An *Arabidopsis* flower.

Plant development

Understanding how flowers and leaves form

Insights into the molecular mechanisms governing how buds develop leaves and flowers could help improve agronomy and horticulture

Genes and molecular mechanisms that allow the plant hormone auxin to control the formation of leaves and flowers have been identified by NAIST researchers. Understanding these complex systems involved in plant development could contribute to advances in plant breeding and genetic engineering of benefit to agriculture and horticulture.

> **"Our findings enable us to manipulate plant development, including organ growth orientation and plant architecture."**

As we watch plants grow and buds form and then develop into leaves and flowers, we can't fail to be impressed by the neatly ordered and beautiful structures created by the hidden chemistry within. Masahiko Furutani and colleagues at the NAIST Graduate School of Biological Sciences investigated the ebb and flow of chemicals that create the impressive botanical architectures we can all admire. They have worked with *Arabidopsis*, small flowering plants widely used as model organisms to investigate plant genetics and genetic engineering (see figure). "The molecular mechanisms that control these dynamic changes were unknown," says Furutani.

The researchers did know that the formation of *Arabidopsis* leaves and flowers is triggered by localised accumulations of auxin, a small and relatively simple plant growth factor or plant hormone. The development of organs such as the parts of a flower are initiated in a spiral manner in the outer layers of the region of undifferentiated tissue at the tip of a growing shoot, known as the meristem. Furutani and his colleagues found that a family of genes known as the MAB4 genes promote organ development by establishing a downwards flow of auxin[1]. This involved the creation of an 'auxin sink' mechanism to promote the localised removal of auxin needed to generate the necessary gradients in auxin concentration. The crucial role of MAB4 genes in establishing the auxin sink is one of the key insights from this research.

The actual flow of auxin from cell to cell is mediated by carrier proteins embedded in the cell membranes, known as PIN proteins. The Furutani's team investigated the role of these proteins in the auxin gradients, and the mutual interactions among auxin, the MAB4 genes and the PIN proteins. Their findings allowed them to propose a new model to describe the details of auxin gradient formation and auxin transport during organ formation in the plants.

Although focused on *Arabidopsis*, the research is likely to have wider relevance for understanding plant development in general. "Our findings enable us to manipulate plant development, including organ growth orientation and plant architecture," says Furutani, explaining the ultimate motivation for unravelling these complex molecular interactions.

Reference

1. Furutani, M., Nakano, Y. & Tasaka, M. MAB4-induced auxin sink generates local auxin gradients in *Arabidopsis* organ formation. *Proceedings of the National Academy of Sciences of the United States of America* **111,** 1198–1203 (2013).

More information about the group's research can be found at the Plant Morphological Dynamics webpage:
http://bsw3.naist.jp/eng/courses/courses106.html