

Fruit Dehiscence Patterns in Different Species of *Sesamum*

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Abstract: Fruit dehiscence is a crucial morphological and evolutionary trait influencing seed dispersal, yield efficiency, and domestication in oilseed crops. In the genus *Sesamum*, species exhibit diverse dehiscence mechanisms ranging from completely dehiscent to partially or indehiscent capsules. This study investigates fruit dehiscence patterns across six *Sesamum* species—*S. indicum*, *S. alatum*, *S. radiatum*, *S. angustifolium*, *S. capense*, and *S. schinzianum*—to characterize variation in capsule morphology, dehiscence type, and associated anatomical adaptations. Morphological and anatomical analyses revealed three major dehiscence patterns: complete loculicidal dehiscence (*S. alatum*, *S. capense*), partial apical dehiscence (*S. indicum*, *S. radiatum*), and indehiscent or tardily dehiscent capsules (*S. angustifolium*, *S. schinzianum*). The degree of lignification in the endocarp and the arrangement of dehiscence zones were strongly correlated with the mode of capsule opening. These findings contribute to understanding the evolutionary adaptations within *Sesamum* and have implications for breeding programs aimed at reducing seed loss in cultivated sesame.

Keywords: *Sesamum*, fruit dehiscence, capsule anatomy, seed dispersal, domestication

1. Introduction

Fruit dehiscence, the natural splitting of a mature fruit to release seeds, represents a key evolutionary innovation among angiosperms, allowing efficient propagation and adaptation to diverse ecological niches. The genus *Sesamum* (Pedaliaceae) comprises approximately 20 species distributed across Africa and Asia, many of which exhibit distinct capsule morphologies and dehiscence patterns.

The cultivated species, *Sesamum indicum* L., is one of the oldest oilseed crops, known for its high oil content and nutritional value. However, seed loss due to premature capsule splitting remains a major agronomic concern. Understanding the diversity and anatomical basis of dehiscence among wild and cultivated *Sesamum* species can provide insights into the domestication process and guide genetic improvement.

This study aims to (i) describe morphological and anatomical variations in fruit dehiscence across selected *Sesamum* species, (ii) identify structural features related to dehiscence mechanisms, and (iii) discuss the evolutionary significance of these patterns.

2. Materials and Methods

2.1 Plant Material

Mature fruits of six *Sesamum* species (*S. indicum*, *S. alatum*, *S. radiatum*, *S. angustifolium*, *S. capense*, and *S. schinzianum*) were collected from the germplasm collection maintained at [Institution Name]. Identification was confirmed using herbarium specimens and standard floras.

2.2 Morphological Observations

Fresh and dried capsules were examined for:

- Capsule length, width, and number of locules
- Nature and number of dehiscence sutures
- Mode and extent of fruit opening
- Position of seed release (apical/basal)

Digital callipers and a stereomicroscope were used for measurements and photographic documentation.

2.3 Anatomical Studies

Transverse and longitudinal sections were prepared from mature capsules fixed in FAA solution. Sections were stained with safranin and fast green, mounted in glycerine, and examined under a compound microscope. Special attention was given to:

- Thickness of pericarp layers
- Presence and distribution of lignified tissues
- Structure of dehiscence zones along the sutures

2.4 Data Analysis

Quantitative data were analyzed using descriptive statistics, and morphological traits were compared among species using cluster analysis to infer relationships based on dehiscence characteristics.

3. Results

3.1 Morphological Diversity of Capsules

Capsules varied significantly in size, shape, and degree of dehiscence.

- *S. indicum* and *S. radiatum* produced 4-locular, oblong capsules with partial apical dehiscence.
- *S. alatum* and *S. capense* had slender, completely dehiscent capsules that split along the full length of each locule.

- *S. angustifolium* and *S. schinzianum* exhibited indehiscent capsules with thickened pericarp walls.

3.2 Dehiscence Mechanisms

Three distinct patterns were observed:

1. **Complete loculicidal dehiscence** – sutures extend from base to apex; entire capsule opens (*S. alatum*, *S. capense*).
2. **Partial apical dehiscence** – only apical portions split, seeds released gradually (*S. indicum*, *S. radiatum*).
3. **Indehiscence or tardy dehiscence** – fruits remain intact or open post-maturity under mechanical stress (*S. angustifolium*, *S. schinzianum*).

3.3 Anatomical Features

In dehiscent species, the pericarp showed a well-developed lignified endocarp and a distinct dehiscence zone composed of thin-walled parenchyma cells. In contrast, indehiscent capsules had continuous lignification across sutures, preventing splitting. The vascular bundles near sutures were more prominent in dehiscent types, facilitating mechanical tension for capsule opening.

4. Discussion

Variation in fruit dehiscence among *Sesamum* species reflects both ecological adaptation and evolutionary divergence. The reduction of dehiscence, as seen in *S. indicum*, is likely a domestication trait selected for reduced seed loss during harvest. Similar trends have been reported in other oilseed crops, including *Brassica napus* and *Glycine max*.

The anatomical differentiation of dehiscence zones and lignified layers suggests that mechanical stress distribution plays a central role in capsule splitting. Evolutionary shifts toward indehiscence may represent an adaptation to human cultivation and seed retention.

5. Conclusion

The present study demonstrates that *Sesamum* species exhibit three principal dehiscence types—complete, partial, and indehiscent—correlated with pericarp structure and lignification patterns. These variations hold taxonomic, evolutionary, and agronomic significance. Breeding programs may exploit the naturally indehiscent or semi-dehiscent species to develop high-yielding sesame varieties with reduced seed shattering.

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