

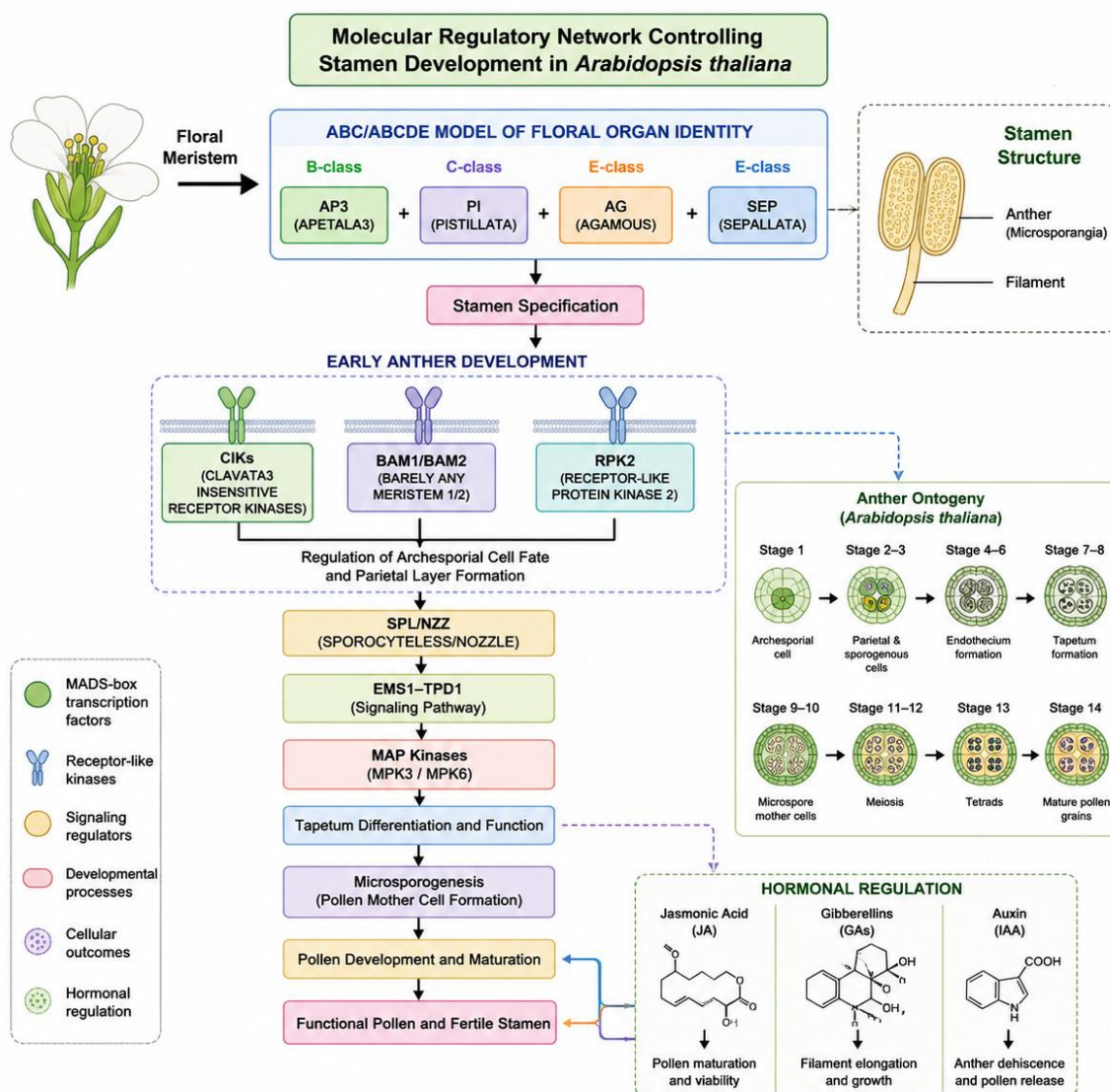


Figure 1 Molecular regulatory network controlling stamen development in *Arabidopsis thaliana*

Image caption: Floral organ identity is established through the coordinated activities of the ABC/ABCDE floral homeotic genes, including APETALA3 (AP3), PISTILLATA (PI), AGAMOUS (AG), and SEPALLATA (SEP). Early anther development is regulated by receptor-like kinases (CIKs, BAM1/BAM2, and RPK2) that control archesporial cell specification and anther patterning. Subsequent activation of the SPL/NZZ, EMS1-TPD1, and MAPK (MPK3/MPK6) signaling pathways promotes tapetum differentiation and microsporogenesis. Plant hormones, including jasmonic acid (JA), gibberellins (GAs), and auxin (IAA), regulate pollen maturation, filament elongation, and anther dehiscence, ultimately leading to the formation of functional pollen and male fertility. The diagram summarizes the major molecular and hormonal regulatory pathways described in this review

## 2.2 Stages of anther development in *Arabidopsis thaliana*

Previous developmental studies have shown that anther development in *Arabidopsis thaliana* proceeds through fourteen distinct stages characterized by sequential cellular and morphological changes. Early stages (1~5) involve the formation of anther primordia and differentiation of archesporial cells into primary sporogenous and parietal cells. Intermediate stages (6~8) are characterized by meiosis of microspore mother cells and tetrad formation, followed by release of microspores. Late stages (9~14) include pollen maturation and anther dehiscence, completing the reproductive process (Owen and Makaroff, 1995; Sanders et al., 1999; Ma, 2005).

## 2.3 Role of receptor-like kinases in early anther development

Accumulated evidence indicates that CLAVATA3 INSENSITIVE RECEPTOR KINASEs (CIKs), BARELY ANY MERISTEM (BAM1/BAM2), and RECEPTOR-LIKE PROTEIN KINASE2 (RPK2) play essential roles in early