

## CHARLES DARWIN'S "ABOMINABLE MYSTERY" – SCIENCE & TECHNOLOGY

**NEWS:** A recent paper published in Nature Plants by the CSIR-Centre for Cellular and Molecular Biology (CCMB), Hyderabad sheds light on the molecular innovations in flowering plants that could solve Charles Darwin's "abominable mystery" question.

- The study described the role of a newfound gene called SHUKR (meaning 'sperm' in many Indian languages) and its effect on the plant *Arabidopsis thaliana*.

### WHAT'S IN THE NEWS?

#### What is the SHUKR Gene?

- **Location:** The SHUKR gene is found in the **sporophyte phase** of flowering plants, which is the dominant and most visible phase in their life cycle.
- **Function:** It **regulates the development of pollen**, which contains the sperm cells required for plant reproduction.
- **Evolutionary Origin:** The SHUKR gene **first emerged in eudicots** approximately **125 million years ago**. Eudicots represent **75% of all flowering plant species**.

#### Role in Pollen Development

- **Previous Belief:** Scientists earlier assumed that **pollen (gametophyte)** development occurred **independently** of the **sporophyte**.
- **New Understanding:** The study has shown that the **sporophyte directly influences** the development of **gametophytes (pollen)**, overturning long-held assumptions.
- **Regulatory Function:** SHUKR regulates a set of **F-box genes** in pollen, which are critical for **pollen viability and function**.
- **Impact of Mutation:** When the SHUKR gene is **non-functional or absent**, flowers **fail to produce viable pollen**, leading to reproductive failure.

#### Evolutionary and Adaptive Significance

- **Rapid Evolution:** Both the **SHUKR gene** and the **F-box genes it controls** are evolving **very rapidly** compared to other plant genes.
- **Environmental Adaptation:** This rapid evolution has helped **eudicots adapt to diverse environmental conditions** by enabling variability in pollen traits.
- **Broader Adaptation:** This gene-driven adaptability has also supported the **development of other critical plant features** such as:
  - Robust **root systems**

- Advanced **vascular tissues** for nutrient and water transport
- Complex **flower-pollinator interaction strategies**

### Scientific Importance

- **Darwin’s “Abominable Mystery”:** Charles Darwin was puzzled by the **sudden appearance and diversification** of flowering plants around 130 million years ago. This study provides **genetic insight** into that rapid evolution.
- **Understanding Plant Reproduction:** Demonstrates how a **sporophyte can precondition gametophyte traits**, offering a new angle in plant reproductive biology.

### Future Applications

- **Climate Resilience:** Insights from SHUKR can guide research on how plants can be **genetically conditioned** to survive in **harsh climates**, including salinity, drought, and heat stress.
- **Plant Engineering:** Potential for **engineering pollen development** through **environment-specific sporophyte conditioning**, thereby improving:
  - Fertility
  - Seed production
  - Environmental resilience
- **Crop Improvement:** By understanding and manipulating SHUKR and its associated genes, scientists could **naturally enhance plant fitness** without transgenic interventions.

### Life Cycle Context in Land Plants

- **Alternation of Generations:** Flowering plants have a life cycle alternating between:
  - **Gametophyte phase:** Produces **haploid gametes** (sperm and egg) with a **single set of genes**.
  - **Sporophyte phase:** Results from **fusion of gametes** and carries **two sets of genes** (diploid). It is responsible for **spore production** through meiosis.
- **Role of Pollen:** Male gametophytes (**pollen grains**) are developed inside the sporophyte, and are crucial for **sexual reproduction** via fertilization.
- **Seed Formation:** Fertilization of egg by sperm leads to the formation of **seeds**, which grow into new **sporophyte plants**.

Source: <https://www.thehindu.com/sci-tech/science/ccmb-team-finds-clues-to-darwins-abominable-mystery-in-common-plant/article69645173.ece>