Phloem unloading in Arabidopsis roots is convective and regulated by the phloem-pole pericycle

In plants, a complex mixture of solutes and macromolecules is transported by the phloem. Here, we examined how solutes and macromolecules are separated when they exit the phloem during the unloading process. We used a combination of approaches (non-invasive imaging, 3D-electron microscopy, and mathematical modelling) to show that phloem unloading of solutes in Arabidopsis roots occurs through plasmodesmata by a combination of mass flow and diffusion (convective phloem unloading). During unloading, solutes and proteins are diverted into the phloem-pole pericycle, a tissue connected to the protophloem by a unique class of 'funnel plasmodesmata'. While solutes are unloaded without restriction, large proteins are released through funnel plasmodesmata in discrete pulses, a phenomenon we refer to as 'batch unloading'. Unlike solutes, these proteins remain restricted to the phloem-pole pericycle. Our data demonstrate a major role for the phloem-pole pericycle in regulating phloem unloading in roots.

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