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Morphometric studies of stingless bees (*Tetragonula iridipennis* Smith) in Saurashtra region of Gujarat state

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Abstract
A morphometry study on worker bee of the stingless bees or dammar bees, *Tetragonula iridipennis* Smith on fifteen morphological characters was conducted at Biocontrol research laboratory, Junagadh University of Agriculture, Junagadh, Gujarat. The twenty bees were collected from the hive entrance, preserved in alcohol and carefully dissected to study the various morphometric parameters. The mean body length was 4.40±0.18 mm, head length was 1.51±0.03 mm, antennal length was 1.89±0.11 mm, tongue length was 1.06±0.08 mm, thorax length was 1.45±0.02 mm and thorax breadth was 1.58±0.02 mm, forewing length was 3.49±0.10 mm and forewing breadth was 1.44±0.07 mm, hindwing length was 2.61±0.08 mm and hindwing breadth was 0.61±0.03 mm, extent of hamuli was 0.16±0.01 mm, number of hooks was 5.00±0.00, hindleg length was 4.51±0.04 mm and hindleg breadth was 0.49±0.02 mm and abdomen length was 1.52±0.07 mm.

Keywords: Honeybee, *T. iridipennis*, morphometry

Introduction
The stingless bees or dammar bees, *Tetragonula irridipennis* are the non-*Apis* bees. They do not belong to the genus *Apis* but they do collect nectar and pollen like honeybees and they help pollinate small flowers. They are distributed in the tropics and subtropics, and even in the temperate region. They built their nests in dark enclosures like cavities in branches or trunks of trees, ant hills, termite tunnels in the ground, wall crevices, or any abandoned receptacle like logs, pots and tins. Stingless bees belong to the superfamily Apoidea, family Apidae and sub-family Meliponinae. It consists of two genera Melipona and Trigona which belongs to the tribe Meliponini and Trigonini, respectively. Meliponinae includes eight genera, having 15 sub-genera and more than 500 species (Wille, 1983) [2]. However, the various characters of morphometric of *T. irridipennis* have been studied across the globe by different workers like Kuberappa *et al*. (2005) [3], Patnaik and Prasad (2007) [9], Danaraddi and Shashidhar (2009) [4], Devanesan *et al*. (2009) [8], Patel and Pastagia (2016) [7], Tej *et al*. (2017) [5], Trianto and Purwanto (2020) [6] and Rasmussen (2013) [10]. In contrast, the information on the various morphometric characters of *T. irridipennis* for Saurashtra region of Gujarat is not available. Therefore, to generate the data base on morphometric characters of *T. irridipennis* this study was undertaken at Junagadh Agricultural University, Junagadh, Gujarat.

Materials and Methods
The study on the morphometric characters of worker bees of stingless bees or dammar bees, *T. irridipennis* was made at Junagadh Agricultural University, Junagadh, Gujarat. For the purpose, twenty worker bees were collected from their hive entrance. The collected bees were killed in acetone to ensure full extension of external parts of the body and preserved in 70 per cent alcohol. The samples were carefully dissected in the Bio-control Laboratory, Department of Agricultural Entomology, College of Agriculture, JAU, Junagadh for studying their morphometrics. In the present studies, the various morphological characters used by Kshirsagar (1981) [1] were adopted. Measurements of fifteen morphometries characters were made after calibration with stage micrometer with the help of a digital microscope (LEICA M205 C) fitted with measurement software. Whereas, the size of the bigger parts was measured with the help of graph paper. In addition, the measurement of body length, head length, antennal length, tongue length, thorax length, thorax breadth, forewing length, forewing breadth, hindwing length, hindwing breadth, extent of hamuli, number of hooks, hindleg length, hindleg breadth and abdomen length were recorded. For all parts, measurements were taken in duplicate (to an accuracy of 0.01 mm).

Results and Discussion

The results on the measurements of various body parts of the worker bees of the *T. iridipennis* are presented in Table 1 and Figure 1 to 10. The body length of *T. iridipennis* was varied from 4.10 to 4.66 mm with an average of 4.40±0.18 mm (Table 1 and Figure 1).

The observations on the head length of *T. iridipennis* revealed that the head length was varied from 1.47 to 1.55 mm with an average of 1.51±0.03 mm (Table 1 and Figure 2). The antennal length of *T. iridipennis* revealed that the minimum antennal length was 1.71 mm whereas, the maximum length was 2.07 mm. The average antennal length was 1.89±0.11 mm (Table 1 and Figure 3). The result on tongue length of *T. iridipennis* worker bee indicated that the tongue length was varied from 0.94 to 1.15 mm with an average of 1.06±0.08 mm (Table 1 and Figure 4).

The average thorax length of *T. iridipennis* was 1.45±0.02 mm, while it was varied from 1.42 to 1.48 mm (Table 1 and Figure 5). The average thorax breadth of 1.58±0.02 mm, whereas maximum and minimum breadth of 1.55 mm and 1.61 mm was recorded, respectively (Table 1 and Figure 5). The length of the forewing of *T. iridipennis* indicated that the forewing length was varied from 3.30 to 3.60 mm with an average of 3.49±0.10 mm (Table 1 and Figure 6). The average forewing breadth was 1.44±0.07 mm and it was varied from 1.33 to 1.55 mm (Table 1 and Figure 6). The length of the hindwing of *T. iridipennis* indicated that the hindwing length was varied from 2.46 to 2.75 mm with an average of 2.61±0.08 mm (Table 1 and Figure 7). The hindwing breadth was varied from 0.55 to 0.65 mm with an average of 0.61±0.03 mm (Table 1 and Figure 7). The observations on the extent of hamuli of *T. iridipennis* was varied from 0.15 to 0.18 mm with an average of 0.16±0.01 mm (Table 1 and Figure 8). The mean number of hooks of *T. iridipennis* was 5.00±0.00 (Table 1 and Figure 8). The length of the hindleg showed that the hindleg length was varied from 4.45 to 4.59 mm with an average of 4.51±0.04 mm (Table 1 and Figure 9). The breadth of the hindleg of *T. iridipennis* was averaged of 0.49±0.02 mm and varied from 0.44 to 0.51 mm (Table 1 and Figure 9).

The observations on the abdomen length of *T. iridipennis* workers collected from the Saurashtra region of Gujarat revealed that the abdomen length varied from 1.41 to 1.61 mm with an average of 1.52±0.07 mm (Table 1 and Figure 10).

The result of the present study is in close agreement with Kuberappa *et al*. (2005) [3], who reported mean body length of *T. iridipennis was* 4.62 mm. According to Danaraddi and Shashidhar (2009) [4] the body length, head length, forewing length, forewing breadth, number of hooks and abdomen length of *T. iridipennis* varied from 3.93 to 4.12 mm, 1.52 to 1.61 mm, 3.30 to 3.78 mm, 1.17 to 1.41 mm, 5.00 and 1.27 to 1.51 mm, respectively. Moreover, Tej *et al*. (2017) [5] reported the mean head length, forewing length, forewing breadth and number of hooks of *T. iridipennis* were 1.53±0.05 mm, 3.38±0.07 mm, 1.53±0.02 mm and 5.00, respectively. As per Trianto and Purwanto (2020) [6] the mean head length, forewing length, forewing breadth, hindwing length, hindwing breadth and number of hooks of *T. iridipennis* were 1.75 mm, 3.74 mm, 1.44 mm, 2.71 mm, 0.63 mm and 5.00, respectively. In addition, Patel and Pastagia (2016) [7] reported the mean antennal length, tongue length, thorax length, hindwing breadth, extent of hamuli, hindleg breadth and abdomen length of *T. iridipennis* was 1.72±0.02 mm, 1.11±0.00 mm, 1.45±0.04 mm, 0.56±0.03 mm, 0.15±0.00 mm, 0.39±0.01 mm and 1.44±0.07 mm, respectively. Moreover, Devanesan *et al*. (2009) [8] reported that the mean forewing length, forewing breadth, hindwing length, hindwing breadth, number of hooks and hindleg length of *T. iridipennis* was 3.6 mm, 1.36 mm, 2.46 mm, 0.63 mm, 5.00 and 4.56 mm, respectively. As per Patnaik and Prasad (2007) [9]; Rasmussen (2013) [10] the mean number of hamuli of *T. iridipennis* was 5.00. Thus, the present findings are more or less in agreement with the results reported by earlier worker's findings.

From the results, it can be concluded that some variation was observed in the morphometric observations of *T. iridipennis* in Gujarat, which might be due to geographical variation.

Table 1: Morphometric measurement of *T. iridipennis*

Sr. No.	Body parts	Range		Mean±S.D. (mm)
		Minimum (mm)	Maximum (mm)	
1.	Body length	4.10	4.66	4.40±0.18
2.	Head length	1.47	1.55	1.51±0.03
3.	Antennal length	1.71	2.07	1.89±0.11
4.	Tongue length	0.94	1.15	1.06±0.08
5.	Thorax length	1.42	1.48	1.45±0.02
6.	Thorax breadth	1.55	1.61	1.58±0.02
7.	Forewing length	3.30	3.60	3.49±0.10
8.	Forewing breadth	1.33	1.55	1.44±0.07
9.	Hindwing length	2.46	2.75	2.61±0.08
10.	Hindwing breadth	0.55	0.65	0.61±0.03
11.	Extent of hamuli	0.15	0.18	0.16±0.01
12.	Number of hooks*	5.00	5.00	5.00±0.00
13.	Hindleg length	4.45	4.59	4.51±0.04
14.	Hindleg breadth	0.44	0.51	0.49±0.02
15.	Abdomen length	1.41	1.61	1.52±0.07

* Character mentioned indicates numbers.

Fig 1: Worker bee of *T. iridipennis*

Fig 2: Head

Fig 3: Antenna

Fig 4: Tongue

Fig 5: Thorax

Fig 6: Forewing

Fig 7: Hindwing

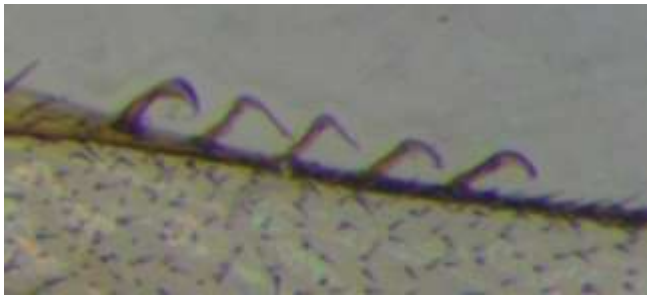

Fig 8: Hamuli

Fig 9: Hindleg

Fig 10: Abdomen

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