research highlights

DEVELOPMENT

Casparian self-healing

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Life depends on physical barriers, at cellular or organ level, that allow the selective transport of molecules and the formation of gradients. In plants, the Casparian strip (CS) is a lignified hydrophobic barrier located inside the root that forbids free apoplastic diffusion of molecules, and forces the selective transport needed for efficient nutrition through endodermal cell membranes. The CS defines two radially separated domains in the root: one outside that is heavily exposed to the surrounding soil composition, and one inside that is isolated from the environment but connected to the vasculature. The precise localization of the CS makes it a model for cell polarization. Different groups have conducted genetic screens to find genes involved in proper CS development. One key component is the membrane receptor SCHENGEN3/GASSHO1 (SGN3/GSO1). In a recent issue of *Science*, two studies announced the discovery of the peptides that are perceived by this receptor.

One group led by Niko Geldner in Switzerland uncovered, through a genetic screen, a tyrosylprotein sulfotransferase that

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post-translationally modifies endogenous peptides. Two candidate targets were named CIF1/2 for CASPARIAN STRIP INTEGRITY FACTOR 1/2. These peptides were also identified by an *in silico* screen by the second group, led by Yoshikatsu Matsubayashi in Japan. Plants mutated in the receptor or the peptide genes show an identical

discontinuous CS phenotype. These two peptides are expressed only inside the stele. Exogenous addition of sulfated peptides increases CS lignification in the wild type, and in the *cif1 cif2* double mutant it seals the CS after just a few hours, restoring ion homeostasis.

In vitro binding assays and photoaffinity labelling definitely proved binding between the receptor and peptides. The final hypothesis is a fascinating model for root self-healing: as long as the CS is intact, CIF peptides (inside) and the previously characterized downstream kinase SGN1 (outside) are spatially separated and cannot form an activated pathway. As soon as the CS is compromised, the CIF peptides diffuse outside, are perceived by SGN3 and activate SGN1, which leads to overlignification and suberization — in effect sealing the endodermal barrier again, like two-part epoxy glue.

This pair of complementary articles illustrates how CS formation is becoming a developmental model as interesting as the stomatal development pathway, with multiscale insights into cellular development, signal transduction, patterning, polarization and plant nutrition.

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