

## Nesting site characteristics of stingless bees, *Trigona iridipennis* in Chalisgaon region, North Maharashtra, India

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### Abstract

The present study aimed to reveal the nesting behavioural p and their preference exhibited by an indigenous resident species of stingless bee, *Trigona iridipennis* at the Chalisgaon region in the North Maharashtra, India. During study, a total of 72 bee colonies were surveyed and observed the nesting preference which includes natural habitats, orientations of nest entrance, height of nest, guard bees. According to observations, the preference to construct colony is higher in stone wall cavities as compare to mud wall, tree cavities. The nest entrance in oval shape was maximum 37 (51.39%), followed by elliptical 23 (31.94%) and irregular shape 12 (16.67%). Over 55% of the nests favored northern and north-eastern orientations compared to other directions. The height of nesting from ground level up to 17 ft while the majority of nests were located at moderate heights in a range of 5-11 feet (49 nests). The length and width of hive entrance tube ranged from 0.3 cm to 4.8 cm and 0.2 cm to 1.6 cm, respectively. The number of guard stingless bee were observed at colony entrance ranged between 1 to 15 with an average of 5.9 bees.

**Keywords:** Stingless bees, *trigona iridipennis*, nesting patterns, nest sites, preferences

### Introduction

Stingless bees, also referred to as dammer or meliponine bees, are small social insects primarily found in tropical and subtropical areas worldwide<sup>[1]</sup>. They are part of the Apidae family, which also includes honey bees (*Apis*), bumblebees (*Bombus*), and orchid bees (*Euglossa*). These bees are highly eusocial and belong to the Meliponini tribe, distinguished by their reduced, nonfunctional sting, rendering them harmless to humans<sup>[1, 2]</sup>. The Meliponini tribe consists of two main genera: *Trigona* and *Melipona*. *Trigona* is the largest and most widespread genus, with over 130 species divided into several subgenera<sup>[1]</sup>. In contrast, the *Melipona* genus comprises about 50 species, mostly confined to the Neotropical region, where many are traditionally kept for honey production<sup>[3, 5]</sup>.

In the Indian subcontinent, *Trigona iridipennis* is among the most prevalent and ecologically important stingless-bee species. These bees form permanent colonies and show a strong preference for specific nesting sites, often found in dark, sheltered places like tree trunk cavities, hollow logs, cracks, crevices in old walls, stone structures, and sometimes underground<sup>[6]</sup>. The characteristics of nest entrances are unique to each species and are crucial for identifying stingless-bee species. These entrances differ in shape, size, length, orientation, and color, often serving as defensive structures against predators and competitors<sup>[1, 7, 8]</sup>. *Trigona iridipennis* is a key pollinator for a variety of wild and cultivated plants, especially those with small flowers and dense inflorescences<sup>[9]</sup>. Their small size and effective foraging behavior allow them to access floral resources unavailable to larger pollinators, thereby improving pollination efficiency and crop yields<sup>[10]</sup>. Their role is particularly crucial in agro-ecosystems where traditional pollinators may be declining. Numerous studies have highlighted that stingless bees are highly sensitive to microhabitat conditions, such as temperature, humidity, and the availability of resin sources needed for nest building<sup>[11]</sup>. As a result, a decrease in nesting substrates can lead to

lower colony density and reduced pollination services, especially in areas with intensive agriculture<sup>[12]</sup>. Therefore, documenting nesting site characteristics is vital not only for species identification but also for developing effective conservation and management strategies.

Although *T. iridipennis* holds significant ecological and economic value, research on its biology, nesting habits, and foraging behavior is still sparse, especially in Indian regions like Assam<sup>[13]</sup>, Karnataka<sup>[8, 14, 15]</sup>, Kerala<sup>[16]</sup> (Mohan and Devanesan, 1999), Kokan, Maharashtra<sup>[17]</sup>, North East India<sup>[18]</sup>, Tamilnadu<sup>[4, 6]</sup>. In North Maharashtra, particularly around Chalisgaon, there is a notable lack of systematic research on the nesting site characteristics and habitat preferences of *T. iridipennis*. This deficiency in localized information hinders effective conservation strategies and the advancement of stingless beekeeping (meliponiculture) as a sustainable agricultural practice in the area. In Chalisgaon, traditional agroforestry systems are practiced alongside modern agriculture, and such studies could facilitate the integration of stingless bee conservation with sustainable farming methods.

### Materials and methods

The research was conducted in Chalisgaon, located at 20.46° N and 74.99° E, with an elevation of roughly 344 meters (1129 feet) in Jalgaon district of Maharashtra. This area is situated near hills and lies along the Titur River, surrounded by wildlife forests.

An initial survey aimed to identify the nesting locations of *T. iridipennis* in areas influenced by human activity, specifically urban and semi-urban zones, which include residential neighborhoods, educational institutions, gardens, and warehouses. The nesting sites of the stingless bee (*T. iridipennis*) were observed using a straightforward observation sampling technique<sup>[7]</sup>. A survey table was created for the observations, detailing nest characteristics such as the location of nesting sites, measurements of nest entrances (including direction, length, diameter, and height

from the ground), shapes (oval, elliptical, or irregular), and color (brown, black, or light brown).

**Result and discussion**

The data presented in Table 1 indicate that the stingless bee *Trigona iridipennis* is widely distributed throughout the Chalisgaon region. The survey revealed that majority of recorded colonies were established in terrestrial shelters compared to the nests located in tree cavities. The terrestrial shelters included agricultural, residential, educational structures, gardens and godowns (Fig. 1). Among these, agricultural buildings such as farmhouses, cattle sheds, storage rooms, and boundary walls were identified as the most common nesting sites, followed by educational, residential structures, gardens and godowns (Fig. 2). The higher frequency of nests in agricultural structures may be attributed to reduced human disturbance, availability of suitable cavities, and proximity to floral resources in surrounding crop fields. Similar preferences for man-made structures have been documented in other regions, highlighting the adaptability of *T. iridipennis* to human-modified environments<sup>[8, 15]</sup>.

The nesting habitat preference of stingless bees in the Chalisgaon region was clearly inclined towards terrestrial shelters (wall cavities) rather than arboreal habitats such as tree hollows (Table 1). Out of the total 72 colonies recorded, 67 colonies (93.06%) were preferred terrestrial nesting while 5 colonies (6.94%) in tree cavities. This observation is consistent with earlier studies conducted in different parts of India, where *T. iridipennis* showed a strong tendency to occupy cavities in buildings and other artificial structures<sup>[14, 15, 19, 20]</sup>. The absence of tree cavity nests in the present study area may be linked to the scarcity of old trees with natural hollows, habitat alteration, and increasing urbanization, which force stingless bees to shift towards alternative nesting substrates.

Regarding nest height, colonies were recorded at elevations ranging from ground level upto 17 feet above ground (Fig. 3). The majority of nests were located at moderate heights in a range of 5-11 feet (49 nests), indicating a preference for easily accessible cavities near ground level as well as avoid any anthropological disturbance. These findings are in agreement with Danaraddi<sup>[14]</sup>, who reported that most stingless bee colonies in southern India were located at heights below 2 meters, possibly due to favorable microclimatic conditions and ease of colony expansion. Pavithra<sup>15</sup> had noticed that about 47% of nest located at an elevation range of 11-15 ft from the ground while 28% of nests were found at the range of 0–10 ft. It indicates that mid elevation preference for nesting is directly associated with the species richness.

The directions of stingless bee nest entrances showed variation at the nesting locations (Fig. 4). A larger percentage of nests faced North (30.56%), North-East (25%), South-West (16.67%), South (12.5%), North-West

(5.56%), West (4.17%), and East and South-East (2.78%) (Fig. 4). Over 55% of the nests favored northern and north-eastern orientations, likely due to beneficial microclimatic conditions, such as ideal sunlight exposure and protection from prevailing winds, which help maintain appropriate temperature and humidity within the nest. Pavithra<sup>15</sup> also observed a similar preference for northward directions within the 91° to 180° arc over other directions. However, other studies indicated that stingless bee colonies preferred nest entrances facing east, followed by those facing west, suggesting that the orientation of the entrance is crucial for colony regulation and survival<sup>[17, 21]</sup>.

Observations of nest entrance characteristics revealed notable variations in shape, colour, and construction materials. Most of the external entrance tubes were irregular followed by elliptical and oval in shape. The colour of nest entrances was predominantly blackish, followed by brownish and yellowish-brown shades. These variations may be influenced by the type of resin collected, environmental exposure, and age of the colony. The use of locally available materials reflects the behavioral flexibility and ecological adaptability of stingless bees<sup>[7, 12, 13, 15]</sup>.

According to Roubik<sup>[12]</sup>, the nest entrance might be oval, slit-like, round or irregular-shaped that may vary geographically in response to local environmental conditions. The analysis of entrance shape frequency revealed that colonies with oval (round) shaped entrances were dominant (37 colonies, 51.39%), followed by elliptical (23 colonies, 31.94%) and irregularly entrances (12 colonies, 16.67%). This variation in entrance morphology may represent species-specific defensive strategies and adaptations to cavity size and orientation. Earlier studies stated that the oval shape nest entrance is more preferred as compare to circular and irregular opening<sup>[13, 15, 17, 21]</sup>.

The length of the nest entrance tube ranged from 0.3–4.8 cm (avrg. 1.92 cm), while the width varied between 0.2–1.6 cm (avrg. 0.82 cm). Such variation in entrance dimensions may be influenced by colony age, cavity depth, and defensive requirements. Smaller entrances are often associated with increased protection against predators and parasites, whereas longer entrance tubes may serve as barriers against intruders and environmental stressors supported by earlier studies<sup>[10, 13]</sup>.

The number of guard bees present at the nest entrance showed noticeable variation among colonies (Table 1). The number of guard stingless bees observed at nest openings ranged from 1 to 15 individuals, with an average of 5.9 guard bees per colony. This variation may reflect differences in colony strength, age, and perceived threat levels at different nesting sites. The present findings are comparable with Jayalekshmi (2015), who reported an average of 6.0 to 9.0 guard bees per colony in *T. iridipennis*. The presence of guard bees at the nest entrance highlights their role in colony defense and nest protection, which is a key behavioral adaptation of stingless bees.

**Table 1:** Variation in nest architectur and site preference of stingless bee

Sr. No.	Parameters	Sub-parameters	Most preferred
1.	Nest Sites	1. Agricultural area 2. Residential area 3. Educational area	Agricultural area
2.	Habitat	1. Wall (Mud, Stone, Brick) 2. Window crevices (wooden)	Stone, mud
3.	Entrance direction	Direction (N, W, E, W, NE, SW, NW, SE)	North

4.	Nest height from ground	Height (from ground) in feet	0 to 15 feet
5.	Shape of nest entrance	oval, elliptical, irregular	oval
6.	Size of nest entrance	Length (in cm) Breadth (in cm)	0.3 to 4 cm 0.2 to 5 cm
7.	Colour of nest entrance	Reddish, brown, grey, blackish, yellowish-brown	blackish
8.	No. of Guard bees	Guard bees at the entrance	1-15

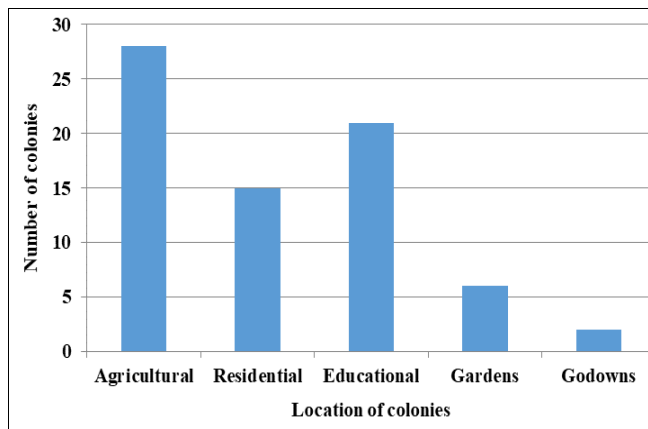


Fig 2: Colonies found in the study area

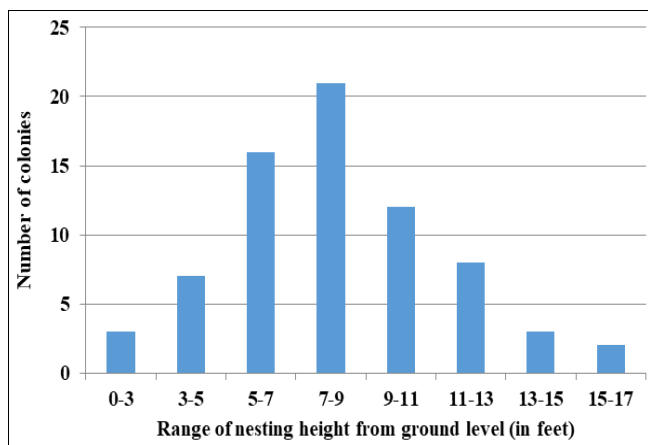


Fig 3: Range of nest height from ground level

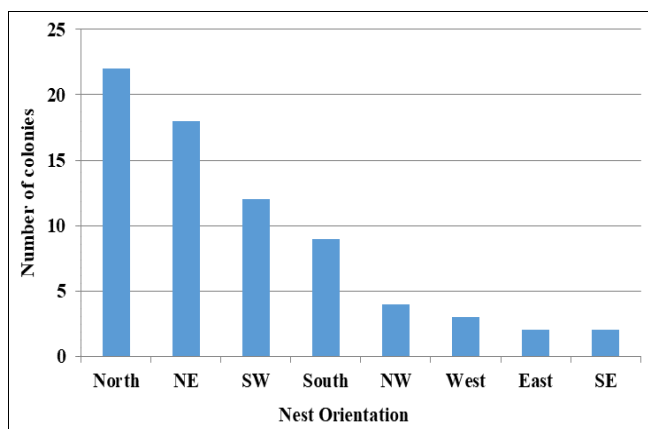


Fig 4: Direction of nest entrance

**Conclusion**

The findings reveal that *T. iridipennis* in the Chalisingaon region demonstrates a pronounced preference for terrestrial, anthropogenic nesting sites, with a notable inclination towards stone wall cavities within agricultural landscapes. This preference represents an adaptive nesting strategy that facilitates the species' persistence and proliferation in considerable habitat alteration driven by agricultural

expansion and human activities. However, enhancing awareness among farmers and local communities regarding the ecological and economic significance of stingless bees, particularly their role in pollination services, is essential. Collectively, these efforts will substantially contribute to the long-term conservation of stingless bees in the region and augment their contributions to agricultural productivity and biodiversity conservation.

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