

## Identification of fertility genes required for microgametogenesis in rice

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The process of microgametogenesis occurs within the developing pollen. It depends on two rounds of meiosis of microspore, and sporophytic functions provided by the surrounding anther tissues. Employing our rice T-DNA insertional mutant library, we identified three mutants exhibit a phenotype of completely sterile compared with their wild types. Genetic analysis of those mutants revealed that the T-DNA insertion tag co-segregated with the sterility phenotype. Two genes, *PAIR3* and *OsRPA1a*, play essential roles in DNA metabolism during meiosis process; and another gene *OsAPI5*, is required for tapetal cell degeneration and pollen development. *PAIR3* encodes a protein that contains putative coiled-coil motifs, and plays a crucial role in homologous chromosome pairing and synapsis in meiosis. During meiotic prophase I, the *pair3* mutant fails in homologous chromosome pairing and synapsis, resulting in no formation of bivalents and subsequent random segregation of the univalents in anaphase I. *RPA1a*, a subunit of Replication protein A (RPA), is highly conserved single-stranded DNA-binding protein in eukaryotes. Mutation in *OsRPA1a* exhibits abnormal chromosomal fragmentation occurred in male meiocytes after anaphase I. Further study identified that the leaves of *OsRPA1a* were hypersensitive to DNA mutagens, suggesting that *OsRPA1a* plays an essential role in DNA repair but may not participate in, or at least is dispensable for, DNA replication and homologous recombination in rice. Recently, we examined the role of *OsAPI5*, a homolog of animal antiapoptosis proteins, in the degeneration of the tapetum during the formation of male gametophytes in rice. Mutation in *OsAPI5* results in delayed degeneration of the tapetum due to inhibition of the tapetal programmed cell death process leading to defects in formation of male gametophytes. *OsAPI5* is a nuclear protein that interacts with two DEAD-box ATP-dependent RNA helicases, *AIP1* and *AIP2* (for *API5* INTERACTING PROTEIN 1 AND 2). *OsAIP1* and *AIP2* can form dimers and interact directly with the promoter region of *CPI*, a rice cysteine protease gene. Suppression of *OsAIP1/2* leads to down-regulation of *CPI* resulting in sterility, which is highly similar to the effects of suppressed expression of *OsCPI*. Our results uncover a previously unknown pathway for regulating programmed cell death during tapetum degeneration in rice, one that may be conserved among eukaryotic organisms.