PRESS RELEASE

"Bio-Timer" That Synchronizes Growth

18 Feb 2014, Singapore – 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.

The findings have been published as a research article in the prestigious international journal *Science*, and provide valuable insight to understanding similar processes that occur in animals since the logic of development and many of the components involved in this molecular circuit are conserved.

Using Arabidopsis as a model plant to study the molecular mechanisms of time-regulated delays in developmental process, Dr Ito's team has demonstrated that flower development utilizes cell division to provide stem cells with a window of opportunity to change fate.

Plant floral stem cells divide a limited number of times before they stop and terminally differentiate, but the mechanisms that control this timing remain unclear. The precise temporal activation of the Arabidopsis zinc finger repressor KNUCKLES is essential for the coordinated growth and differentiation of floral stem cells.

Dr Ito's team has identified an epigenetic[1] 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.

"We are curious with what causes each plant to have its own flowers that come in different shapes and number of floral organs," said Dr Ito. "Timing regulation is important for the co-ordination of multiple processes in nature as well as in industry. In parallel to pursuing basic research, we plan to develop timer modules that are useful in translational aspect of synthetic biology."

Dr Toshiro Ito received his Ph.D from Kyoto University in Japan and worked for California Institute of Technology, USA as a postdoctoral fellow (1997-2003) and as a senior research fellow (2003-2005). In 2005, he joined TLL to lead the Plant Systems Biology Group to focus on reproductive organ development in plants.

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1. Epigenetic refers to external modifications to DNA or histone proteins that turn genes "on" or "off". It involves genetic control by factors other than an individual's DNA sequence. (Nature Education 2013)

Dr Ito has been studying the flower development using Arabidopsis and rice as model plant species to understand the molecular basis of plant growth and differentiation. “80% of human food is produced from flowering plants such as grains and fruits. Hence, the fundamental understanding of flower development may help to improve the supply of food,” said Dr Ito.

“In TLL, we utilize a broad range of model organisms such as Arabidopsis to study development biology which can provide insights into the functions and mechanisms of other more complex organisms,” said Prof Chan Soh Ha, Executive Director of TLL. “The discovery from Dr Ito provides basic understanding on how a plant controls its growth which is important for all living organisms and this has the potential for many downstream applications.”

About Temasek Life Sciences Laboratory (TLL)

TLL, established in 2002, is a beneficiary of Temasek Trust and is affiliated to the National University of Singapore and Nanyang Technological University. The research institute focuses primarily on understanding the cellular mechanisms that underlie the development and physiology of plants, fungi and animals. Such research provides new understanding of how organisms function, and also provides foundation for biotechnology innovation.

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For media queries, please contact:
Cheryl Chng
Intellectual Property Office & Marketing Communications
Temasek Life Sciences Laboratory Limited
Tel: (65) 68727068
Email: cheryl@tll.org.sg