DEPARTMENT OF BIOENVIRONMENTAL RESEARCH II

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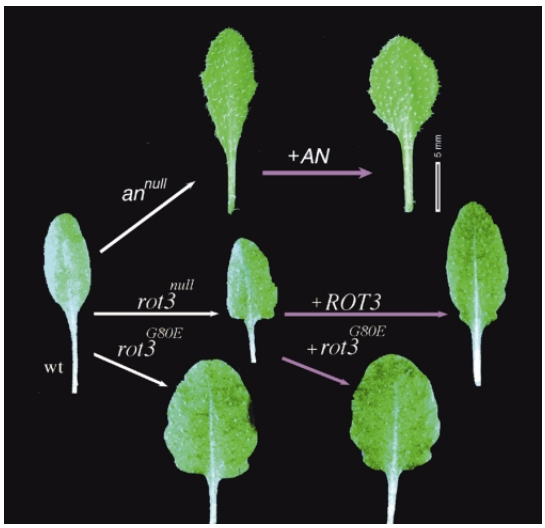
Diversity of plant form is mostly attributable to variation of leaf and floral organs, which are modified, leaves. The leaf is the fundamental unit of the shoot system, which is composed with leaf and stem. So the leaf is the key organ for a full understanding of plant morphogenesis. However, the genetic control of development of these shapes had remained unclear. Recently, studies of leaf morphogenesis has been in a turning point, after our successful application of the techniques of developmental and molecular genetics to it, using model plants, *Arabidopsis thaliana* (L.) Heynh. Our purpose is to understand Plants from view point of molecular genetic control of leaf morphogenesis.

Focusing on mechanisms that govern polarized growth of leaves in a model plant, *Arabidopsis thaliana*, we found that the two genes act independently to each other on the processes of polar growth of leaves: the *AN* gene regulates width of leaves and the *ROT3* gene regulates length of leaves. The *AN* gene controls the width of leaf blades and the *ROT3* gene controls length. The *AN* gene seems to control orientation of cortical microtubules in leaf cells. Cloning of the *AN* gene revealed that the gene is a member of gene family found from animal kingdom (Tsukaya et al., in prep). The *ROT3* gene was cloned by us in 1998. Transgenic experiments proved that the *ROT3* gene regulates leaf-length without affect on leaf-width (Kim et al., 1999). We are trying to identify molecular function of the above genes which are essential for leaf morphogenesis.

While *ROT3* regulates the length of both leaf blades and petioles, *ACL2* appears to regulate petiole length exclusively. Genes for perception of environmental stimuli such as light and/or phytohormone perception also affect the petiole length relative to the length of the leaf blade. Genetic studies suggested that petioles and leaf blades share some regulatory pathways but petioles also have their own developmental programs that are independent of those of leaf blades (Tsukaya and Kim, submitted).



Apart from polar elongation, we identified the following genes involved in leaf expansion process. The *AS1* and *AS2* genes are needed for proportional growth of the leaf. Molecular and anatomical analysis of the *as2* mutant is now underway, in collaboration with Prof. Machida, Nagoya University (Endang et al., submitted).

On the other hand, we are trying to identify molecular mechanisms which distinguish developmental pathway of leaves from that of shoots. For such purposes, we introduced tropical plants having queer developmental program for leaf morphogenesis, namely, *Chisocheton*, *Guarea* and *Monophyllaea*, as materials for molecular studies.

In addition, we are interested in roles of such genes for environmental adaptation, from view point of biodiversity. Leaf index, relative length of leaf to width, is one of the most diverse factor of leaf shape. For instance, rheophytes are characterized by narrow leaves, which represent an adaptation to their habitats. Are *AN* and *ROT3* genes are involved in regulation of adaptive change of leaf index in natural condition? Are these genes the responsible for evolution of rheophytes? So called “Evo/Devo” study of leaf morphogenesis is also one of our research project in NIBB.

Publication List:

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