Genetic self-activation maintains plant stem cells

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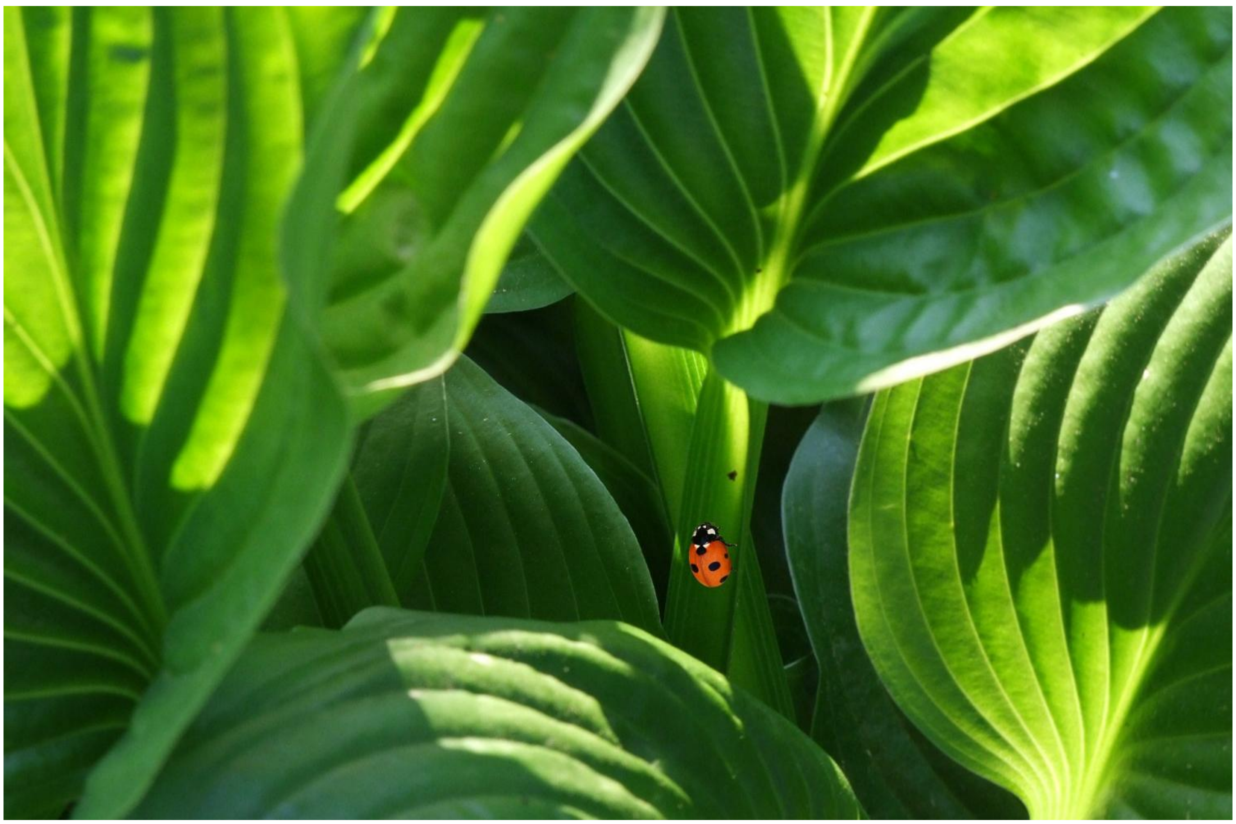

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Branching allows plants to occupy space in three dimensions, an innovation considered essential for their adaption. Stem cells are key to this process because they promote the establishment of new growth axes.

But where do these stem cells come from?

New research led by investigators from the Institute of Genetics and Developmental Biology (IGDB) of the Chinese Academy of Sciences (CAS) helps answer this question.

The study, which will be published in *Current Biology* on April 2, describes how a key shoot stem cell-promoting gene activates its own expression, thus maintaining a stem cell lineage in the leaf axil that enables branching. This knowledge may help scientists optimize crop architecture and boost yields, which is especially important in an era of global climate change.

Unlike animals, plants form lateral organs throughout their life from a specialized stem cell-containing tissue—the meristem. Shoot apical meristems form leaves, while buds established at the leaf axil enable branching. Importantly, buds are formed by axillary meristems that have the same developmental potential as the shoot apical meristem.

In previous research, the IGDB-led team showed that a meristematic cell lineage is maintained in the leaf axil in order to provide progenitor cells for axillary meristem initiation. In the current study, they show how cell fate is maintained in this cell lineage.

"Meristematic cells use a very simple mechanism to keep their identification," said Prof. Jiao Yuling, corresponding author of the paper.

Specifically, leaf axil meristematic cells maintain the expression of SHOOT MERISTEMLESS (STM), a transcription factor promoting shoot meristems. This expression is important because it keeps the STM locus accessible to other binding proteins, according to first author Cao Xiuwei, a postdoctoral fellow in Jiao's lab. Binding the STM locus to other transcription factors is needed before axillary meristem initiation.

The key finding, however, is that maintenance of STM expression relies on self-activation. In other words, STM binds to its own promoter and then activates gene expression.

The researchers also discovered that STM works in cooperation with the STM-interacting partner protein ATH1. The former is responsible for transcriptional activation, while the latter is responsible for DNA binding.

Although the current study focuses on plants, it may also be applicable to animal research. "Plant cells do not migrate, providing a more tractable system for studying cell lineage and fate determination," said Jiao. "This research helps us to understand how cell fate can be maintained, and this regulatory circuit may also be utilized by animal stem cells," he noted.

Overall, this study inspires future investigation into the molecular mechanisms underlying stem cell fate maintenance in both plants and in animals.

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