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Pollination Secrets Behind Profitable Dragon Fruit Farming

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Dragon fruit (*Hylocereus spp.*), popularly known as the "Queen of the Night", is an emerging high-value fruit crop in India with increasing cultivation in semi-arid regions. Despite its commercial importance, information on pollination biology and the role of insect pollinators under Indian conditions remains limited. A farmer participatory research study funded by the National Bee Board was conducted in Karnataka during 2021–22 to investigate the floral biology, pollinator diversity and the impact of different modes of pollination on fruit yield and quality of dragon fruit. Two commercially important species, *Hylocereus undatus* (white flesh) and *Hylocereus polyrhizus* (pink flesh), were selected for the study. Detailed observations revealed that dragon fruit flowers are nocturnal, short-lived, and exhibit heterostyly, necessitating biotic agents for effective pollination. A total of fifteen floral visitor species were recorded, among which honeybees (*Apis dorsata*, *A. cerana*, *A. mellifera*, and *A. florea*) were the most frequent and efficient pollinators. Comparative evaluation of open, diurnal, nocturnal, hand pollination, and control treatments demonstrated that open and diurnal pollination significantly enhanced fruit set, fruit weight, quality attributes, and economic returns. The study highlights the critical role of honeybees in dragon fruit production and emphasizes the need for pollinator conservation and integration of beekeeping with dragon fruit cultivation for sustainable and profitable horticulture.

Keywords: Dragon fruit, pollination biology, pollinator diversity, effective pollination

Introduction

Dragon fruit (*Hylocereus spp.*), famously called the **"Queen of the Night"**, has rapidly transformed from an exotic curiosity into a highly profitable fruit crop in India. Introduced in the 1990s and now cultivated across several Indian states, dragon fruit offers farmers high returns but only when one invisible factor works efficiently: pollination. A National Bee Board–funded farmer participatory research study conducted in Karnataka clearly shows that pollinators, especially honeybees, play a decisive role in fruit set, fruit quality, and economic returns of dragon fruit cultivation.

Understanding the Crop: More Than Just a Cactus

Dragon fruit belongs to the family Cactaceae and thrives well in red loamy, red sandy, and gravel soils, while black soils need careful management to avoid cracking and waterlogging. Farmers in Karnataka mainly grow two commercial types:

- White-fleshed dragon fruit (*Hylocereus undatus*)
- Pink-fleshed dragon fruit (*Hylocereus polyrhizus*)

The crop is vegetatively propagated using 4-6 inch stem cuttings from healthy, disease-free mother plants. Plants are trained on stone or concrete poles fitted with plates, tyres, or steel structures to support heavy canopy growth. Proper training and top pruning during the vegetative phase ensures better branching and flowering.

A Flower That Blooms for Just One Night. Why Pollinators Are Essential?

Dragon fruit flowers are among the largest and most spectacular flowers in horticulture, but they are also short-lived. Although dragon fruit flowers are hermaphrodite, the study revealed strong heterostyly the stigma and anthers are positioned at different heights. This floral structure prevents effective self-pollination and makes biotic agents (insects) essential for pollen transfer.

The study recorded that:

- Floral buds appear in the third week of April
- Buds take 17–19 days to develop fully
- Flowers begin opening between 7:00–7:30 pm
- Full bloom occurs around 1:30 am
- Flowers start closing by 3:40 am and fully close by 11:30 am–12:00 noon
- Total flower life is only about 16 hours
- Anther dehiscence occurs around 2:00 pm
- Pollen becomes viable only after 5:00 pm
- Stigma receptivity begins around 11:00 pm and continues until flower closure
- Sepals of unopened buds secrete nectar, attracting insects even before flower opening

Because of this narrow window, successful pollination must happen quickly, efficiently and these features strongly favour insect-mediated cross-pollination.

Meet the Pollinators: Bees Lead the Team

The study documented 15 floral visitor species belonging to Hymenoptera, Lepidoptera, and Coleoptera. Among them, honeybees dominated in both frequency and efficiency. Key honeybee species recorded are *Apis dorsata* (giant honeybee), *Apis cerana* (black and yellow strains), *Apis mellifera* (European bee) and *Apis florea* (Little bee). These bees actively foraged for pollen and nectar during early morning hours, making repeated visits and effectively depositing pollen on stigma lobes. Other visitors included are Wasps (*Ropalidia marginata*) Ants (*Camponotus compressus*, *Tapinoma melanocephala*) Butterflies (*Tirumala* sp.) Beetles such as *Popillia*, *Mylabris*, and *Carpophilus* (the only nocturnal visitor) Interestingly, although dragon fruit is bat-pollinated in its native regions, no bats or moths were observed in Karnataka orchards.

Pollination Treatments: What Works Best?

To measure the real impact of pollinators, five pollination modes were compared:

1. Open pollination
2. Diurnal (day-time insect) pollination
3. Nocturnal pollination
4. Hand pollination
5. Control (no pollination)

The results clearly showed:

- Open pollination gave the highest fruit set, fruit weight, pulp quality, and market value
- Diurnal pollination alone produced yields almost equal to open pollination
- Nocturnal pollination contributed very little
- Control treatments resulted in poor fruit set and inferior fruits

Multiple Flowering Cycles, Continuous Opportunity

The study recorded Seven flowering phases per year in *H. undatus*, eight flowering phases per year in *H. polyrhizus*, 30–35 days from flowering to fruit harvest, 50–55 days from bud initiation to harvest. This extended flowering period makes managed pollination and bee conservation even more important.

Lessons for Farmers and Policymakers

- Dragon fruit is a pollinator-dependent crop
- Honeybees are irreplaceable natural farm workers
- Integrating beekeeping with dragon fruit orchards can dramatically improve yields

- Avoiding pesticide sprays during flowering is critical
- Pollinator-friendly farming is both ecologically and economically rewarding

Conclusion: Protect Bees, Prosper Better

Dragon fruit farming is not just about infrastructure and inputs — it is about working with nature. This study proves that bees silently decide the success of the harvest. Protecting pollinators and encouraging their activity can turn dragon fruit orchards into highly profitable and sustainable farming systems.

Healthy bees mean heavier fruits, better quality, and higher profits

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