteins for each localized to the plasma membrane, consistent with a role in cellular export. Mutant analysis suggested that members of one subclade, *ABCG1* and *ABCG16*, are important in pollen wall formation. Triple mutants disrupted in the other subclade, *ABCG2*, *ABCG6*, and *ABCG20*, resembled mutants deficient in suberin: Their seeds and root systems had increased permeability (see figure). In addition, the suberin layer structure and component profile was altered, indicating that ABCG2, ABCG6, and ABCG20 function in roots to export suberin layer components, particularly those conferring impermeability.

In a nice parallel, **Landgraf et al. (2014)** recently found that a related ABCG transporter acts in suberin barrier formation in potato (*Solanum tuberosum*). Landgraf et al. showed that potato ABCG1 is localized to the plasma membrane and expressed in roots and tuber skin. Tubers downregulated in *ABCG1* had altered periderm and suberin composition and lost water twice as fast as the wild type.

St-ABCG1 is most similar to At-ABCG1 and At-ABCG16 among all of the ABC transporters in *Arabidopsis*, suggesting that this entire clade might have a conserved function in suberin barrier formation in various tissues. Consistent with this, a member of the same clade from rice (*Oryza sativa*) was just reported also to play a role in suberin barrier formation (Shiono et al., 2014). Together, these studies address one of the big questions in suberin layer formation, namely, how the components get outside the cell, and also promote efforts to assign functions to the wide array of ABC transporters.



Roots of the *abcg2 abcg6 abcg20* triple mutant are more permeable to dye. Increased staining by propidium iodide (PI) in the stele of triple mutant roots compared with the wild type (Col). (*Adapted from Yadav et al. [2014], Figure 4E.*)

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