December 4, 2007

Dwarf plant provides insights into cellular development

Researchers have clarified the mechanism behind what makes a plant grows to full size by determining what makes one dwarf plant so small.

Scientists in an international project, including researchers at RIKEN's Plant Science Center in Yokohama, have found evidence that a monitoring mechanism within plant cells acts to slow or shut down the 'factory' processes that allow it to multiply, grow and produce nutrients, if damage has occurred to the plant's DNA.

Published in *The Plant Cell* journal, their research presents fresh and provocative insights into how plant cells function in the early stages of cell division and development. Unlocking these secrets is a long-sought goal of plant scientists in their century-long search for ways to develop more productive, hardier, and disease- and insect-resistant plants.

To find out how a plant grows to full size, the researchers turned their attention to a previously identified mutant strain of one of the most-studied plants in genetic science, *Arabidopsis thaliana*, or Thale Cress, a small flowering plant that is widely used as a model organism in plant biology. As the 'fruit fly' of the plant world, geneticists have long studied *A. thaliana* as a means to understand and describe genetic processes considered common to plants in general. Intuiting that if they could figure out what made the dwarf mutant as much as 75% smaller than normal, the researchers believed that they could clarify the molecular and cellular processes that control plant cell development.

By isolating and then manipulating the expression of a particular DNA damage-linked protein they found that they could largely turn on and off the plant's dwarfism characteristics. This revealed to them, they said, that a close link exists between cell size and 'ploidy' (the number of matched sets of chromosomes in an individual cell) with clear evidence that cell expansion is a result of an increase in ploidy during early cell development. In other words, a plant's reaching normal size is the result of key genetic factors combined with the plant's ability to 'know' when its DNA has been damaged.
Analysis revealed that the expression level of several DNA-damage response genes was two to nine times higher in the mutant strain compared with normal seedlings.

Expanding on previously published research, the researchers noted that the duration of cell proliferation during plant organ development appeared to be a primary factor in determining the ultimate size. They pointed out that the primary defect in the dwarf strain of *A. thaliana* was in cell expansion rather than in cell proliferation and that this is associated with a failure in the normal progression of cell development. One of the previously unreported findings of their study was the way in which the growth is mediated by several independent genetic processes that either promote or terminate cell development. In the case of the dwarf plant, this includes arresting growth through DNA monitoring well before normal size could be reached.

The study was reported this week by a research team including at RIKEN's Plant Science Center in Yokohama, with cooperation by researchers in Japan, the U.S. and the U.K. Published in *The Plant Cell*, a peer-reviewed journal of the American Society of Plant Biologists, the study can be viewed online at http://www.plantcell.org.

**Original work:**
BIN4, a novel component of the plant DNA Topoisomerase VI complex, is required for endoreduplication in *Arabidopsis*. *The Plant Cell*, published online on Dec. 4, 2007

For more information, please contact:

RIKEN Public Relations Office
Email: koho@riken.jp