

# **Newly discovered mechanism of plant hormone auxin acts contrarily**

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Increased auxin accumulation (blue areas) in the concave side of the apical hook of *Arabidopsis thaliana*. Credit: IST Austria - Marçal Gallemí Rovira/Eva

Benková group

Increased levels of the hormone auxin usually promote cell growth in plant tissues. Chinese scientists, together with researchers from the Institute of Science and Technology Austria (IST Austria), have now shown that in special areas of the seedling, increased auxin levels trigger a different gene expression pathway leading to growth inhibition. The discovery, published in the journal *Nature*, helps to explain the formation of the typical bend or so called apical hook that helps the seedling to break through the soil following germination.

Varied auxin concentrations mediate distinct developmental outcomes in different [plant tissues](#). For instance, auxin accumulating in stem tissues triggers a gene expression [pathway](#) that ultimately leads to increased cell elongation, resulting in stem growth. A growth scenario, which cannot be explained in an analogous way, however, is the development of the apical hook that the early plant forms to protect its delicate growing apex when breaking through the soil. In the cells of the inner bend of the hook, i.e. the concave side, auxin accumulates; however, to grow into the form of a hook, the seedling's shoot must grow less at the inner concave than on the outer convex side. Scientists thus faced a paradoxical situation and asked themselves: Can auxin do something opposite from what it has been known to do in other parts of the plants?

## **One hormone—two different gene expressions**

To solve the puzzle, the research group around Tongda Xu from the Chinese Academy of Sciences collaborated with IST Austria plant cell biologist Jiri Friml and his postdoc fellow Zuzana Gelová. By testing various mutants of the model plant *Arabidopsis thaliana*, the scientists revealed a previously unknown gene expression pathway triggered by

auxin accumulation and leading to the inhibition of growth at the concave side of the hook. While the previously known pathway is located at the nucleus and involves the receptor protein transport inhibitor response 1 (TIR1), this newly discovered pathway starts at the cell surface—and involves a different perception component, transmembrane kinase (TMK1), the function of which had been unclear.

## A paradox and TMK1 explained

In the newly discovered mechanism, auxin activates TMK1 at the [cell surface](#) and triggers cleavage of the intracellular part of this protein. Within the cell, the cleaved part of TMK1 interacts with specific transcriptional repressors. While auxin degrades similar repressor proteins in the nucleus-based TIR1 pathway to trigger gene expression leading to [cell growth](#), it stabilizes the repressors connected to the TMK1 pathway, resulting in growth inhibition rather than stimulation.

Thus, TIR1 and TMK1 interact with different subsets of transcriptional proteins and therefore facilitate auxin signaling by two different mechanisms, allowing the shoot to grow on one side, but not the other. Co-author Jiri Friml: "We have wanted to understand for a long time how TMK1 works as well as whether and how auxin accumulation can function in two different ways. Thanks to our persistence and the major contributions of our Chinese colleagues, we now know both." Starting from here, it would also be worthwhile to the scientists to understand the full repertoire of the developmental process beyond the apical hook controlled by this novel [auxin](#) signaling pathway.

**More information:** TMK1-mediated auxin signalling regulates differential growth of the apical hook, *Nature* (2019). [DOI:](#)

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