DOCTORAL THESIS

Gametogenesis and flower development controlled by AtAnamorsin1 and AtPUB4

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Gametogenesis and Flower Development Controlled by AtAnamorsin1 and AtPUB4

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Declaration

I hereby declare that this thesis represents my own work which has been done after registration for the degree of Ph.D at Hong Kong Baptist University, and has not been previously included in a thesis, dissertation submitted to this or other institution for a degree, diploma or other qualification.

Signature: _____

Date: January 2015

Abstract

Flowers are the organs for sexual reproduction in angiosperms. Gametogenesis in floral organs leads to formation of sperms and eggs and their fertilization forms a zygote that develops into a new plant. Gametogenesis and embryogenesis involve precisely regulated biological processes controlled by complex networks of genes and pathways.

In this study, AtANA1, which was identified as a redox sensitive protein in previous study, was found to be essential for embryogenesis and also plays an important role in both male and female gametogenesis. Without a functional AtANA1, embryo development is arrested after the first cell division of the zygote. The ana1 mutation also causes arrest in different steps of male and female gametogenesis. Aborting pollen and embryos caused by the ana1 mutation exhibit enhanced accumulation of reactive oxygen species and DNA fragmentation, marks of programmed cell death. Presence of aborting *ana1* pollen was also found to lead to abortion of wild type pollen in the same anther, raising a possibility that the aborting ana1 pollen might release a death signal. ANA1 could be involved in an oxidative stress signaling pathway, and loss of its function triggers death of gametophytic and embryonic cells.

Another important protein involved in Arabidopsis reproductive processes is PUB4, an E3 ubiquitin ligase. The *pub4* mutation was previously found to cause abnormal enlargement of tapetal cells and incomplete degeneration of the tapetum layer, resulting in a defect in pollen release and conditional male sterility. In this study, we characterized PUB4's role in controlling floral meristem determinacy. The *pub4* mutation causes formation of ectopic floral organs inside of carpels/siliques. It was found that the *pub4* mutation leads to ectopic expression of *WUSCHEL*, an important regulator which is essential for maintaining shoot apical meristem and floral meristem, which could be responsible for the flower-in-flower phenotype. PUB4 appears to work additively with AGAMOUS (AG) to control appropriate expression of the *WUS* gene. Three extra large G proteins (XLGs) in *Arabidopsis*, which interact with PUB4, also play roles in controlling tapetal cell enlargement and degeneration. However, XLGs might not function in floral meristem determinacy.

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