The role of membrane tethering complexes in vacuole development in *Arabidopsis thaliana*

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As plants are sessile organisms, the ability to adapt to a wide range of environmental stresses plays a key role in their evolutionary success. A plant-specific membrane-bound organelle called the lytic vacuole is involved in maintaining the overall cell homeostasis during these environmental adaptation processes. On the one hand lytic vacuoles act as the main storage for essential nutrients and metabolites and on the other hand vacuoles are also able to sequester harmful substances thereby detoxifying the cytosol. In addition, degradation processes of cell components occur in vacuoles in order to recycle them. And in the combination with the cell wall vacuoles generate the necessary hydraulic stiffness for cell elongation and plant growth.

Previous work of our group could show that the lytic vacuole develops as a single compartment with a highly complex morphology in the *Arabidopsis* root tip showing different sizes of constrictions and tubules. The tubular vacuole architecture inflates during root development until the vacuole morphology lost its tubular organization completely and fills up to 90 % of the cell volume in the more differentiated part of the root. However, in the early state of the vacuole development displaying a highly constricted morphology rapid rearrangements of the vacuole membrane can be observed. These remodelling processes are somehow reminiscent of fission and fusion events. In baker's yeast, the HOPS (Homotypic Fusion and Protein Sorting) membrane tethering complex facilitates the fusion of vesicles with the yeast vacuole and the fusion of one vacuole with another vacuole (Balderhaar and Ungermann, 2013). By investigating the orthologues HOPS complex in plants we found that it is indeed essential for vacuole to vacuole fusion and proper vacuole development in plants. In yeast, many other components orchestrated by the HOPS complex are necessary for vacuole membrane fusion. And also in plants factors required for membrane fusion with the vacuole membrane lose their proper localization within the cell, when the HOPS complex is not fully functional indicating its importance in vacuole dynamics and protein trafficking towards the vacuole. Moreover, we found that the cytoskeleton, which gives mechanical stability to the plant cell, is disturbed by interfering with the HOPS complex revealing a complex interplay between vacuole development and the coordination of the cytoskeleton during cell growth.

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