

Plant organ development breakthrough

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Plants grow upward from a tip of undifferentiated tissue called the shoot apical meristem. As the tip extends, stem cells at the center of the meristem divide and increase in numbers. But the cells on the periphery differentiate to form plant organs, such as leaves and flowers. In between these two layers, a group of boundary cells go into a quiescent state and form a barrier that not only separates stem cells from differentiating cells, but eventually forms the borders that separate the plant's organs.

Because each plant's form and shape is determined by [organ formation](#) and organ boundary creation, elucidating the underlying mechanisms that govern these functions could help scientists design the architecture of [crop plants](#) to better capture light and ultimately produce more crop yield with less input. New research from two teams led by Carnegie's Zhiyong Wang and Kathryn Barton focuses on the role of the crucial [plant hormone](#) brassinosteroid in the creation of plant-shoot architecture. Their work is published by [Proceedings of the National Academy of Sciences](#) during the week of December 3.

Like all organisms, plant growth and development is regulated by internally produced [chemical signals](#), including hormones like brassinosteroid, which is found throughout the plant kingdom. The brassinosteroid signaling pathway is involved in regulating more than 1,000 [plant genes](#). [Mutant plants](#) that are deficient in brassinosteroid that are grown in the dark show features of plants grown in the light. They also have defects at many phases of the plant life cycle, including reduced seed germination, dwarfism, and sterility.

The new study lead by Wang and Barton uncovered yet another role of brassinosteroid: the formation of boundaries between organs. Plants made hypersensitive to brassinosteroid displayed fused organs.

The team included lead author's Carnegie's Joshua Gendron and Jiang-Shu Liu, as well as Min Fan, Mingyi Bai, and Stephan Wenkel, from Carnegie, and Patricia Springer from the University of California Riverside.

Their investigations showed that activation of the brassinosteroid pathway represses a group of genes called the cup-shaped cotyledon, or CUC family, which is responsible for organ boundary formation. Using sophisticated techniques the team demonstrated that the protein in the brassinosteroid pathway that is responsible for binding to DNA and, in this case, for inhibiting CUC genes, is present at high levels in the meristem's undifferentiated stem cells and developing organ primordia, but very low in the boundary cells, suggesting that different levels of brassinosteroid activity contribute to the opposite growth behavior of these three types of cells.

"This work links the plant steroids to growth and development, organ boundary development, providing a link between the physiology of the plant and its architectural design," Wang and Barton said.

Provided by Carnegie Institution for Science

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