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Journal club

GROWTH VERSUS DEVELOPMENT

For most of the past century, scientists interested in plant growth and development generally fell into two different camps. Those interested in growth worked on plant hormones such as the small indolic molecule auxin, which regulates plant cell division and expansion. Meanwhile, plant developmental biologists tried to determine the principles of pattern formation — the organization of plant tissues and organs — and to identify the molecules that regulate this. Because physiological studies had implicated auxin in a bewildering array of growth responses, its effects were thought to be too general to function in patterning.

A study from the Scheres laboratory, published in 1999, was an exciting landmark in the unification of the groups interested in plant growth and plant development.

> "this study firmly established auxin as a hormone involved in both growth and development."

This laboratory works on the *Arabidopsis thaliana* root, which is a good system for looking at patterning events because it is easily accessible and it follows a highly regular developmental programme in both time and space. The root stem cells, located near the root tip, produce all of the cell types in the root through a series of stereotypical divisions. Using an auxin-responsive transcriptional reporter, they revealed the presence of an auxin response gradient with a maximum response near the stem cells. By manipulating the gradient, either genetically by using auxin signalling and auxin transport mutants, or by applying auxin transport inhibitors, they showed that the site of maximum auxin concentration is a distal organizer of the root. Most dramatically, treatments that result in uniformly high auxin levels in a band of root cells, rather than an auxin gradient, result in a duplication of root structures distal and proximal to this band. This suggests that auxin accumulation is sufficient to confer and organize cell fate. Although several *A. thaliana* auxin mutants had previously been shown to have patterning defects, this study firmly established auxin as a hormone involved in both growth and development.

In the 10 years since this paper was published, auxin has been shown to be a key pattern organizer in various contexts in the plant, including in the embryo and the apical meristem. In the coming decade we can expect to learn how the function of auxin in cell growth relates to its more recently identified role in pattern formation.

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ORIGINAL RESEARCH PAPER Sabatini, S. *et al.* An auxin-dependent distal organizer of pattern and polarity in the *Arabidopsis* root. *Cell* **99**, 463–472 (1999)