

Death of pollen tetrads caused by chromosomal rearrangement

Y. Kazama,^{*1} H. Abe,^{*1} K. Ishii,^{*1} M. Sato,^{*2} T. Hirano,^{*3} K. Toyooka,^{*2} and T. Abe^{*1}

Chromosomal rearrangements can be induced with high efficiency by using high-LET irradiation.¹⁾ They are considered one of the important mutations during evolution, because chromosomal rearrangements can affect the gene expression patterns.²⁾ On the other hand, they sometimes cause a defect in the inheritance of chromosomes, because of the loss of a large set of essential genes (Fig. 1).

To observe such a defect of chromosome inheritance, we used an *Arabidopsis* T-DNA tagging mutant (SALK_123114), which was provided by the Arabidop-

sis Bio-Resource Center (ABRC). A whole genome analysis followed by the mutation detection with AMAP³⁾ revealed a reciprocal translocation between chromosome 1 and 2 in this mutant (Fig. 1). The T-DNA was inserted in the junction region. We crossed this mutant with another mutant (SALK_056345) to trace the inheritance of the chromosome by inserting T-DNA in chromosome 2 of SALK_056345. In the F2 generation, we detected only three types of chromosomes, namely wild type, F1 type, and SALK_123114 type (Fig. 1), and no double mutant had both T-DNA. This result indicates that half of the zygote would be dead in the F1 plants. Indeed, about half of the pollens in the anthers of F1 plants were dead (data not shown), and about half of the seeds in siliques could not mature in the F1 plants (data not shown), indicating that cell death occurred in both pollen and egg developments.

From the whole genome mutation analysis, cells having pairs of a non-translocated chromosome and a translocated chromosome were expected to be dead during the development of pollens and eggs due to the loss of large sets of genes. One pair lacked a part of chromosome 2, which contains 1,734,820 bp. The other pair lacked a part of chromosome 1, which contains 5,804,110 bp. To determine the timing of the cell death, we observed the pollen development in the F1 plants. When TUNEL assay¹, which can detect fragmentation of the DNA generated during cell death, was performed, positive signals were detected in some of the tetrad cells in the F1 plants. This result indicates that the death of the pollen cells occurred just after meiosis.

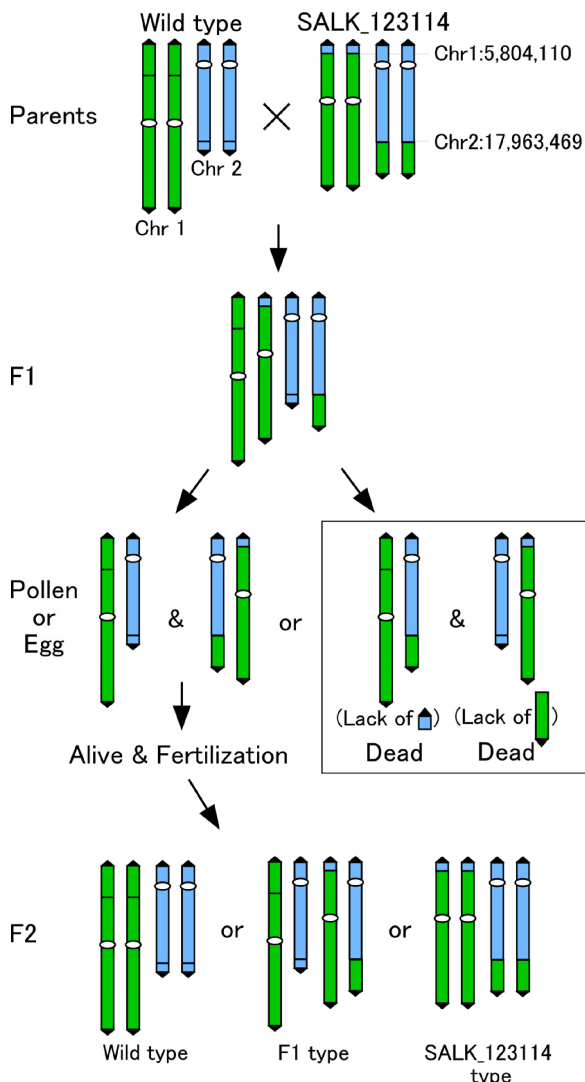


Fig. 1. Ideogram of cell death occurring due to the genetic cross of the rearrangement mutant.

^{*1} RIKEN Nishina Center

^{*2} RIKEN Center for Sustainable Resource Science

^{*3} Department of Agriculture, Miyazaki University

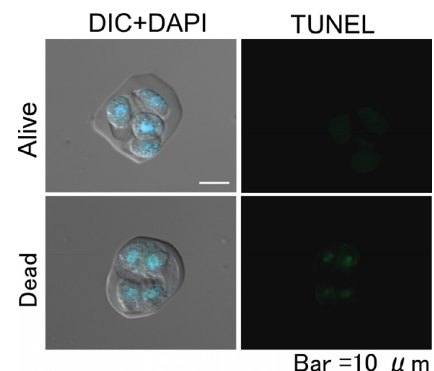


Fig. 2. Images of TUNEL assay in pollen tetrads.

References

- 1) Y. Kazama *et al.*, *Plant J.* **92**, 1020 (2017).
- 2) Y. Kazama *et al.*, *Cytologia* **83**, 125 (2018).
- 3) K. Ishii *et al.*, *Genes Genet. Syst.* **91**, 229 (2016).