



Nesting structure of stingless bees, *Lophotrigona canifrons* Smith and *Tetragonula iridipennis* Smith (Hymenoptera: Apidae) in natural forests of Nagaland, India

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ABSTRACT: The nesting sites of two species of stingless bees were located in Medziphema and Punglwa village which fall under the Dimapur and Peren districts of Nagaland. The nest of *Lophotrigona canifrons* Smith is subterranean in nature constructed inside cavities below ground and that of *Tetragonula iridipennis* Smith is arboreal in nature constructed on tree trunks inside cavities. The length and width of the entrance tube of *T. irridipennis* measured 26mm in length, 22mm in width and the total length of the tube including the accessed tube that connected with the nest measured 70mm. The area of the honey in *T. irridipennis* was 80x60x50mm, with 112g stored honey and 0.72g individual honey pot. In the case of *L. canifrons* length of the entrance tube was 20 mm and width 15 mm for the underground nest-1 (UG-1); and for the UG-II, the length and width measured 10mm and 14mm respectively. The honey pots of *L. canifrons* were dark brown to black in colour just like that of pollen pots. For UG-I, the honey area was 100x65x59mm; with 127g honey and 0.78g single honey pot. Similarly, in UG-II the honey area was 70x62x55mm with 114g honey and 0.80g of a single honey pot. © 2022 Association for Advancement of Entomology

KEYWORDS: Nest architecture, entrance tube, brood cell, pollen pots, honey pots,

Stingless bees belong to the family Apidae and are close relatives of true honey bees, carpenter bees, orchid bees and bumble bees. Stingless bee is the smallest (4.0 to 5.0 mm long) of the honey bees living in social colonies which are perennial, shows polymorphism (queen, worker and males) with division of labour. They make their nests in dark places like empty logs, cavities in tree trunks, cracks and crevices in old walls etc., where the nest entrance mostly projects as an external tube (Roopa, 2000; Gajanan; 2005). They prefer closed structure for nesting rather than open space. One

major component of the stingless bee's nests is the excellent insulation made by propolis-structure called batumen, especially with the exposed nests. Nests in large trunks or in soils are particularly well insulated. Stingless bees also produce hive products like honey, pollen, bee wax and resins; they have been reported to be important pollinators of many crops in tropical and subtropical regions (Roubik, 1995). Stingless bees have been reported to be efficient pollinators of many crops and in almost sixty crops were efficiently pollinated by stingless bees (Heard, 1988). Studies on the nesting habit

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and nest structure of stingless bees is well documented in southern parts of India (Roopa, 2000; Gajanan *et al.*, 2005 and Danaraddi *et al.* 2009), however, it is still in infant phase in North eastern part of India. Hence, the present study has been formulated to know the details of nesting habits and nesting structure of *Lophotrigona canifrons* Smith a subterranean in nature constructed inside cavities below ground and that of *Tetragonula iridipennis* Smith in Nagaland.

The study was carried out at the Experimental farm AICRP Honey Bees and Pollinators, Department of Entomology, School of Agricultural Sciences and Rural Development (25° 75'961N, 93.853698°E), Medziphema under Dimapur district and at Punglwa (25°37'20"N; 93°50'14"E), under Peren district of Nagaland, India. The surveys were conducted to locate the arboreal nest of the stingless bee, *T. iridipennis* and underground nest of stingless bee, *L. canifrons* in all the natural vegetation in and around the University campus, Medziphema, Dimapur district and in Punglwa, Peren District during 2020-2021. The observations on natural nest architecture in two species of stingless bees were observed. Initially the activity of bees was recorded consecutively for three days at the nesting site and then the nest was extracted and brought to the laboratory for further studies. Nesting habit was studied based on shape, size and location of nest. Dimensions of the cavities, entrance length and width were recorded. The internal structure of the nest was studied by dissecting the colonies. The

nest characteristics *viz.*, area of pollen, honey and brood, their location in the nest, no. of brood/food cells per linear, weight of single pollen, honey and brood cells, were recorded.

Total of four colonies were located in the survey, two colonies each of *L. canifrons* in Punglwa, Peren district and *T. iridipennis* in Medziphema, Dimapur district. The first nest of *L. canifrons* was located nearby a stream in a forest area at the end of Punglwa village (N 25°39'22.05621''; E 93°51'31.83443''). The area was sloppy in nature with big trees. The underground nest I (UG-I) was located in between small shrubs at about 45cm below the ground level and was found in a hollow area with many stones. The size of the cavity was around 40x45x60cm. The nest was built inside the cavities, attached to the side walls through slight evaginations of the outer involucre. The second underground nest (UG-II) was located in a grassy area near to the Punglwa village (N 25°39'31.61152''; E 93°51'12.34298''). Similar to the previous nest, the nesting area was sloppy in nature and nested among stones but compactly within the cavity (Table 1, Fig. 1). As of *Tetragonula iridipennis*, two arboreal nest was found nested on a tree. However, due to the presence of one nest in a large tree, the insides of the nest could be studied only for one.

The shape of the two underground nests were somewhat elliptical to oval in shape and the colour of the nest was totally black (Fig. 2). It was covered

Table 1. Nesting habits of stingless bees- *Tetragonula iridipennis* Smith and *Lophotrigona canifrons* Smith

Nesting place	Height above/below ground (cm)	Cavity dimension (cm)	Nest dimension (cm)	Tube (mm)		Colour of entrance
				Width	Length	
<i>Tetragonula iridipennis</i>						
Tree trunk	274.6	22	26, 70	Creamy white
<i>Lophotrigona canifrons</i> (Subterranean)						
Nest—I	45	40x45x60	35x24x17	15	20	Black
Nest—II	38	43x38x45	31x27x19	14	10	Black



Fig. 1 Nesting site of *L. canifrons*



Fig. 2 Nest of *L. canifrons*



Fig. 3 Entrance tube of *L. canifrons*



Fig. 4 Entrance tube of *T. iridipennis*



Fig. 5 Internal structure of nest of *T. iridipennis*



Fig. 6 Brood cells of *L. canifrons*

Fig. 7 Pollen pots of *T. iridipennis*Fig. 8 Honey pot of *L. canifrons*Fig. 9 Honey pots of *T. iridipennis*

by a thick and multiple layer of involucrem or batumen which provided thick insulation to the colony. The colour of the entrance was black, circular in shape and the structure of the entrance was made up of sand and soil particles mixed with cerumen in the case of *L. canifrons* (Fig. 3). The entrance tubes exposed to the outside was very short for both the underground nest. The length and width of the entrance tube were 20 mm and 15 mm for the UG-I and 10mm and 14mm for UG-II, respectively. The entrance tube of *T. iridipennis* that was exposed to the outside measured 26mm in length, 22mm in width and the total length of the tube including the accessed tube that connected with the nest measured 70mm. The colour was creamy white in color with small brown specks and was very soft in texture (Fig. 4).

The internal colony structure consisted of brood area and food area in both nests (Table 2, Fig. 5). The brood cells of *L. canifrons* were oval in shape, light brown in colour and were smaller in size when compared to pollen and honey pots (Fig. 6). The brood cells were arranged in a loose manner and present in the middle, surrounded by pollen and honey pots on the sides and below it. The dimension of the brood cell of the UG-I measured (110x90x50mm) mm and the weight of the total brood was 159g with 0.0065g (mean of 10) weighed single brood cell. Similarly, in UG-II, area of brood cell was 170x118x70mm, total brood weight was 198g and single brood cell was 0.0066g respectively. The number of cells per linear cm (4) and per cubic cm (12) was recorded. As for the brood cell of *T. iridipennis*, the brood cell dimension was

Table 2. Internal characters of stingless bee nest

Parameters/ Type of nests	Underground nest of <i>Lophotrigona canifrons</i>		Arborreal nest of <i>Tetragonula irridipennis</i>
	Nest—I	Nest—II	
Brood cell area (l X b X h) mm	110 x 90 x 50	170 x 118 x 70	250 x 130 x 60
Wt. of brood area (g)	150	198	233
Wt. of single brood cell (g)	0.0065	0.0066	0.0061
No. of cells/linear cm	4	4	4
Pollen area (l x b x h) mm	100 x 80 x 50	85 x 60 x 75	162 X 125 X 50
Wt. of pollen pots (g)	147	153	188
Wt. of single pollen pots (g)	0.65	0.54	0.49
No. of pots/linear cm	1 (0.8)	1(0.8)	1 (0.9)
Honey area (l x b x h) mm	100 x 65 x 59	70 x 62 x 55	80 x 60 x 50
Weight of honey pots (g)	127	114	112
Weight of single honey pot (g)	0.78	0.80	0.728
No. of pots/linear cm	1 (0.9)	1 (0.9)	1 (0.8)

250x130x60 mm. The brood cells were oval in shape, brown in colour with a light tinge on the top surface. The newly constructed brood cells were lighter in colour as compared to the old ones. The cells were attached to each other on the sides and arranged in a horizontal comb with one layer after another forming a kind of terrace. The brood cells were surrounded by several layers of waxy sheets and vertical pillars which provided strength and insulation. The dimensions of the nest vary according to the species and age of the stingless bee colony. The weight of the total brood and single brood cell were 233g and 0.0061g, respectively.

The food area was divided into pollen area and honey area. In *L. canifrons*, the pollen pots were deep dark brown to black in colour. They were made up of soft cerumen and the pollen pots were located on the sides surrounding the brood. For UG-I, the dimension of the pollen area was 100x80x50 mm; the total weight of the stored pollen was 147g and the weight of a single pollen pot was 0.65g. The dimension of the pollen area was 85x60x75 mm, total weight of the stored pollen and single

pollen pot were 153g and 0.54g, respectively in UG-II. As for *T. irridipennis*, the honey and pollens were stored in separate pots. The pollen pots were found to be located at the sides or the periphery of the colony surrounding the brood cells. The pollen pots varied in shape from circular to oval and were light brown in colour (Fig. 7). The pollen area measured 162x125x50 mm; the weight of the stored pollen mass was 188g and weight of a single sealed pollen pot was 0.49g.

The honey pots of *L. canifrons* were dark brown to black in colour just like that of pollen pots (Fig. 8). They were located on the periphery and here in this case it was also found below the brood cells. For UG-I, the dimension of the honey area was 100x65x59mm; the total weight of the honey was 127g and single honey pot was 0.78g. Similarly, in UG-II the dimension of honey area was 70x62x55mm, the total weight of the honey recorded as 114g and the weight of a single honey pot as 0.80g. In the nest of *T. irridipennis*, the honey pots were dark brown in colour (Fig. 9) and in all the cases, once filled, the honey pots were found sealed and

stored. The dimension of the honey area was 80x60x50mm; the weight of the stored honey was 112g and the weight of a single honey pot was 0.72g, respectively. The honey was slightly sour to taste with a distinct odour.

Dannaradi *et al.* (2009) reported nesting site of *T. iridipennis* on wall crevices and tree trunks at Dharwad, Karnataka. Barbosa *et al.* (2013) reported subterranean nest of *Geotrigona subterranea* in a simple cavity between the ground and a masonry structure. The present findings of entrance tube are in conformity with the findings of Roopa (2002) and Gajanan *et al.*, (2005) who observed variations in the length of *T. iridipennis* in and around Bangaluru and in Dharwad area, Karnataka (Dannaradi *et al.*, 2009). The size of the nest varies with age and number of individuals in a colony. The length of the entrance tube appears to be a species-specific character and also depended on the type of nesting site as the entrance tube of *T. gribodei* reported by Pooley and Michener, (1969) was very short. Barbosa *et al.* (2013) observed entrance holes to be circular with a diameter that ranges from 0.85 cm to 1.20 cm and an average value of 1.0 cm. Dannaradi *et al.* (2009) reported the brood cells as oval, brownish in colour that looked like jowar grains and arranged in a network of narrow vertical pillars with horizontal connectives. Similar findings were observed by Roopa (2002) and Gajanan *et al.*, (2005) reported oval shaped pollen pots made up of soft cerumen which were dark brown in colour that were usually observed at the periphery of the colony. Barbosa *et al.* (2013) observed combs were supported by many pillars, with varying thickness. The investigations provided better understanding of the nest characteristics of stingless bees which paved the way in carrying out research to rearing them under domesticated conditions.

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