Timing Mechanism Dependent on Cell Division Is Invoked by Polycomb Eviction in Plant Stem Cells

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“Bio-Timer”, the Metronome that Provides the Rhythm for Growth

A team led by Dr Toshiro Ito, Senior Principal Investigator at Temasek Life Sciences Laboratory (TLL), has discovered a timing mechanism that controls the growth rate in flowering plants. This molecular circuit acts as a “bio-timer” that controls the diverse growth and differentiation pathways in plants and animals.

In Plants, Floral stem cells divide a limited number of times before they stop and terminally differentiate, but the mechanisms that control this timing remain unclear. Using Arabidopsis as a model plant to study the molecular mechanisms of time-regulated delays, Dr Ito’s Team have demonstrated that flower development utilizes cell division to provide stem cells with a window of opportunity to change fate. The precise temporal activation of the Arabidopsis zinc finger repressor KNUCKLES is essential for the coordinated growth and differentiation of floral stem cells. The induction timing of KNUCKLES is determined by a cell division-dependent changes in histone modification caused by the competitive action of an upstream transcription factor and an epigenetic factor. This molecular circuit may act as a “bio-timer” that controls the diverse growth and differentiation pathways in plants and animals.

Dr Ito’s team has identified an epigenetic mechanism in which the floral homeotic protein AGAMOUS induces KNUCKLES at approximately two days of delay which results in proper and complete flowering of the plant. Premature induction of KNUCKLES will result in incomplete flowers. The developmental timing is measured by the floral stem cells by a cell division-dependent timer.

Understanding the basic principles of plant growth and development has significant impact for basic biology. It helps to create biotechnological improvements for the production of high-value crops, especially in the ever-changing environments. This “bio-timer” also provides fine-tuning ability for the design of cell factories to produce useful and valuable metabolites and compounds.

The full paper can be accessed via http://www.sciencemag.org/content/343/6170/1248559
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