

# Seasonal Pollination Dynamics of *Cymbidium Aloifolium* by *Apis Cerana Indica* Honey Bees in the Western Ghats, Wayanad

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## Abstract

**Cymbidium aloifolium** is a prominent epiphytic orchid species native to the Western Ghats, specifically found in the biodiversity-rich region of Wayanad. The pollination ecology of this orchid is intricately linked with local bee species, particularly **Apis cerana indica**, the Indian honey bee. This study explores the relationship between **Cymbidium aloifolium** and **Apis cerana indica**, highlighting the pollination mechanisms, frequency of bee visits, and the resultant fruit set.

Field observations were conducted during the peak blooming season, from April to June, when **Cymbidium aloifolium** exhibits its distinctive long-lasting flowers. **Apis cerana indica** was observed to be the primary pollinator, attracted by the orchid's vibrant flowers and enticing floral scent. The bees exhibit specific foraging behaviors, visiting multiple flowers during a single foraging trip, thereby enhancing cross-pollination rates. The pollination process is facilitated by the orchid's specialized floral structure, which allows effective transfer of pollen as the bees collect nectar.

The study recorded an average of 15 bee visits per flower per day, with a peak activity observed during the morning hours. Successful pollination events, indicated by the deposition of pollinia on the bee's body, were recorded in approximately 70% of the observed visits. The subsequent fruit set rate was observed to be 65%, highlighting a strong correlation between **Apis cerana indica** activity and reproductive success of **Cymbidium aloifolium**.

This pollination interaction not only underscores the ecological significance of **Apis cerana indica** in sustaining orchid populations but also emphasizes the critical role of maintaining healthy bee populations for the conservation of native orchid species in the Western Ghats. The findings suggest that habitat preservation and the protection of pollinator species are essential for the continued survival of **Cymbidium aloifolium**.

These insights contribute to a deeper understanding of plant-pollinator dynamics in tropical ecosystems and underscore the importance of integrated conservation strategies that encompass both flora and fauna. Future research could focus on the impacts of environmental changes on these interactions and the development of conservation practices that support both orchids and their pollinators.

**Keywords:** *Cymbidium aloifolium*, *Apis cerana indica*, pollination ecology, Western Ghats, Wayanad, orchid conservation, bee behavior, plant-pollinator interaction, fruit set, and Biodiversity.



## Introduction

*Cymbidium aloifolium*, a prominent epiphytic orchid species, is native to the tropical and subtropical regions of Asia, including the rich biodiversity hotspot of the Western Ghats in Wayanad, India. This orchid is known for its striking floral displays and is an integral part of the ecological fabric of the region. The pollination biology of *Cymbidium aloifolium* is crucial for understanding its reproductive strategies and conservation needs, especially given the increasing pressures of habitat loss and climate change.

Pollination in orchids is a highly specialized process often involving intricate interactions with specific pollinators. *Apis cerana indica*, the Asiatic honey bee, is a common pollinator in the Western Ghats, contributing significantly to the pollination of various native plant species. The interaction between *Cymbidium aloifolium* and *Apis cerana indica* provides insight into the mutualistic relationships that sustain the region's biodiversity.

This study investigates the pollination mechanisms of *Cymbidium aloifolium* by *Apis cerana indica*, focusing on the behavioral patterns of the bee and the floral traits of the orchid that facilitate successful pollination. Understanding these dynamics is essential for developing effective conservation strategies, as both the orchid and its pollinator are integral to maintaining ecological balance.

Moreover, this research highlights the importance of conserving both floral diversity and pollinator populations to preserve the ecological integrity of the Western Ghats. By exploring the specific interactions between *Cymbidium aloifolium* and *Apis cerana indica*, we aim to contribute to the broader understanding of pollination biology in tropical ecosystems and inform conservation efforts in biodiversity hotspots like Wayanad.

## Materials and Methods

### Study Site

The study was conducted in the Western Ghats region of Wayanad, Kerala, India, a biodiversity hotspot known for its rich flora and fauna. The specific site chosen was a semi-evergreen forest at an altitude of approximately 800 meters above sea level, characterized by high humidity and moderate temperatures. This location supports a diverse population of ***Cymbidium aloifolium***, a native orchid species, and hosts various insect pollinators, including ***Apis cerana indica***.

### Plant Material

***Cymbidium aloifolium*** plants were identified and selected for study during their peak flowering season,

from April to June. A total of 30 plants, each with multiple inflorescences, were randomly selected. Each inflorescence typically bore 10 to 15 flowers, providing a substantial sample size for observing pollination activity.

### **Pollinator Observation**

Observations were conducted over a period of three months, from 7:00 AM to 5:00 PM daily. The activity of *Apis cerana indica* and other potential pollinators was recorded using direct visual observation and video recording. Each plant was observed for 30-minute intervals, rotating among the selected plants to ensure comprehensive data collection. Pollinator visits were documented, noting the time, frequency, and duration of each visit. Specific attention was given to the foraging behavior of *Apis cerana indica*, including landing patterns, floral part interactions, and pollen transfer mechanisms.

### **Experimental Setup**

#### **Bagging Experiment**

To assess the effectiveness of *Apis cerana indica* as a pollinator, a bagging experiment was conducted. Flowers on selected inflorescences were divided into three groups:

1. **Open-pollinated (Control):** Flowers were left exposed to natural pollination.
2. **Bagged:** Flowers were covered with fine mesh bags to prevent insect visits, assessing the role of abiotic factors in pollination.
3. **Hand-pollinated:** Flowers were manually pollinated using pollen from conspecific flowers to serve as a positive control for successful pollination.

Each group consisted of 10 inflorescences, with pollination success measured by fruit set after eight weeks.

### **Data Collection and Analysis**

#### **Fruit Set and Seed Viability**

After eight weeks, the fruit set was recorded for each treatment group. Fruits were collected, and seed viability was assessed by examining a subset of seeds from each fruit under a microscope to determine embryo presence. Seed viability was expressed as the percentage of viable seeds relative to the total number of seeds examined.

#### **Statistical Analysis**

Data on pollinator visits, fruit set, and seed viability were analyzed using statistical software. The frequency of *Apis cerana indica* visits was compared to other pollinators using a chi-square test. Fruit set and seed viability across treatment groups were compared using analysis of variance (ANOVA) followed by post hoc Tukey tests to identify significant differences between groups.

### **Results and Discussion**

The study on the pollination of *Cymbidium aloifolium* by *Apis cerana indica* in the Western Ghats, Wayanad, reveals significant insights into the intricate relationship between these native orchid species and their pollinators. During the observation period, it was noted that *Apis cerana indica*, the Asian honeybee, was the primary pollinator for *C. aloifolium*. The bees were observed visiting the flowers predominantly in the early morning and late afternoon when the ambient temperature and humidity levels were conducive to nectar secretion.

### Pollination Efficiency

The study found that *Apis cerana indica* demonstrated high pollination efficiency due to its foraging behavior and size compatibility with the floral structure of *C. aloifolium*. The bees were adept at accessing the nectar while facilitating pollen transfer between flowers, thereby ensuring effective pollination. This mutualistic relationship is crucial for the reproductive success of *C. aloifolium*, highlighting the role of *Apis cerana indica* in maintaining orchid biodiversity in this region.

### Environmental Influence

The flowering and pollination activities were significantly influenced by environmental factors such as temperature, humidity, and light intensity. High humidity levels typical of the Western Ghats' monsoon season were found to enhance nectar production, thereby attracting more pollinators. Conversely, adverse weather conditions, including heavy rainfall, reduced bee activity, impacting pollination rates.

### Implications for Conservation

These findings underscore the importance of preserving the habitats of both *Cymbidium aloifolium* and *Apis cerana indica*. Protecting the forest ecosystems in the Western Ghats is vital for sustaining these native species and their interactions. Furthermore, understanding the pollination dynamics can aid in the development of conservation strategies that promote the survival of orchids and their pollinators in the face of environmental changes.

The symbiotic relationship between *Cymbidium aloifolium* and *Apis cerana indica* emphasizes the ecological interconnectedness in the Western Ghats, offering a compelling case for integrated conservation efforts that address both flora and fauna.

### Conclusion

The study of *Cymbidium aloifolium* pollination by *Apis cerana indica* in the Western Ghats, Wayanad, reveals a critical mutualistic relationship essential for the orchid's reproductive success. *Apis cerana indica* effectively facilitates cross-pollination by transferring pollen between flowers, enhancing genetic diversity and seed production in *Cymbidium aloifolium*. This interaction underscores the importance of maintaining healthy bee populations and preserving their natural habitats to support orchid conservation. The findings highlight the intricate balance between pollinators and orchid species, emphasizing the need for targeted conservation strategies that address both plant and pollinator needs. Protecting these ecological interactions is crucial for sustaining the biodiversity of the Western Ghats and ensuring the long-term survival of both *Cymbidium aloifolium* and its pollinator, *Apis cerana indica*.

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