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Chavan KG
M.Sc. Student, Department of
Agriculture Entomology,
College of Agriculture, Dapoli
Maharashtra, India

Wankhede SM
Junior Entomologist,
Department of entomology,
Regional Coconut Research
Station, Bhatye, Ratnagiri,
Maharashtra, India

Shinde BD
Associate Professor (CAS),
Department of Agricultural
Entomology, College of
Agriculture, Dapoli,
Maharashtra, India

Sanap PB
Vegetable Specialist, Vegetable
Improvement Scheme, CES,
Wakawali, Dapoli, Ratnagiri,
Maharashtra, India

Jalgaonkar VN
Head, Department of
Agricultural Entomology,
DBSKKV, Dapoli, Ratnagiri,
Maharashtra, India

Naik KV
Professor, Department of
Agricultural Entomology
(CAS), DBSKKV, Dapoli,
Ratnagiri, Maharashtra, India

Patil SP
M.Sc. Student, Department of
Agriculture Entomology,
College of Agriculture, Dapoli,
Ratnagiri, Maharashtra, India

Corresponding Author:
Chavan KG
M.Sc. Student, Department of
Agriculture Entomology,
College of Agriculture, Dapoli
Maharashtra, India

Study of nesting pattern of stingless bee in Konkan region of Maharashtra

Chavan KG, Wankhede SM, Shinde BD, Sanap PB, Jalgaonkar VN, Naik KV and Patil SP

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Abstract

A total of 50 stingless bee colonies were surveyed for its natural habitats, nest entrance directions, height of nest, guard bees on gate. Among these most of the colonies found in electrical poles and wall cavities than in tree cavities with maximum (44.0%) circular (round) nest entrance was, followed by elliptical (38.0%) and irregular shape (18.0%). The nest of stingless bees were found higher preference to the East direction, followed by West, South, North, Northeast, Northwest, Southeast and Southwest. The height of hive entrance from ground level of stingless bees ranged from 1.5 ft to 21.0 ft with an average height of 5.59 ft, observed that 66 per cent of stingless bee colonies were found with lower elevation zone comprising of 0.0-5.0 ft. The length and width of hive entrance tube ranged from 0.1 cm to 3.5 cm and 0.2 cm to 1.5 cm, respectively. The number of guard stingless bee were observed at colony entrance ranged between 0 to 17 with an average of 3.97 bees.

Keywords: Colony, entrance tube, hive, nesting pattern, stingless bee

Introduction

Stingless bees are group of small to medium-sized bees with a dormant sting that live in subtropical and tropical regions of the world. They construct their own species-specific nest entrances. They also exhibit extraordinary variation in the structure of nest within and across species. Major constituents of their nest construction are propolis or cerumen, a mixture of wax with gums and resins. A typical nest has the following components – brood comb, entrance tube, store pots, batumen, involucrum, waste and resin dumps and the stingless bees were modifying these structures based on nest location and other requirements (Divya, 2016) [5]. The size of this entrance is under conflicting selective pressures. Smaller entrances are easier to defend, however, a larger entrance accommodates more forager traffic. Most of these bee species build their nests in either tree hollows or abandoned nests of other social insects (such as ants and termites), which can be found both above and below ground (Roubik, 1980) [9]. In the Konkan region, stingless bee colonies have been observed in plumbing pipes, electric poles, wall cracks, window cracks, door cracks, live and dead trees, and other hidden places (Wankhede *et al.* 2022) [11]. Roubik (1980) [9] observed that the nests of many stingless bee species are yet to be characterized and hence the observation on nesting pattern of stingless bee is important for equatorial India especially Maharashtra, where very few studies have been conducted.

Materials and Methods

Nest sites: A visual based method was applied to search the nesting sites. Consequently, a suitable nesting site is a significant reason for the evaluation of habitats, and Dr BSKKV Dapoli campus is found to be one. Stingless bees have chosen a variety of habitats or sites to build their nests around manmade structures, such as residential sites, brick walls, rock crevices, pillars, metallic sheaths, iron water pipes, and so on were taken into consideration.

Entrance tube character and structure: The observations of an entrance structure's, shape, colour and material were recorded. The measurements of the entrance tube's length and width were also recorded. A total of fifty colonies (only those which were in reach) were observed.

The material utilized for the nest entrance building were gathered from each place and examined under a magnified lens and microscope to identify each individual material

Design of Hive Entrance: The hive entrance designs were categorized as slit (elliptical), round and irregular openings. The number of hive entrances under each design was noted.

Nest orientation: Orientation with categorical variable were divided into eight levels for assessment among unmanipulated nests: four perfect directions (North, South, East and West) were connected with four intermediate directions, such as northeast (0–90°), southeast (91°–180°), southwest (181°–270°) and northwest (271°–360°), through recording. A standard orienteering compass were used to note the nest's varied orientation.

Height of colony from ground level: A measuring tape was used to record the height of each colony. however, when a colony was too high to see, black markings were recorded in order to identify the colony. These black markings, which are frequently found on brick and stone walls, indicated the presence of a colony. Following that, the location was determined by observing bee movements.

Length and Width of Hive Entrance: The length and width of the hive entrance were measured on a centimeter scale. The hive entrance length was measured from base to apex and divided into three categories: <1 cm, 1-3 cm, and >3 cm. The hive entrance width was measured from the mouth of the tube and classified as <1 cm, 1-2 cm, and >2 cm based on maximum horizontal length.

Number of Guard Bees: Additionally, the number of guard bees at the entrance gate was counted and averaged at various times throughout the day.

Results and Discussion

The data presented in table 1 and Fig. 1 indicated that the stingless bee species was found to be distributed throughout the Dr. BSKKV, Dapoli university campus. Stingless bees were constructed their natural colonies inside both terrestrial and arboreal shelters. Preference to nesting sites was appropriately divided into 5 main groups namely; cavities in electric pole (Street lamps), cavities inside iron pipes (unused drainage pipes), cavities in mud walls cavities in stone/cement walls and cavities inside tree trunk

Out of 50 colonies studied, 47 colonies used terrestrial shelter for hives and 3 used arboreal shelter for hive construction viz: Bhend (*Thespesia populnea*), Tamhan (*Lagerstroemia speciosa*) and Gulmohar (*Delonix regia*). The terrestrial shelters consisted of both residential and non-residential buildings. Among all the identified nesting sites, the electric poles were found to be excellent common sites followed by stone wall. The nesting habitat preference of stingless bee in Konkan region was more towards the terrestrial shelter (wall cavities) than that of tree cavities (Table 2). Similar results were reported by Pavithra *et al.* (2013) [7] and Roopa *et al.* (2015) [8]. Wankhede *et al.* (2022) [11] and Danaraddi *et al.* (2009) [4] also found the nesting sites of stingless bee from electric pipe, plumbing pipe,

electric meter board, live tree trunk, cracks of house wall, brick wall and stone wall.

Data was recorded visually on thirteen different sites, walls of residential and non-residential buildings, electric poles and pipes accommodating 41 live colonies and 9 deserted colonies of stingless bees to know the aggregation of stingless bee colonies. Most of the external entrance tubes that were seen brittle. Colour of hives was mostly blackish followed by brownish and yellowish brown. The primary building material utilized for construction of nest by bees was cerumen (a mixture of plant resins and bees wax) along with extensive use of batumen, a mixture of mud, wood material and plant resins. The investigation was also in agreement with the findings of Pavithra *et al.* (2013) [7] where the hive entrance of stingless bee (*T. iridipennis*) in Karnataka, was made up of resin, bees wax, wooden pieces, mud, sand, stone, cow dung, animal feces, pollen, blue paint and grease. The results revealed that out of the fifty colonies located, colonies having circular (round) entrance shape (22 nos.) were dominant followed by elliptical (19 nos.) and irregular (9 nos.). Jayalekshmi (2015) [6] reported that the stingless bees preferred round type nest entrance at southern Kerala.

The average length of hive entrance was found to be 0.74 cm, while the average width of hive entrance was found to be 0.68 cm. The present findings are in close conformity with the findings of following workers. Chinh *et al.* (2005) [1] observed that entrance length of stingless bees (*L. carpenter*) is in a range of 0.5 cm to 5.0 cm. The description of Viraktamath (2017) [10] on *L. chandrai* entrance opening also supports the present works. The different nests from various location got sorted with a height ranging from ground level to 20 feet above ground level of the region and results indicated a collective mean distance of 5.59 feet. Surprisingly, 66 per cent of nest colonies were found with clear preferences and range for lower elevation zone comprising of 0.0-5.0 feet than the middle range of 5.0-10.0 feet (16%) and higher range of 10.0-15.0 ft (16%). Only two colonies (2%) were found at elevation greater than 15 feet (Table 2). The present findings are in close conformity with the findings of Danaraddi *et al.* (2007) [3] who reported that most of the feral colonies in southern region prefer an average height of < 2 m at smaller elevation.

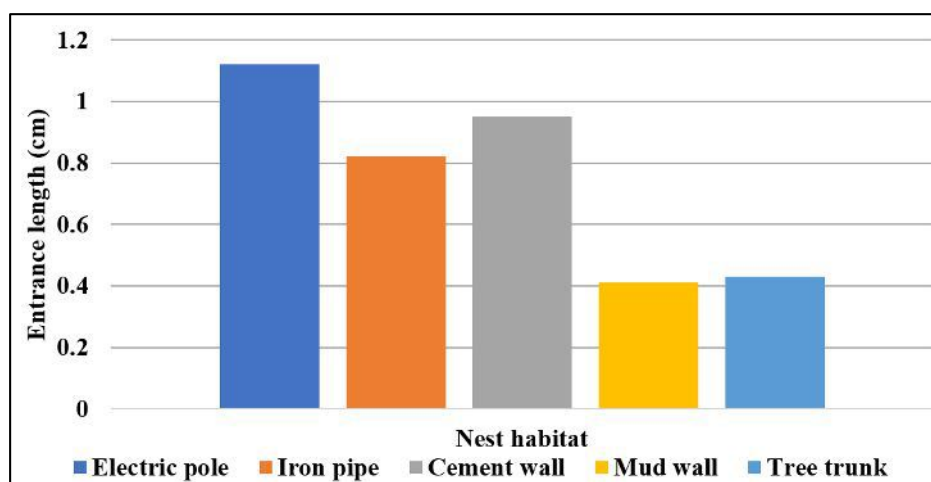
The nest of stingless bees found in various direction (fig. 2) at nest sites, there was a higher preference to the East direction (36%), followed by West (28%), South (10.0%), North (8%), northeast and northwest (6.0%), southeast (4.0%) and southwest (2.0%). The present investigation was also in agreement with the findings of Choudhary *et al.*, (2021) [2] who found that higher number of colonies (34; 54.67%) preferred making a nest entrance facing east followed by an entrance facing west (13; 21.67%). Data presented in table 2 on the number of guard bees at nest entrance in Konkan region revealed, the number of guard bees of stingless bee at nest opening varied considerably from one colony to the other. In the present survey, the number of guard stingless bees were observed at nest opening ranged between 0 to 17 with an average of 3.9 bees/colony entrance. This result is in line with findings of Jayalekshmi (2015) [6] who revealed that the average number of guard bees of stingless bee (*T. iridipennis*) colonies ranged from 6.0 to 9.0 numbers per colony.

Table 1: Nest architectural variation and site preference of stingless bee

Sr. No.	Attributes	Criteria's	Most preferred
1	Nest site	1. Agricultural area 2. Residential area 3. Commercial area	Residential area
2	Habitat	1. Street electric pole 2. Iron pipe 3. Live tree trunk 4. Crevices of window 5. Mud wall 6. Stone wall	Street electric poles
4	Entrance direction	East, west, north, south, south-east, north-east, south-west, north-west	East
5	Nest height from ground	1. Smaller elevation zone (0-5.0 ft) 2. Medium elevation zone (5.0-10 ft) 3. Higher elevation zone (>10 ft)	Electric pole, mud wall and tree trunk Cement wall Iron pipe
6	Shape of nest entrance	Round, elliptical, irregular	Round
7	Size of nest entrance	Large, medium, small	Small sized
8	Entrance tube colour	Reddish, brown, grey, blackish, yellowish-brown	Blackish
9	Nest enclosure material	Resin, wax, wooden pieces, mud, stone, cow dung, propolis, dried plant material, pollen	Resin
10	Colony status	1. Live 2. Deserted	Live
11	Entrance measurements	1. Entrance length (0.1-3.5 cm), Average- 0.74 cm 2. Entrance width (0.2-2.0 cm), Average- 0.67 cm	Electric pole Cement wall
12	Entrance opening-circumference	1. Small opening (0.5-2.0 cm) 2. Medium opening (0.5-2.0 cm) 3. Large opening (0.5-2.0 cm)	Small opening (0.5-2.0 cm)
13	No. of guard bees at entrance	Range 0-17	3.97

Table 2: Averages and ranges of entrance length, width, height and number of guard bee

Nest habitat	No. of colony	Entrance length (cm)		Entrance width (cm)		Height from ground level (ft)		No. of guard bees	
		Range	Mean $\pm$ S.D.	Range	Mean $\pm$ S.D.	Range	Mean $\pm$ S.D.	Range	Mean $\pm$ S.D.
Electric pole	18	0.1-3.5	1.12 $\pm$ 0.88	0.3-1.5	0.68 $\pm$ 0.32	2.4-6.15	3.61 $\pm$ 0.81	0-8	2.88 $\pm$ 2.47
Iron pipe	09	0.4-3.0	0.82 $\pm$ 0.85	0.4-1.3	0.67 $\pm$ 0.21	9.1-21.0	11.08 $\pm$ 3.79	0-11	5.77 $\pm$ 3.92
Cement wall	14	0.1-3.0	0.95 $\pm$ 0.92	0.4-2.0	0.91 $\pm$ 0.47	2.4-11.7	6.63 $\pm$ 3.65	0-17	3.85 $\pm$ 4.62
Mud wall	06	0.3-0.8	0.41 $\pm$ 0.19	0.2-0.6	0.43 $\pm$ 0.15	1.5-2.6	2.18 $\pm$ 0.49	1-6	3.33 $\pm$ 2.16
Tree trunk	03	0.3-0.6	0.43 $\pm$ 0.15	0.7-0.8	0.65 $\pm$ 0.15	3.1-7	4.46 $\pm$ 2.28	0-7	4.0 $\pm$ 3.60
Mean $\pm$ SD			0.74 $\pm$ 0.60		0.67 $\pm$ 0.26		5.59 $\pm$ 3.89		3.97 $\pm$ 3.35

**Fig 1:** Distribution of stingless bee colonies on terrestrial and arboreal shelters in relation to entrance length

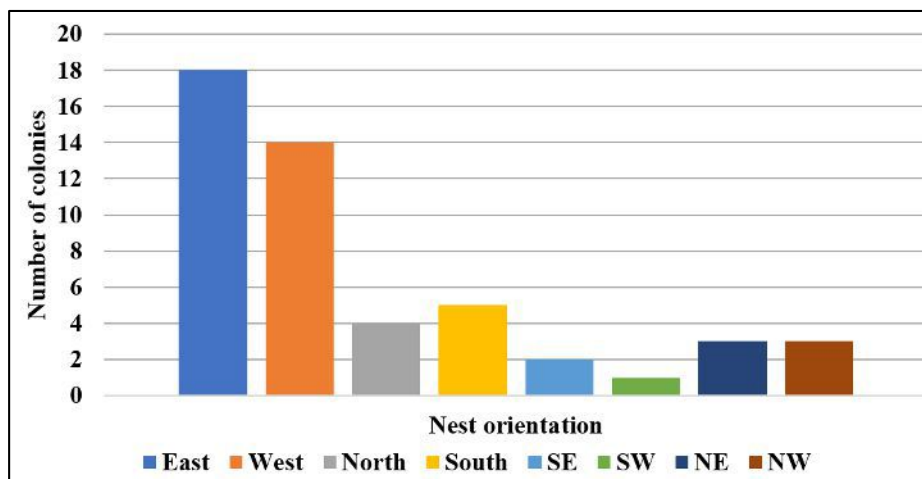


Fig 2: Nest orientation preferred against occurrence of number of colonies

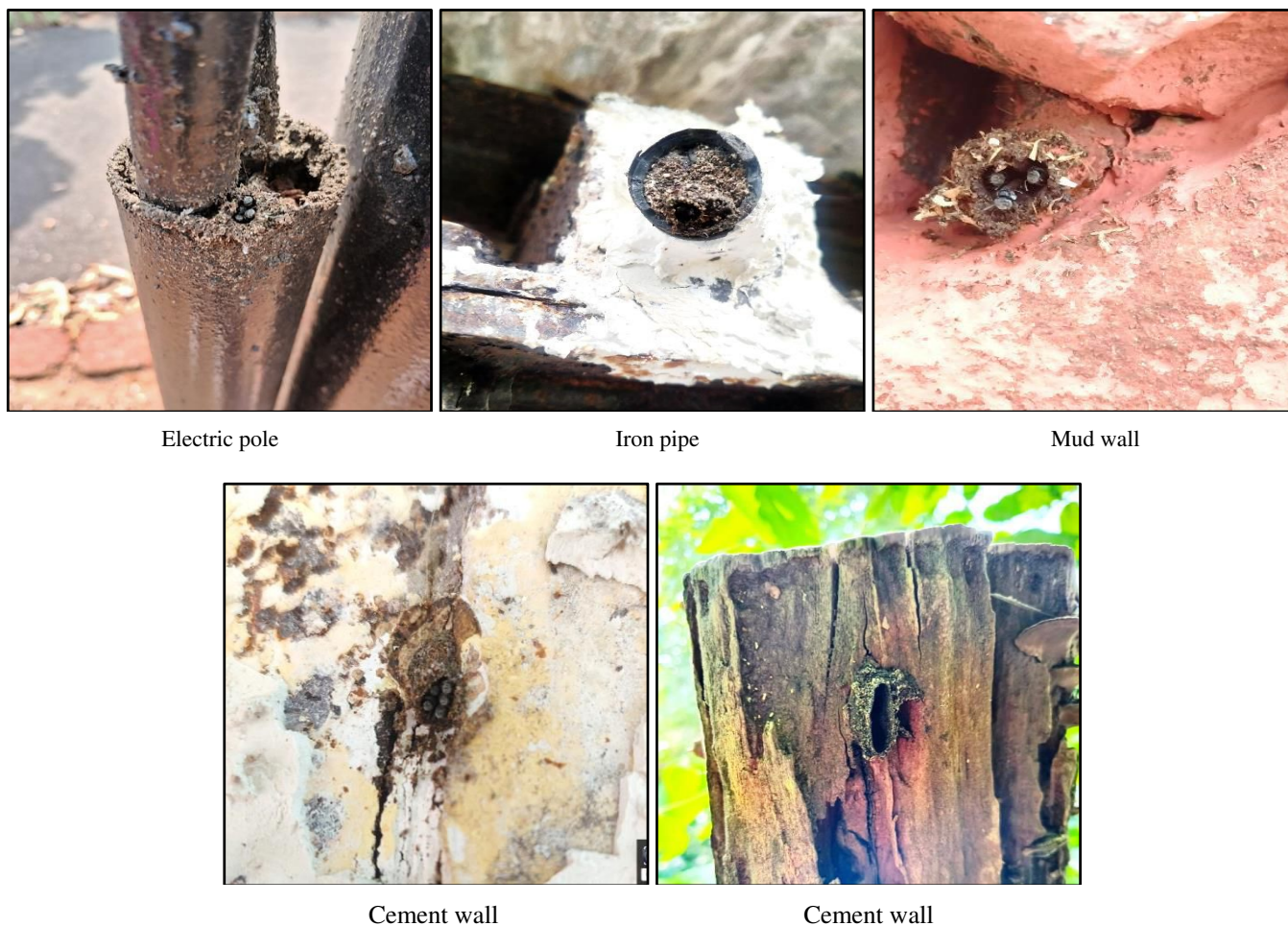


Plate 1: Different forms of nesting habitats

Conclusion

Most of the colonies were observed in electrical poles and wall cavities than in tree cavities. Among the colony, the circular (round) nest entrance was maximum and showing higher preference to the East direction. The average height of hive entrance from ground level of stingless bees was 5.59 ft. The length and width of hive entrance tube ranged from 0.1 cm to 3.5 cm and 0.2 cm to 1.5 cm, respectively.

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