

genetics, functional genomics, and comparative evolutionary studies will strengthen our understanding of male reproductive development and support sustainable agricultural production under changing environmental conditions.

5 Materials and Methods

5.1 Literature survey and data sources

The present study is based on a comprehensive review of published literature related to stamen and anther development in angiosperms. Peer-reviewed research articles, review papers, and experimental studies were collected from standard scientific databases, including Google Scholar, PubMed, and Web of Science. Emphasis was placed on studies involving *Arabidopsis thaliana* as a model system, along with comparative data from other plant species such as *Salvia* and *Gerbera*.

5.2 Selection criteria

Relevant studies were selected based on their focus on:

- Floral organ identity and the ABC/ABCDE model
- Genetic regulation of stamen development
- Anther ontogeny and cellular differentiation
- Role of receptor-like kinases and transcription factors
- Hormonal regulation of reproductive development

Only studies providing clear experimental evidence on gene function, signaling pathways, and developmental processes were included.

5.3 Data extraction and organization

Information from selected studies was systematically extracted and categorized into key thematic areas, including:

- Floral organ identity genes (A, B, C, D, E classes)
- Stages of anther development
- Molecular regulators (e.g., SPL/NZZ, EMS1, BAM1/2, RPK2, CIKs)
- Signaling pathways (MAP kinase pathways, receptor kinase signaling)
- Hormonal regulation (jasmonic acid, gibberellins, auxins)

The extracted data were organized to establish a logical sequence from early stamen specification to late-stage pollen development.

5.4 Comparative analysis

Comparative evaluation was performed across different plant species to identify conserved and divergent mechanisms of stamen development. Gene expression patterns and functional studies in *Arabidopsis*, *Salvia*, and *Gerbera* were analyzed to highlight evolutionary conservation and species-specific variations.

5.5 Synthesis of information

The collected data were critically analyzed and integrated to construct a unified framework describing the molecular and genetic regulation of stamen development. Special attention was given to linking classical genetic models (ABC model) with recent findings in signaling pathways and genomics.

5.6 Limitations

As this study is based on previously published data, no new experimental work was conducted. The conclusions are therefore dependent on the accuracy and scope of the cited literature.