ARCHITECTURAL DESIGN OF STINGLESS BEE HIVES

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ABSTRACT

Stingless bee colonies were collected from different altitudes of Upper Subansiri district of Arunachal Pradesh and Nagaland. Thirty-four colonies of *Lepidotrigona arcifera* were successfully domiciled. Three hive types were designed, viz., Mo = Natural hive (NH), M1= Bamboo hives (BH) and M2 = Log artificial hive (LAH) for better establishment of colonies. These were kept at two heights (two feet above the ground (H0) and five feet (H1) above the ground). Wooden hives yielded 665 ml/hive/season as compared to bamboo and natural hives. The rate of colony establishment was best in wooden hive followed by natural hive. Bamboo hive failed to establish perennial colony while wooden hives performed better.

Key words: *Lepidotrigona arcifera*, wooden hives, bamboo hives, natural hives, rearing, acceptance, honey yield, performance

North East India comprises of eight states viz. Arunachal Pradesh, Assam, Meghalaya, Mizoram, Manipur, Nagaland, Sikkim and Tripura. Propagation of stingless bee colonies contributes to preservation of biodiversity (Watanabe, 1994; Biesmeijer et al., 2006; Goulson et al., 2008). Logging, bush fires and habitat destruction are the cause of the decline in the stingless bee diversity (Kwapong et al., 2010). These problems directly affect bee pollination within natural landscapes such as forests (Kwapong et al., 2010). It has therefore become necessary to identify and conserve the bee species suitable for managed pollination in both agricultural and natural landscapes. For it, suitable, standardised hives needs to be made available for domestication of stingless bees.

Stingless bee belongs to order Hymenoptera and family Apidae, the tribe Meliponini, subtribe Meliponina and these are considered as one of the effective pollinators in glasshouses (Kakutani et al., 1993). The total number of species within the Meliponina is estimated to be about 400 (Silveira et al., 2002). Stingless bees are social insect, living in colony and are present in all tropical and sub-tropical parts of the world. Several workers have designed hives globally for better honey yield and pollination. Some of examples are; Nogueira-Neto-type hive, the UTOB hive, bamboo hive of Kani tribe and Naga tribes’s stingless bee hives (Sommeijer, 1999; Kumar et al., 2012 and Singh, 2016). However, scientific and standardised hives are yet to be designed. Therefore, feral colonies from Arunachal and Nagaland were collected and relocated in types of hives and their rate of colony establishment and honey yield evaluated in this study.

MATERIALS AND METHODS

The experiments were carried out during 2016-2018. Collection of feral colonies, domestication and standardization of hives were carried out in the Darin farm, Riporijo, Bui village, under Gusar circle of Upper Subansiri district of Arunachal Pradesh. Riporijo is situated at 28°4’16”N and 94°12’4’”E,424 masl. The primary data recorded, evaluation and interpretation of statistical analysis were done at the School of Agricultural Sciences and Rural Development, Nagaland University Campus- Medziphema (25°45’53”N, 93°53’04”E, 310 masl). For comparative study on architectural design of hives, different designs were used with an exploration for the scope of easy handling for monitoring the internal growth of the colonies without much disturbance or injury to developing colony. Three types of hives were used: Mo: Natural hive (NH), M1: Bamboo hive (BH) and M2: Wooden hive (LAH). Each type of hive has six subtypes viz., Natural Hives (NH1 (30 x 7.0 x 4.0 cm), NH2 (18 x 6.0 x 5.9 cm), NH3 (17 x 7.0 x 5.04 cm), NH4 (18 x 8.5 x 6.04), NH5 (24 x 10 x 7.0 cm) and NH6 (20 x 10 x 5.07 cm); Bamboo Hive (BH1(80 x 7.5), BH2 (45 x 6.5), BH3 (80 x 7.5 cm), BH4 (45 x 6.5 cm), BH5 (82 x 8.0 cm) and BH6
(80 x 8.0 cm)) and Wooden Hive (LAH1 (45 x 7.0 x 5.0 cm), LAH2 (60 x 18 x 7.0 cm), LAH3 (100 x 710 x 5.0 cm), LAH4 (45 x 7.0 x 5.0 cm), LAH5 (40 x 18 x 8.0 cm) and LAH6 (40 x 18 x 8.0 cm). In LAH hives, three designs were used; Split, Side open and Top open types. In case of bamboo hives, middle part split and both end open types were used. However, natural hives were kept as whole colony habitat.

To domesticate stingless bee under field conditions, the feral colonies were inoculated into the newly designed hives and placed in previously tagged spots in the shade house and then allowed them to establish freely. External features such as nest entrances were observed and recorded by taking their dimension at the time of their honey harvest. Entrance funnels being one of the most diagnostic field traits for distinguishing closely related species. Internal nest structure was viewed during honey harvest. Honey and pollen chamber were measured.

This experiment was conducted to see whether three treatments i.e. Natural hive (NH); Bamboo hive (BH); Wooden hive (LAH) were significantly different, and also to find out the interaction effect between treatments (factor A) and the height of the hive placement in shade house (factor B). The observations were made on the selected parameters for two years w. e. f. 5th March, 2016 to 6th April, 2018. After inoculation of brood chamber along with involucrum in a new improved hive, in how many days and months it took to establish full strength colony was observed at the time of honey harvest. The size of the honey and pollen chamber was recorded by measuring the dimensions of the chamber precisely during honey extraction on completion of one year. In case of those, which were absconded, the data were recorded on the next day from the day of absconding.

After the extraction of honey, the quantity ml/hive/year were observed. In case of those, which were absconded, the data were recorded on the next day from the day of absconding. The durability of hives were measured in terms of non-cracking/ split into aperture, enable easy handling and required less maintenance to know which type lasts longer without trivial maintenance and care off were the basis of durable assessments in term of months. Under daily routine, regular site inspection was done. When less activity of foraging bees were observed in the hives, those were marked and designed as the colonies which were absconding. The data collected was statistically analysed for various parameters using statistical software IBM SPSS 16.0 (2007), by in two way factor ANOVA.

RESULTS AND DISCUSSION

Among three different hive types designed, wooden hive (LAH) were the best followed by natural hives (NH), and bamboo hives were the worst.

Establishment and growth of colony (days)

Data on establishment and growth of *L. arcifera* colonies revealed that the establishment was significantly different (Table 1). All the hives placed above 5 feet (H1) from the ground performed better in comparison to 2 feet above the ground (Ho) but were non-significant statistically. Interaction effect on hive height placement and hive types were significantly different. Colonies in Mo hives placed at H1 performed better with 366 days in comparison to Ho with 224.4 days. Colonies stayed longer at BH placed at H1 (116.4 days) than the Ho (64.6 days). Performance of colonies in Mo is at par at Ho and H1. It is observed that *L. arcifera* stayed longer period in M2 (LAH) 310.083 days in comparison to Mo (NH) with 295.25 days. Shortest duration recorded in M1 (Bamboo hive) with 85.58 (Table 2). Present study concluded that 15 colonies established as perennial colony out of 36 colonies introduced. M2 hive recorded best with 8 (66.66%) colonies out of 12 colonies introduced, followed by 7 (58.33%) in Mo hives. BH recorded with 0% colony establishment rate. Overall establishment rate was 41.66%.

Martins et al. (2004) had observed that in Northeastern Brazil, mostly tree trunks were used to domesticate the stingless bee by Meliponinae beekeepers. In the present study, the colonies placed at higher elevation performed better though not statistically significant. The present results are in accordance with those of Nayak et al. (2012) who studied the nesting heights of *Trigona*, and observed that the nesting elevations offered above ground level showed very distinct preference of 47% between an elevation range of 11-15 ft from the ground point, while between 0-5 ft and 6-10 ft of ranges only 28% of nests were found.

Honey and pollen chamber distribution and dimensions

Internal nest structure studies during honey harvest revealed honey and pollen pots of *L. arcifera* were located on the periphery of the brood chamber. The dimensions in terms of size of honey and pollen
chambers in hives were non-significant statistically. Statistically directly proportional relationship was observed in duration of stay and honey production. The interaction effect in between hive types and height placement in relation to the size of honey and pollen chambers are not significant statistically. In Australia for honey production (1.0 kg/hive/year), the beekeepers used different types of hive designed box for *Austroplebeia australis* so that the honey stores can be reached without damaging the rest of the nest structure.

### Honey production

Data on honey production in wooden hives (M2) was much higher (2445.8 ml) than natural hives (Mo) which was 1766.5 ml but in bamboo hives (M1), the honey production was negligible (1.75 ml) during 2016-17 and 2017-18. However, in 2017 the honey production in M2 was found less due to use of split type M2 (LAH) in which rate of absconds was high. Total honey production in hives was 4891.7 ml (58.03%) in M2, 3533.1 ml (42%) in Mo and 3.5 ml (0.04%) in M1 over two years. Data on the performance of different hives individually during 2017 and 2018, the wooden hive (LAH 5) was found best with yield of 665 ml over two years. Natural hives (NH5), (NH4) and (NH1) were with a mean yield of 550 ml, 540 ml and 500 ml, respectively (Table 3). The interaction effect in between hive types and hive height placement in relation to the honey production are not significant statistically. The honey productions of *L. arcifera* was 1404 ml while per hive production was 117.02 ml/hive/ season, which is conformity with the finding of Rahman et al. (2015). Similarly, Kumar et al. (2012) reported that 600-700 g/year honey was extracted from the domestication of *Tetragonula iridipennis* in log cylindrical hives.

### Durability and portability

The durability and portability of different hives in terms of non-cracking/ split into aperture, enable easy handling and required less maintenance and last longer without trivial maintenance and care off was evaluated. M2 (10.81 months) hives were best followed by Mo (10.13) expressed in term of months While bamboo hives M1 (5.71 months) required frequent maintenance in sealing the cracks. Durability was affected to some extent with the hive height placement. M1 (bamboo hives) placed at 5 feet (H1) above the ground last longer. The interaction effect in between different hive types and hive height placement in relation to the durability are significant statistically. Durability of Mo hives at H1 last longer (12.10 months) than those (Mo) placed at Ho (8.1 months). Similarly, M2 hives placed at Ho is at par with that of H1. Nayak et al. (2012) also studied the nesting heights of *Trigona* and reported that the
nesting elevations offered above ground level showed very distinct preference of 47% between an elevation range of 11-15 ft.

It was observed that on exposures to direct sunlight and rain during summer and rainy seasons the hives were less durable. Similar findings had been reported by Kwapong et al. (2010). The studies revealed that *L. arcifera* can be domesticated successfully in Arunachal Pradesh in wooden hives. The farmers can get maximum 665.0 ml of honey per year from the wooden hives as compared to other traditional hives. The durability of wooden hives is more in comparison to log hives and bamboo hives. The bees stayed for less time in bamboo hives so these hives should not be used for commercial stingless bee honey production in Arunachal Pradesh.

**REFERENCES**


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