Computational morphodynamic research explains lateral organ feedback on stem cell homeostasis in plants

With the support by the National Natural Science Foundation of China, and the National Basic Research Program of China (973 Program), the research team led by Prof. Jiao YuLing (焦雨铃) at the Institute of Genetics and Developmental Biology, Chinese Academy of Sciences, and Prof. Zhang Lei (张磊) at Beijing International Center for Mathematical Research, Peking University, discovered how lateral organs feedback on stem cell homeostasis through modulating auxin transport, which was published in *Developmental Cell* (2018, 44: 204—216).

In plants and animals, stem cells generate new tissues and organs and maintain themselves. The activities of stem cells are precisely controlled to balance self-renewal and differentiation. Plants have evolved the WUS—CLV feedback loop, which forms a self-correcting mechanism and maintains a stem cell pool of constant population. In animals, the control of stem cell proliferation involves negative feedback factors, which are secreted from differentiated cells to control stem cell proliferation. It is expected that plants have similar feedback loops, but their molecular mechanism remains elusive.

In the shoot apex, the control circuits that underlie feedback on the shoot apical meristem (SAM) from lateral organs, such as leaf primordia and floral primordia, remain largely unknown. The team found that flowers and leaves, which are differentiated from the SAM, could feed back on stem cells by restricting the SAM size. Furthermore, they discovered that long-distance auxin transport mediates this feedback in a non-cell-autonomous manner. A low-auxin zone is associated with the SAM organization center, and auxin levels negatively regulate the SAM size. Using computational model simulations, the team showed that auxin transport from lateral organ primordia could inhibit auxin transport from the SAM through an auxin transport switch, and thus maintains SAM auxin homeostasis and SAM size. Genetic and microsurgical analyses confirmed the model's predictions. Thus, the study showed that plants use a distinct feedback control mechanism from those in animals. This canalization-based auxin flux switch shown in the *Developmental Cell* paper can be widely adapted as a feedback control mechanism in plants.

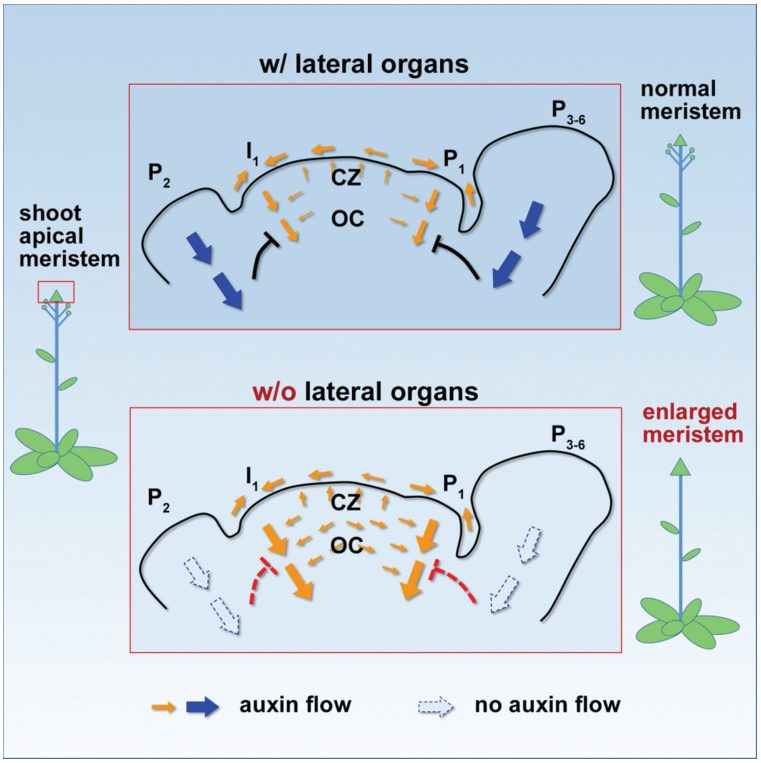

Figure A conceptual model showing auxin transport in inner and epidermal cells in the SAM.