(ISSN: 0973-7049(P))

The Bioscan AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES 21(3): S.I (3), 1557-1562, 2026 www.thebioscan.com

MORPHOMETRIC STUDIES OF STINGLESS WORKER BEES (*TETRAGONULA PAGDENI*) IN SINDEWAHI REGION DISTRICT CHANDRAPUR (M.S.), INDIA

H. P. BHOYAR and U. S. INDURKAR

Institution of Higher Learning Research Centre

Shri Dnyanesh Mahavidyalaya Nawargaon, Ta Sindewahi, Dist Chandrapur, Gondwana University,Gadchiroli (MS), India email- hinapbhoyar71957@gmail.com.

DOI: https://doi.org/10.63001/tbs.2026.v21.i03.S.I(3).pp1557-1562

KEYWORDS

Tetragonula pagdeni,
stingless bees,
worker bees,
morphometrics, taxonomy.

Article Info
Received:
08.07.2026
Accepted:
21.08.2026
Published:
07.09.2026

Abstract

Tetragonula pagdeni (Hymenoptera: Apidae) is an ecologically and economically valuable stingless bee species vital for crops and wild flora pollination. This study evaluated the morphometric characteristics of *T. pagdeni* worker bees to establish precise baseline morphological data for species identification and population assessment. A total of 15 worker bees were sampled from hive entrances across three distinct geographic sites, preserved in ethanol, and dissected for detailed examination of eleven key morphological observations. The study reports the average morphological measurements of the specimens. The average body length is 3.88±0.12 mm, with the head measuring 1.49±0.03 mm in length and 2.18±0.06 mm in width. Antennal length is recorded at 1.87±0.11 mm, thorax length at 1.42±0.05 mm, and thorax width at 1.55±0.02 mm. The abdomen length averages 2.05±0.10 mm. Forewing measurements include a length of 3.40±0.08 mm and a width of 1.37±0.05 mm, while hindwings measure 2.61±0.08 mm in length and 0.61±0.03 mm in width. The number of hamules averaged at 5.00±0.00. These morphometric parameters provide crucial reference metrics for taxonomic differentiation, population variability assessments, and meliponiculture management of *T. pagdeni.*

Introduction

The stingless bees (Apidae, Meliponini) comprise over 600 species, mainly found in tropical and subtropical regions globally. They are essential pollinators in both natural and agricultural settings. All species from Asia and Africa belong to the tribe Trigona. Stingless bees are classified within the superfamily Apoidea, family Apidae, and subfamily Meliponinae. Eusocial insects live in organized colonies together. They exhibit complex communication and establish permanent colonies and categorizes into queens,male and worker. Stingless bees, characterized by larger queens and strong mandibles, construct their nests in dark spaces such as tree cavities, ant hills, or human structures. They utilize propolis for hive construction and defense against pathogens, playing a crucial role as pollinators for various plants (Sakagami 1983),(Starr and Sakagami 1987), (Sakagami et al. 1989),(Slaa *et al*. 2006).

They produce small amounts of honey but are significant as pollinators. Morphometric studies of stingless bees aid in understanding their taxonomy, ecology, and adaptations. Key traits such as body size, head width, tongue length, and wing venation are vital for assessing foraging efficiency and distinguishing species. This study specifically examines the morphometric

characteristics of worker bees of Tetragonula nr. Pagdeni.(Mounika Jarpla *et al.* 2025)The genus-group names for Indian stingless bees are Trigona and Lisotrigona, while Tetragonula is the largest and most widespread genus located in the Indo-Malayan regions, with a presence noted in India..Differentiated Tetragonula *iridipennis* from the iridipennis group based on morphological characteristics of both male and female specimens(Vijayakumar and Jeyaraaj 2013).

Rasmussen (2013) identified eight species of stingless bees from the Indian subcontinent, suggesting the possibility of finding additional species in the area. Vijayakrumar and Jayaraj (2013) added to this by identifying three species in India: T. iridiepnnis, T. laeviceps, and T. arcifera, using geometric morphometry methods. The focus of research in India largely revolves around the biology, morphometry, natural enemies, and pollination biology of stingless bees. (Muthuraman and Saravanan 2004; Danaraddi and Viraktamath, 2009).

In this study, the morphological characteristics of stingless bees from Sindewahi Tehsil, District Chandrapur, Maharashtra, were described.

Material and Methods

The study area for the investigation of diversity of Bees include the whole of geographical area under the Sindewahi administration of Chandrapur district in Sindewahi region area there is no listed the diversity of bees species. The research conduct for the determine the bees diversity in the Sindewahi region of Maharashtra through random sampling collection.

The study analyzed the morphometric characteristics of fifteen worker bees from the species T. pagdeni, collected from their hive entrance. The sample immobilized on ice and preserved in 70% alcohol for morphological study. The body parts were dissected using binocular microscope and treated with 10% KOH at 80°C for 15 minutes, then washed, dehydrated through increasing grades of alcohol, cleared in Xylene, and mounted in DPX. Identification and measurement of morphometrics were conducted in the Laboratory of Zoology Department, SDMV Nawargoan. Taxonomic identification of stingless bees is explored through the analysis of nest architecture and morphological characteristics, referencing the foundational works of Sakagami (1978) and Schwarz (1939).

Measurements of eleven morphological characters were carried out utilizing a digital microscope, calibrated with a stage micrometer. Larger part sizes were assessed using graph paper. The detailed measurements recorded comprised body length, head length, head width, antennal length, thorax length and width, forewing length and width, hindwing length and width, the number of hamuli, and abdomen length.

Observation and Result

The assessment of worker bees from three sites and fifteen samples revealed moderate consistency in their body proportions. Minor variations were noted, indicative of uniformity in phenotypic traits across the samples studied.In Tetragonula species from above studies indicate that worker bee was small bodied an antennae length was smaller than body length. Head broader than long, thorax indicating strong flight muscles, abdomen length was elongated its houses of vital organs. Forewings of stingless bees were significantly longer than hindwings.

(ISSN: 0973-7049(P))

The Bioscan AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES 21(3): S.I (3), 1557-1562, 2026 www.thebioscan.com

Diagnostic characters of worker bee

Whole Body Measurments: Average body length stingless bee workers was 3.88±0.12 mm, characterizing them as small-bodied. Antennae length averaged 1.87±0.11 mm, smaller than body length, Underscoring the significance of tactile and olfactory navigation, this highlights their critical roles in foraging behavior.

Head Measurments: Head morphology analysis reveals an average head length of 1.49±0.03 mm and width of 2.18±0.06 mm, indicating a structure that is broader than long. This shape is suggested to enhance field vision and mandibular strength, thereby improving foraging efficiency and nest construction activities.

Thorax Morphology: The thoracic measurements of the bees showed an average length of 1.42±0.05 mm and a width of 1.55±0.05 mm. These dimensions suggest a robust attachment of flight muscles, which enhances the bees' agility while foraging in restricted floral environments.

Abdomen Measurments: The abdomen, averaging 2.05±0.10mm in length, exhibits an elongated structure that accommodates vital organs, wax-producing glands, and a sting apparatus, all crucial for colony defense and hive maintenance.

Wing Morphometrics: Wing morphology of stingless bees reveals that their forewings are significantly longer than their hindwings, with forewings averaging 3.40±0.08 mm in length and 1.37±0.05 mm in width. In contrast, hindwings measure an average of 2.61±0.08 mm in length and 0.61±0.03 mm in width, demonstrating a membranous structure that is well-adapted for flight. Additionally, the presence of five hamulii, which are wing hooks, is crucial for synchronizing wing movement during flight.

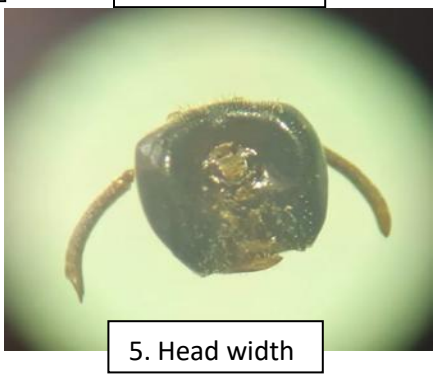
1.stingless bee

2.Body length

3. Antennal length

Head width 11

4. Head length



5. Head width

6. Thorax length

7. Thorax width

8. Abdomen length

9. Forewing length

10. Forewing width

11. Hindwing length

12. Hindwing width

Table 1: Morphometric dimensions of Worker bee

Body parts (mm)	Site 1	Site 2	Site 3	Mean
Body length	3.85	3.89	3.90	3.88±0.12
Antennal length	1.88	1.85	1.89	1.87±0.11
Head length	1.45	1.53	1.54	1.49±0.03
Head width	2.18	2.16	2.20	2.18±0.06
Thorax length	1.38	1.40	1.47	1.42±0.05
Thorax width	1.52	1.54	1.60	1.55±0.05
Abdominal length	2.00	2.05	2.05	2.05±0.10
Forewing length	3.30	3.45	3.50	3.40±0.08
Forewing width	1.30	1.44	1.35	1.37±0.05
Hindwing length	2.55	2.50	2.62	2.61±0.08
Hindwing width	0.55	0.60	0.65	0.61±0.03

Number of hamuli	5.00	5.00	5.00	5.00

Discussion

The measurements of various body parts of worker bees were recorded, highlighting the significance of these metrics in understanding their morphology and functionality. *T. pagdeni* from this study presented the body length of *T. pagdeni* was 3.88±0.12mm (Table 1 and Figure 2). Similar observation by Kuberappa *et al*. (2005) in *T. iridipennis* was 4.62mm. Danaraddi and Shashidhar (2009) in *T. iridipennis* was 4.12mm. Ade Efin *et al.* (2019) *in* T. laeviceps was 4.44mm. Sharma VG *et al*. (2023) in T. *iridipennis* was 4.40±0.18 mm. The antennal length of *T. pagdeni* was 1.87±0.11mm (Table 1 and Figure 3). Similar findings by Patel and Pastagia (2016) in *T. iridipennis* was 1.72±0.02mm. Sharma VG *et al*. (2023) in *T. iridipennis* was 1.89±0.11 mm.

The average head length of *T. pagdeni* in this obeservation was 1.49±0.03mm (Table 1 and Figure 4). Recorded by Danaraddi and Shashidhar (2009) in *T. iridipennis* varied from 1.52 to 1.61mm. Trianto and Purwanto (2020) in *T. iridipennis* was 1.75mm. Ade Efin *et al.* (2019) in T. laeviceps was 1.55mm. Sharma VG *et al*. (2023) in was 1.51±0.03 mm. The mean head breath of T. *pagdeni* was 2.18±0.06mm (Table 1 Figure 5). Similar reported by Sharma VG *et al*. (2023) in T. *iridipennis* was 2.18±0.06 mm. Ade Efin *et al.* (2019) in T. *laeviceps w*as 1.91mm.

The mean thorax length of T. *pagdeni* was 1.42±0.05mm (Table1 Figure 6). Similarly, Sharma VG *et al*. (2023) recorded in *T. iridipennis* was 1.45±0.02 mm. The mean thorax width of T. *pagdeni* was 1.55±0.05mm (Table1 Figure 7). Similar reported by Sharma VG *et al*. (2023) in *T. iridipennis* was 1.58±0.02 mm.

The mean abdomen length of *T. pagdeni*in in this study was 2.05±0.10 mm(Table 1 and Figure 8). Sharma VG *et al*. (2023) who noted in *T. iridipennis* was 1.52±0.07 mm.

The mean forewing length and width of T. *pagdeni* in this study was 3.40±0.08 mm and 1.37±0.05 mm respectively (Table 1 and Figure 9 and 10). Similar observation made by Sharma VG *et al*. (2023) in *T. iridipennis* was 3.49±0.10 mm and 1.44±0.07 mm. Ade Efin *et al.* (2019) in T. *laeviceps* was 4.26 mm and 1.49 mm. Trianto and Purwanto (2020) in *T. iridipennis* was 3.74 mm and 1.44 mm.

The mean hindwing length and width of T. *pagdeni* in this study was 2.61±0.08 mm and 0.61±0.03 mm respectively (Table 1 and Figure 11 and 12). Trianto and Purwanto (2020),who noted similar in *T. iridipennis* was 2.71 mm and 0.63 mm respectively. Sharma VG *et al*. (2023) in of *T. iridipennis* was 2.61±0.08mm and 0.61±0.03 mm respectively. Ade Efin *et al.* (2019) in T. *laeviceps* was 2.85 mm and 0.73 mm respectively.

The study addresses the limited reports on stingless worker bee, specifically detailing the diagnostic characteristics of Tetragonula *pagdeni*. The external morphology of the worker bee is examined to differentiate it from other species within the Tetragonula genus. T. *pagdeni* is predominantly found in Southeast Asia as

noted by Sakagami (1990). Sakagami (1978), with prior studies indicating statistically significant morphological differences between T. *pagdeni* , T. *iridipennis* (Vijayakumar and Jeyaraaj 2020), Trianto and Purwanto (2020) and T. *laeviceps* Ade Efin *et al.* (2019).

References

1. Manap trianto et al 2024 Taxonomic study on selected species of stingless bees (Hymenoptera: Apidae: Meliponini) in Sulawesi Island, Indonesia, BIODIVERSITAS, Volume 25, (5):2290-2306
2. Mounika Jarpla et al 2025 Morphometric characterization of worker bees of Tetragonula nr. pagdeni from feral colonies, International Journal of Advanced Biochemistry Research 2025; SP-9(9): 1929-1934
3. Rasmussen C. 2013. Stingless bees (Hymenoptera : Apidae:Meliponini) of the Indian subcontinent: Diversity, taxonomy and current status of knowledge.Zootaxa.,3647(3):401-428.
4. Sakagami S.F.1978. Tetragonula stingless bees of the continental Asia and Sri Lanka (Hymenoptera, Apidae). Journal of the Faculty of Science, Hokkaido University, Series VI, Zoology, 21: 165–247.
5. Sakagami S.F.1978. Tetragonula stingless bees of the continental Asia and Sri Lanka (Hymenoptera, Apidae). Journal of the Faculty of Science, Hokkaido University, Series VI, Zoology, 21, 165–247
6. Sakagami SF, Inoue T, Yamane S, Salmah S. 1983. Nest architecture and colony composition of the Sumatran stingless bee Trigona (Tetragonula) laeviceps. Kontyû 51 (1): 100-111.
7. Sakagami SF, Inoue T, Yamane S, Salmah S. 1989. Nests of the Myrmecophilous stingless bee, Trigona moorei: how do bees initiate their nest within an arboreal ant nest? Biotropica 21 (3): 265-274.
8. Schwarz H.F. 1939.The Indo-Malayan species of Trigona. Bulletin of the American Museum of Natural History, 76:83–141.
9. Slaa EJ, Chaves LAS, Malagodi-Braga KS, Hofstede FE. 2006. Stingless bees in applied pollination: practice and perspectives. Apidologie 37 (2): 293-315.
10. Starr CK, Sakagami SF. 1987. An extraordinary concentration of stingless bee colonies in the Philippines, with notes on nest structure (Hymenoptera: Apidae: Trigona spp.). Insectes Sociaux 34 (2): 96 107.
11. Vijayakumar and Jeyaraaj 2020 Taxonomic notes onTetragonula pagdeni Schwarz (Apidae: Meliponini) from India, IJALS, Volume 13(1): 2277– 758X.
12. Vijayakumar K. and Jayaraj R. 2013. Geometric morphometry analysis of three species of stingless bees in India. Int. J. LifeSci. and Edu. Research.,1: 91–95