Researchers discover novel 'to divide or to differentiate' switch in plants

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Scientists from VIB and Ghent University under the guidance of Prof. Dr. Jenny Russinova have uncovered a novel mechanism in plants that controls an important decision step in stomatal lineage to divide

asymmetrically or to differentiate. This is a decisive step for the formation of stomata, tiny pores on the plant surface, produced by asymmetric cell division. In the model plant Arabidopsis thaliana, they identified a scaffolding protein, POLAR, and demonstrated that POLAR brings a subset of GSK3-like kinases to their interacting partners at the polarized end of the stomatal precursor cell to initiate asymmetric cell division. This surprising regulation through scaffolding might be a more common mechanism to control GSK3-like kinases functions in plants.

Anaxi Houbaert and colleagues under the guidance of Prof. Dr. Jenny Russinova (VIB-UGent) study the development of stomata. It was already known that a GSK3-like kinase can simultaneously promote and inhibit stomatal formation, but it wasn't clear how this can exist in the same stomatal lineage cell. Using protein interactomics approaches established at the VIB-UGent Center for Plant Systems Biology and at the Wageningen University, the researchers identified a plant- and stomatal lineage-specific scaffolding protein, POLAR, that can regulate the subcellular locations of the GSK3-like kinase.

Anaxi Houbaert (VIB-UGent), first author of the paper, explains: "We showed that when POLAR and GSK3-like kinases are co-expressed, the kinase is targeted to the plasma membrane and polarized at one side of the stomatal precursor cell, leading to asymmetric cell division. On the other hand, we saw that when POLAR is absent, the kinase is located in the nucleus to promote cell differentiation."

One of the strongest lines of evidence supporting their claims originated from research with a confocal microscopy equipped with gating technology. This feature allowed the researchers to clear out auto-fluorescence coming from cellular compartments such as chloroplasts, vastly present in the cells constituting the plant leaf epidermis. As a result, the signal to noise ratio could greatly be improved and allowed the visualization of endogenously low expressed kinases during leaf

development.

Anaxi Houbaert (VIB-UGent): "We knew that stomatal development is strictly regulated with positive and negative feedback loops keeping each other in check and forming a flexible but yet robust mechanism to drive epidermal development. But it was a surprise to discover the role of POLAR as a scaffolding protein. We would like to investigate the function of the POLAR family and to explore if similar scaffolding proteins regulate GSK3-like kinase activities in other plant tissues."

Prof. Jenny Russinova (VIB-UGent): "Our findings put in light molecular mechanisms that drive cell division and differentiation in Arabidopsis. Since orthologues for the GSK3-like kinase and POLAR protein family can be found throughout both monocot and dicot plant species, it remains to be studied if these orthologues behave in the same way in other plant species and whether these can be used as potential targets for crop improvement."

POLAR-guided signaling complex assembly and localization drive asymmetric cell division, by Houbaert et al. is published in *Nature*.

More information: Anaxi Houbaert et al. POLAR-guided signalling complex assembly and localization drive asymmetric cell division, *Nature* (2018). DOI: 10.1038/s41586-018-0714-x

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