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SHORT NOTE

Fostering Colony Growth Post Division: Earthen Pot Hives for Stingless Bees, *Tetragonula* sp. (Hymenoptera: Apidae)

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Abstract

Stingless bee colony multiplication is vital for expanding agricultural pollination and sustainable honey production, yet it is often constrained by slow natural establishment after division in standard hive systems. This study evaluated the use of red earthen pots as an ideal, natural artificial hive to facilitate the successful division and management of stingless bee colonies. Three different hive types, viz., wooden square hives, red earthen pots, and wooden rectangular hives, were evaluated for the colony establishment after division. Significantly greater percentage of colony establishment was recorded in red earthen pots (62.55%) with initiation of forage activity in a lesser time period (8.80 ± 0.84 days). The study found that using localized red earthen pots will help in faster colony establishment after division and sustainable multiplication. Internal hive architecture, such as the pillars and involucrum, was recorded at a significantly shorter period after colony division in red earthen pots (6.40 ± 1.14 days). They provide a durable, porous, and well-insulated environment that mimics natural tree hollows, protecting the brood from heat and moisture and enabling faster colony establishment. Pot hives provide a sustainable alternative to wooden boxes and allow for easy inspection and harvesting for hobbyists.

Stingless bees (Meliponini) are highly effective, generalist pollinators for numerous agricultural crops, particularly in tropical regions and greenhouse settings (Layek & Karmakar, 2018). Their small size, prolonged foraging activity, and high flower fidelity enable them to increase yields and fruit quality in crops such as strawberries, cucumbers, coffee, and chili (Atmowidi et al., 2022). Colony division, or hive splitting, is a vital management task in meliponiculture used to propagate colonies, increase hive numbers for pollination, and boost honey production (Newis et al., 2023). Developing colonies of stingless bees in small red earthen pots is a traditional form of meliponiculture that offers significant advantages, particularly regarding environmental simulation, economic accessibility, and honey quality management. Red earthen pots mimic the natural nesting habits of these bees, which often build nests in tree hollows, wall cavities, or earth banks. Colony maintenance of stingless bees in red earthen pots is indigenously followed in different parts of the country (Shelke et al., 2020). Stingless bees often prefer cavities, and red earthen pots closely simulate their natural nesting conditions, leading to higher adaptation rates than wooden boxes (Amala et al., 2023; Chavan et al., 2025). They provide excellent insulation, keeping the nest cool during hot weather and protecting the colony from severe temperature fluctuations. Red earthen pots are economical, readily available, and ideal for small-scale backyard or rural beekeeping (meliponiculture), enabling low-investment, sustainable income generation.

Although red earthen pots have traditionally been used to maintain stingless bee colonies, there are no systematic studies on colony development parameters in earthen pots. Providing an appropriate hive after colony division is critical for the success of stingless bee splitting, as it directly impacts

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the colony's ability to regulate its internal microclimate, defend against pests, and establish a new queen (Sumin et al., 2024). Proper housing protects the vulnerable "daughter" colony from temperature fluctuations and predators, thereby preventing rapid colony failure (Mohan Rao et al., 2025).

The study was conducted in the meliponiary of ICAR-National Bureau of Agricultural Insect Resources, Bengaluru, Karnataka, India. Three types of hives were used for the colony division of stingless bees, viz., wooden square hives (11 cm length x 11 cm width x 11 cm depth), small red earthen pot hives (12x8 cm), and wooden rectangular hives (35 length x 10 cm width x 5 cm depth). Wooden hives were fabricated by the local vendors. The stingless bee colonies were divided using three different hive designs: square hives, rectangular hives, and small red earthen pots. A small red earthen pot (12 x 8 cm) was collected from local markets for dividing the colonies of stingless bees, *Tetragonula* sp. Five pots as replicates were maintained. One small hole, 0.5 cm in diameter, was made on one side of the pot by hand with a steel rod to serve as the entrance/exit for the stingless bees. The bee entrance was sealed with a layer of resin collected from the mother colony to enable faster colony settlement. The top of the earthen pot hive was closed with a black paper sheet to enable darkness inside the hive. After placing the black sheet of paper, the top was tightly fastened with cello-tape to ensure complete closure of the nest.

A strong colony with the hive box filled with brood cells, pollen, and honey pots firmly sealed with resin along the borders of the hive box, with no further scope for expansion, was selected. This strong colony was considered the mother colony. From the mother colony, a handful of pupal brood cells (cells appearing pale yellow in color), 5-6 pollen pots, and one queen cell were collected. The queen cell, brood cells, and pollen pots were placed inside the hives. A thin resin layer was also collected from the mother colony and placed inside the pot. The percent colony establishment and the number of days required to initiate forage activity were compared among square hives, rectangular hives, and small red earthen pots. The percent colony establishment was calculated as the ratio of the number of established colonies to the total number of divided colonies in stingless bees. The divided colonies with active forager entry/exit activity carrying pollen/nectar reward were considered as a sign of established colonies. The number of days taken for initiation of forage activity is calculated by taking the time interval between the day of colony division and initiation of forage activity. The number of days required to construct the internal nest architecture in the three hive designs was recorded.

The further development of the colony of stingless bees in the small red earthen pots was recorded. The mean number of days required for the bees to resume foraging activity after inoculation in the pot hive was recorded. The mean number of days to initiate brood cells was recorded. The number of storage pots constructed 30 days after colony division was recorded.

The colony characters, viz., mean ± SD of the number of days taken for the initiation of foraging activity, construction of brood cells, and storage pots, were calculated. Analysis of variance (GLM in SAS 9.3; SAS Institute, Cary, NC) was used to compare the percent colony establishment and time taken for the initiation of foraging activity in the different hive structures, where a significant difference was detected; treatment means were separated using Tukey's HSD Test (0.5%).

Percent colony establishment of stingless bees differed significantly between the different types of hives (F value = 23.77; $P < 0.001$) (Figure 1). Significantly greater percent establishment of stingless bee colonies was recorded in small earthen pots (62.55%), which was statistically at par with square box hives (46.35%). The percent colony establishment of divided colonies in a rectangular shape was significantly lower (12.32%). The time taken for the initiation of foraging activity varied between the different hive types in the newly divided colonies of stingless bees (F value = 23.77; $P < 0.001$)

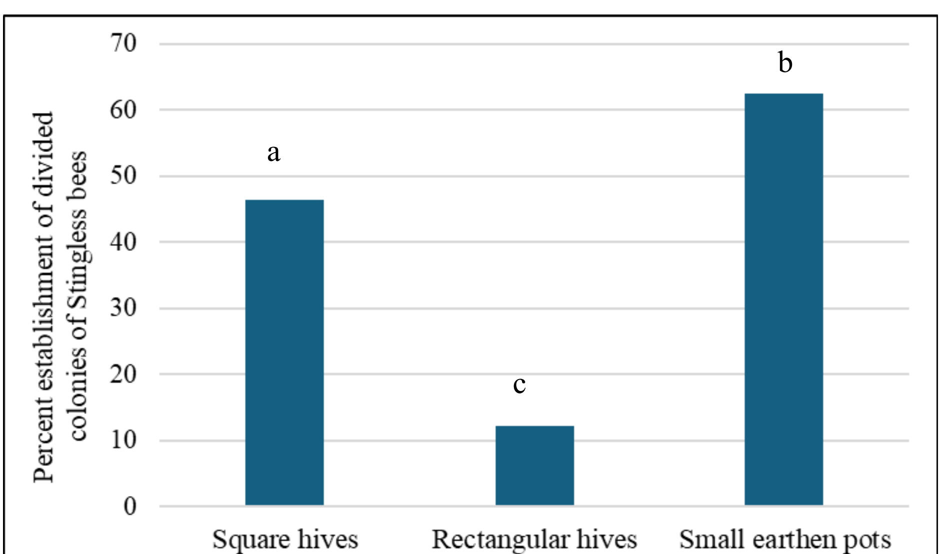

Fig 1. Percent establishment of divided colonies of stingless bees in different hive types.

(Fig 2). The foraging activity was initiated at a significantly lesser time period in the small earthen pot hives (8.80 ± 0.84 days), followed by square hives (15.40 ± 2.07 days) and rectangular hives (24.80 ± 6.53 days). There was a significant difference in the number of days taken for the formation of internal hive architecture, which was recorded (F value = 7.59; P < 0.001) (Fig 3). Internal hive architecture, like pillars and involucrum, was recorded at a significantly lesser period of time after colony division in red earthen pots (6.40 ± 1.14 days), followed by square hives (12.40 ± 2.30 days) and rectangular hives (25.20 ± 2.17 days).

The colony architecture, such as the pillars and involucrum, was constructed by the bees within a week of colony division in the red earthen pot hives. The mean number of days taken for the settlement of foragers after the colony division was 3.61 ± 0.54 days. The initiation of construction of brood cells was observed 55.20 ± 6.31 days after colony division (Fig 4). The bees were observed to start the forage bouts at 12.80 ± 2.71 days after division. The mean number of pollen pots and honey pots constructed by the bees one month after the division was 4.60 ± 0.55 and 1.60 ± 0.55 pots, respectively.

Fig 2. Number of days taken for initiation of foraging activity after colony division in different hive types.

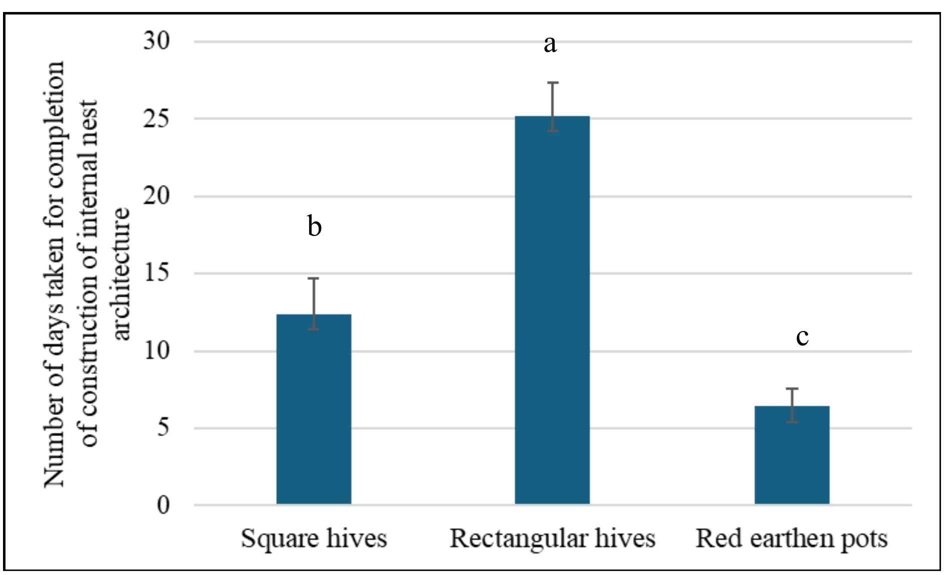

Fig 3. Number of days taken for completion of internal hive architecture after colony division in different hive types.

The study summarised that small earthen pots are ideally suited for the multiplication of stingless bee colonies. The clay provides excellent insulation, which helps regulate the hive's internal temperature. Amala et al. (2021) reported that coconut shell traps are an ideal tiny structure to house the swarm of stingless bees, *T. iridipennis,* owing to their compact size, which is ideal for colony settlement and establishment. Earthen pots provide excellent insulation, maintaining stable, cooler temperatures and appropriate humidity levels, which are crucial for brood development and for protecting the colony from extreme weather. The system of thermoregulation in the nests of bees is vital for the coordination of the activities of workers that build the nest, so that the colony-level development of stable brood nest temperatures is achieved. Saai Vignesh et al. (2023) reported that mud pot hives supported faster colony establishment and a higher rate of brood development in stingless bees after colony division in Tamil Nadu, India. Stingless bees prefer to nest in cavities and thick-walled, insulated structures, which provide a higher rate of brood survival and development (Jones & Oldroyd, 2006). The porous nature of the red earthen pot and its ability to keep the interior dry help to prevent mould and yeast growth. Beekeepers often smear the inside of empty red earthen pots with beeswax (cerumen) and hang them in gardens or near forests to attract feral stingless bee colonies. Prabhu (2008) reported that red earthen pot hives can be viably used for hiving small-sized colonies of stingless bees. Earthen pots smeared with resin/wax to attract feral colonies of stingless bees were reported in the forest areas of the Western Ghats, India (Charanakumar et al., 2022).

Fig 4. Established colony of stingless bees inside the earthen red pot.

Red earthen pots are excellent, cost-effective, and sustainable containers for maintaining stingless bee colonies in urban environments, such as on balconies. They are considered ideal for small-scale, traditional, and backyard beekeeping because they mimic natural nesting environments, provide good thermal insulation, and can be easily managed within limited spaces. Hobbyists can use small terracotta or red earthen pots, often configured in a two-pot system to facilitate colony management and honey harvesting.

Author's Contribution

A.U.: conceptualization, methodology, investigation, writing-original draft, writing-review & editing, drafted the manuscript. V.H.S.: formal analysis, writing-original draft

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References

Amala, U., Shylesha, A.N. & Shivalingaswamy, T.M. (2021). Coconut shell traps: an easy and economic way to attract stingless bees (*Tetragonula iridipennis*) Smith. Sociobiology, 68: e7220. https://doi.org/10.13102/sociobiology.v68i4.7220

Amala, U., Venu, H., Chandramanu, K.G.R., Shivalingaswamy, T.M., Shylesha, A.N., Subaharan, K. & Sushil, S.N. (2023). A Sustainable Technique for Colony Multiplication by Eduction of Wild Nests of the Stingless Bee *Tetragonula iridipennis* Smith. Sociobiology, 70: e9148. https://doi.org/10.13102/sociobiology.v70i3.9148

Atmowidi, T., Prawasti, T.S., Rianti, P., Prasojo, P.A. & Pradipta, N.A. (2022). Stingless Bees Pollination Increases Fruit Formation of Strawberry (*Fragaria* x *annanassa* Duch) and Melon (*Cucumis melo L.*). Tropical Life Sciences Research, 33: 43-54. https://doi.org/10.21315/tlsr2022.33.1.3

Charanakumar, C.P.B. & Chandrashekar, J.S. (2022). Current status of meliponiculture and its cultural importance in the

Western Ghats, India. Journal of Apicultural Research, 61: 706-716. https://doi.org/10.1080/00218839.2022.2115270

Chavan, K.G., Wankhede, S.M., Shinde, B.D., Sanap. P.B., Jalgaonkar, V.N., Naik, K.V. & Patil, S.P. (2025). Study of nesting pattern of stingless bee in Konkan region of Maharashtra. International Journal of Advanced Biochemistry Research, 9: 212-216. https://doi.org/10.33545/26174693.2025.v9.i1c.3667

Jones, J.C. & Oldroyd, B.P. (2006). Nest Thermoregulation in Social Insects. Advances in Insect Physiology, 33: 153-191. https://doi.org/10.1016/s0065-2806(06)33003-2

Layek, U. & Karmakar, P. (2018). Nesting characteristics, floral resources, and foraging activity of *Trigona iridipennis* Smith in Bankura district of West Bengal, India. Insectes Sociaux, 65: 117-132. https://doi.org/10.1007/s00040-017-0593-4

Mohan Rao, K., Suroshe, S.S., Kumarnag, K.M., Alekhya, G. & Srinivas, T. (2025). Standardization of hives for rearing stingless bee, *Tetragonula pagdeni* Schwarz. Indian Journal of Entomology, 87(Special Issue): 141-145.

Newis, R., Nichols, J., Farrar, M.B., Fuller, C., Bai, S.H., Wilson, R.S. & Wallace, H.M. (2023). Stingless bee (*Tetragonula carbonaria*) foragers prioritise resin and reduce pollen foraging after hive splitting. Apidologie. 54: 38. https://doi.org/10.1007/s13592-023-01018-8

Prabhu, K. (2008). Studies on some aspects of stingless bee, *Trigona iridipennis* Smith, Colony reproduction, capturing and management techniques. MSc. Thesis, Tamil Nadu Agricultural University, Coimbatore, 112 pp.

Shelke, R.T., Rajendrarao, K. & Riya, V. (2020). Current status of meliponiculture and its cultural importance in the Western Ghats, India. International Journal of Chemical Studies, 8: 407-409.

Sumin, V.S., Langkan, F.J., Damit, H.A., Wasli, M.E. & Besar, N.A. (2024). Exploring the adoption of modern hives among stingless beekeeping in Sabah, Malaysia: The approach of diffusion of innovation theory. Food Security Symposium: Future Advancements in Agriculture for Sustainability. IOP Conference Series: Earth and Environmental Science, 1397: 012036. https://doi.org/10.1088/1755-1315/1397/1/012036

Saai Vignesh, B., Anujaa, B., Suresh, K., Elamparithi, R., Selvakumar, S. & Ramesh Kumar, R. (2023). Domestication, Proliferation and Hive Modeling of Feral Stingless Bee (*Tetragonula iridipennis* Smith) Colonies. Biological Forum – An International Journal, 15: 263-266. https://doi.org/10.13102/sociobiology.v72i3.11205.

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