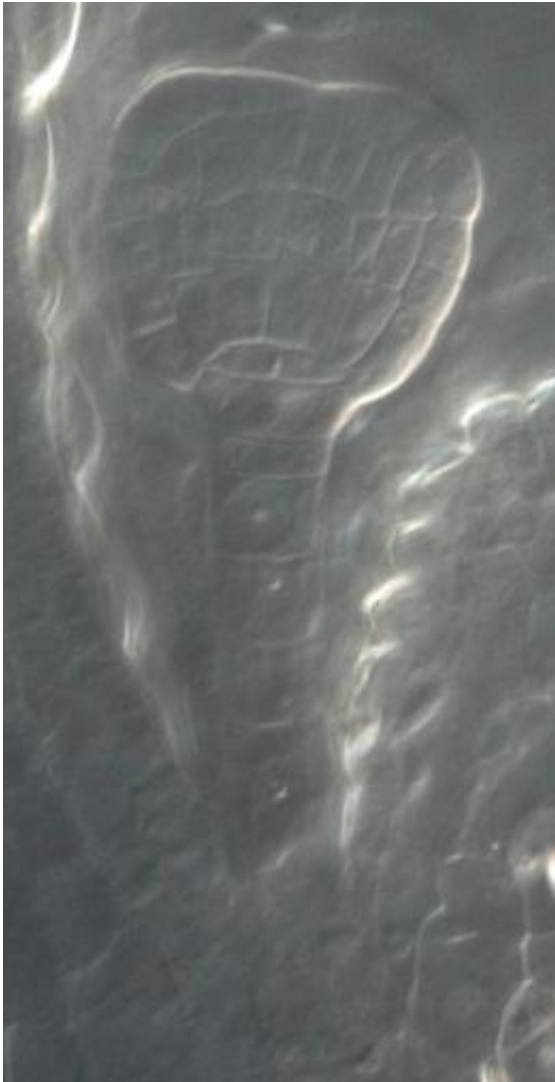


Plant hormone auxin triggers a genetic switch

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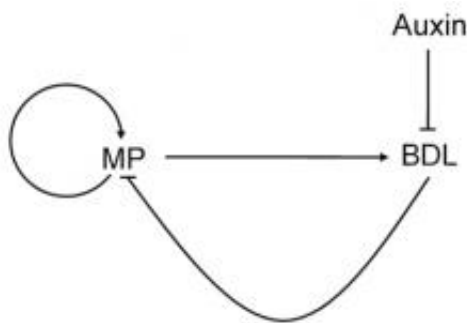
Two-day-old thale cress embryo (*Arabidopsis thaliana*). Credit: Steffen Lau/MPI for Developmental Biology

(PhysOrg.com) -- During the development of organisms, a particular event repeatedly occurs: a signal appears temporarily, but the processes it triggers must be maintained – for example, when the fate of cells in the embryo is established. The plant hormone auxin plays an important role as a signalling molecule during embryo development of the thale cress (*Arabidopsis thaliana*), a model plant widely used in genetic studies. Researchers from the Max Planck Institute for Developmental Biology and the University of Tübingen were already familiar with important components, through which auxin exerts its influence, and some of their interactions. They have now combined several of these components in a regulatory network such that an increasing concentration of auxin can “switch on” genes for the embryo’s normal development. Once a certain point has been reached, the genes do not halt their increased activity, or only do so gradually, even if the auxin concentration declines. Similar switching mechanisms are also known from the animal kingdom.

In the normal course of events, a plant embryo becomes a seedling and the seedling grows into a plant with all of its organs: roots, stem, leaves and flowers. The foundations for this development are laid during early embryonic development. The plant [hormone](#) auxin is an important signal transmitter during this phase of development. It was already known that it promotes, for example, the breakdown of an inhibitor that can prevent certain factors from activating their target genes. In an early phase of embryo development, the auxin concentration rises in the cells located at the top of the embryo, from which the above-ground parts of the plant will later form. Shortly after that, auxin is transported into the lower cells. So complicated, so good. However, this does not fully explain the exact role of auxin in pattern formation in the embryo.

In their study on the effect of auxin, Steffen Lau, Ive De Smet, Martina Kolb and Gerd Jürgens from the Department of Cell Biology and Hans Meinhardt, all from the Max Planck Institute for Developmental Biology

in Tübingen, and some also affiliated with the University of Tübingen, initially focused on a simplified system. Instead of carrying out their experiments with thale cress (*Arabidopsis thaliana*) embryos, they worked with thale cress protoplasts: living cells without a cell wall that offer a less complex environment. Test conditions using protoplasts can be varied rather conveniently, and it is relatively easy to measure gene activity in these cells. Using this system, the scientists tested the effects of a gene-activating factor called MONOPTEROS and that of its inhibitor BODENLOS. This and subsequent experiments showed that MONOPTEROS promotes both its own production and that of its inhibitor BODENLOS. They form a system comprising two linked feedback loops. The system is controlled by auxin, which promotes the breakdown of the inhibitor.



Effect of auxin on plant cells with regard to the transcriptional regulators "MONOPTEROS" and "BODENLOS": MONOPTEROS (MP) controls its own expression and the expression of its inhibitor BODENLOS (BDL), with the plant hormone auxin acting as a threshold-specific trigger by promoting the degradation of the inhibitor. Credit: Steffen Lau/MPI for Developmental Biology

Based on these results, the scientists also carried out computer simulations in which they reconstructed the regulatory network.

“Everything points to the fact that auxin triggers a switch in the system,” says Steffen Lau. And this is how it works: when the concentration of auxin increases, breakdown of the inhibitor BODENLOS also increases. As a result, MONOPTEROS is less strongly blocked. And once a certain auxin concentration is reached, the MONOPTEROS-BODENLOS system is boosted to a higher level of activity. “As long as the auxin concentration does not fall below a certain level, the activated system does not fall back to the initial level, even if most of the [auxin](#) is transported away,” explains the scientist.

This regulatory mechanism in the embryonic development of plants had not previously been described, and displays similarities to a signalling pathway in embryonic stem cells in mammals, for example. “Whether this type of regulation occurs in other developmental processes in thale cress remains to be investigated,” says Steffen Lau.

More information: Steffen Lau, et al. Auxin triggers a genetic switch, *Nature Cell Biology*, 10 April 2011, [doi: 10.1038/ncb2212](https://doi.org/10.1038/ncb2212)

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