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Comparative morphometrics of fruit fly species in North Gujarat

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Abstract

An extensive survey was conducted from March 2024 to March 2025 to determine the distribution of fruit fly species in North Gujarat. A total of seven species were identified during the study. Morphometric analysis of ten morphological characters body length, body width, length of head, thorax, abdomen, foreleg length, mid-leg length, hind-leg length, forewing width and forewing length were measured. Among all fruit fly species *Z. cucurbitae* was larger in size followed by *B. dorsalis*, *Z. caudatus*, *B. zonata* and *D. ciliatus* while the lowest length and width was recorded from *C. vesuviana*. However, female flies were longer than their male counterparts because female have ovipositor. Moreover length of fore leg, mid leg and hind leg of adults of fruit flies revealed that the middle leg length was highest than that of fore leg and hind leg in all the species recorded.

Keywords: North Gujarat, Morphometrics, *Z. cucurbitae*, *B. dorsalis*, *Z. caudatus*, *B. zonata*, *D. ciliates*, *C. vesuviana*

Introduction

Fruit flies belong to the family Tephritidae, a fascinating and highly diverse group. They are commonly known as “fruit flies” or “orchard flies” because of their close association with fruits and are also referred to as “peacock flies” due to their characteristic habit of strutting and vibrating their wings. The family Tephritidae is one of the largest families within the Diptera order, comprising approximately 4,353 species across 483 genera (Kapoor, 2004) [7]. In India, the tribe Dacini, which includes the genus *Bactrocera*, is particularly significant. Economically, *B. cucurbitae*, *B. dorsalis* and *B. zonata* are the most common pest species, while *B. correcta*, *B. diversa* and *B. latifrons* remain restricted to specific areas (Kapoor, 2005) [8]. Fruit fly activity is observed throughout the year, with peak activity coinciding with the maturity and harvesting periods of fruits (Jena *et al.*, 2022) [5]. These pests cause direct yield losses and indirect losses through reduced trade and export opportunities (Sharma *et al.*, 2015), resulting in an estimated annual monetary loss of 144.4 million dollars (Stonehouse *et al.*, 2001) [17].

Morphometric analysis is a valuable technique for detecting morphological differences among organisms. It helps distinguish closely related species, justify synonymies, demonstrate morphological variation across altitudinal or geographical gradients and propose new species (Adsavakulchai *et al.*, 1999) [1]. This method is particularly useful for visualizing dissimilar geometrical shapes, even from the smallest distinctions (Zaelor and Khittawee, 2018)

[20]. According to Schutze *et al.* (2012) [13], wing shape is highly accurate for discriminating between fruit fly species and this approach has been applied to distinguish morphologically similar pest taxa within the *B. dorsalis* complex (Khamis *et al.*, 2012) [9].

The management of fruit flies is challenging due to their wide climate tolerance, polyphagous nature, high reproductive potential, multivoltine character and high dispersal capacity. However, an integrated approach combining sanitation with the use of lures, traps and baits has proven to be one of the most effective control methods. In this context, we have undertaken an extensive survey in North Gujarat to find out morphological difference among the fruit fly species.

Materials and Methods

An extensive survey was conducted at Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, from March 2024 to March 2025. The study involved a systematic survey of fruit flies and sampling of infested fruits across different habitats in the North Gujarat region during the summer, *kharif* and *rabi* seasons. During the peak period of fruit fly infestation, samples of infested fruits, vegetables and plantation crops were collected and traps such as methyl eugenol, cue lure, Rashvee insecticide-free liquid lure-based attractant traps and poison baits were installed. The survey covered six districts of North Gujarat i.e. Banaskantha, Sabarkantha, Mehsana, Patan, Gandhinagar and Kutch. Three talukas were selected from

each district based on the abundance of fruit orchards and vegetable farms during the respective seasons. Specimens collected from traps, poison baits and rearing cages were used for morphometric studies. Morphometric analysis of ten morphological characters i.e. body length, body width, head, thorax and abdomen length, foreleg length, mid-leg length, hind-leg length, forewing width and length also colour pattern of adult fruit fly were recorded under a microscope.

Results and Discussion

During the present investigation, fruit flies were reared from infested host samples and adults were also collected using traps placed at various locations across North Gujarat. A total of seven fruit fly species were collected and taxonomically identified. Species-wise morphometric measurements were recorded by using a stereo-trinocular microscope equipped with MOSAIC imaging software.

Bactrocera dorsalis (Hendel)

The observations on body length of adult *B. dorsalis* for male and female fruit flies was 8.09 ± 0.27 and 9.14 ± 0.29 mm, respectively. Also the mean body width was recorded as 12.55 ± 0.27 mm for males and 12.65 ± 0.35 mm for females (Table 1). The above findings on body length and width of *B. dorsalis* are in close conformity with Sharma and Gupta (2018) who found that adult male mean length and breadth with expanded wings for *B. dorsalis* were 8.18 ± 0.06 mm and 12.40 ± 0.07 mm, whereas the female mean length and breadth with expanded wings were 8.21 ± 0.06 mm and 13.13 ± 0.10 mm. These findings are in agreement with Drew *et al.* (2008) [3], who reported a thorax length of 2.93 mm for *B. dorsalis*.

The forewing length of *B. dorsalis* was recorded as 5.58 ± 0.10 mm in males and 5.58 ± 0.12 mm in females, with corresponding forewing widths of 1.86 ± 0.11 and 1.89 ± 0.08 mm, respectively. The average foreleg length measured as 5.43 ± 0.10 mm in males and 5.35 ± 0.12 mm in females. The mid-leg length was 6.02 ± 0.11 mm in males and 6.03 ± 0.08 mm in females. Similarly, the hind-leg length was recorded as 5.56 ± 0.10 mm in males and 5.57 ± 0.09 mm in females.

Kumar (2023) [10] reported that the average foreleg lengths of male and female *B. dorsalis* were 4.76 ± 0.36 and 4.89 ± 0.22 mm, respectively. The average midleg lengths for males and females were 5.65 ± 0.32 and 5.79 ± 0.22 mm, respectively. Similarly, the average hind leg lengths ranged from 5.06 ± 0.19 mm in males to 5.11 ± 0.28 mm in females. In comparison, Manurung *et al.* (2022) [12] observed the hind leg and tibia lengths of *B. dorsalis* as 5.75 and 2.25 mm, respectively. These findings are more or less consistent with the present study.

The fruit fly was comparatively large in size, characterized by a brownish chestnut-colored body and a yellow-striped thorax. The forewings exhibit a prominent black band along the anterior margin, while the abdominal region displays distinct black T-shaped markings. These morphological features are coinciding with the descriptions provided by Drew and Raghu (2002) [2], White and Elson-Harris (1992) [19], David and Ramani (2011) and Kumar (2023) [10].

Bactrocera zonata (Saunders)

Observations on the body length of adult *B. zonata* collected

from various locations in North Gujarat revealed that the body length of males was recorded as 7.45 ± 0.21 mm and 8.06 ± 0.15 mm for females. The body width of was recorded as 11.41 ± 0.25 mm for males and 11.98 ± 0.26 mm for females (Table 2). These findings on body length and width are in close agreement with those reported by Sharma and Gupta (2018), who observed that the mean body length and width (with expanded wings) of adult males were 7.68 ± 0.11 and 12.36 ± 0.10 mm, respectively, whereas females exhibited mean values of 8.05 ± 0.07 mm and 12.65 ± 0.05 mm on mango. Similarly, Singh and Sharma (2013) reported mean wing expanses of 11.96 ± 0.8 mm for males and 12.62 ± 0.2 mm for females of *B. zonata*. More prominent differences were observed in the abdominal dimensions, with males exhibiting an abdominal length of 3.09 ± 0.07 mm, while females displayed an abdominal length of 3.68 ± 0.08 mm (Table 2).

The observations on wing dimensions showed that the total wing length for male was 4.75 ± 0.08 mm, while for female, it measured as 4.77 ± 0.09 mm. The wing width was recorded 1.77 ± 0.08 mm for male and 1.78 ± 0.10 mm for female. Regarding leg measurements, the average length for fore leg length both male and female fruit flies was 5.26 ± 0.07 and 5.26 ± 0.09 mm, respectively. The mid-leg length was observed as 5.87 ± 0.12 mm in male and 5.86 ± 0.11 mm in female. For hind legs, male had an average length of 5.48 ± 0.10 mm, while female exhibited a slightly longer measurement of 5.50 ± 0.12 mm (Table 2).

Bactrocera zonata has a reddish-yellow body with a faint yellow stripe. The black band along the anterior margin of the wing is incomplete and the posterior margin lacks bands. Additionally, the abdomen does not feature the characteristic T-shaped marking. These findings are similar to the description given by Drew and Raghu (2002) [2]; White and Elson-Harris (1992) [19]. Also, Jena and Patel (2022) [6] revealed that the male *B. zonata* were slightly smaller than female flies which is similar to the current findings.

Bactrocera correcta (Bezzi)

The observations on body length of adults of *B. correcta* collected from different locations of North Gujarat indicated that the mean body length was recorded as 6.74 ± 0.16 mm for males and 7.12 ± 0.18 mm for females. Also the observations on body width of adults of males was 9.81 ± 0.11 and 9.83 ± 0.10 mm for female (Table 3). The above findings on body length and width of *B. correcta* are in close conformity with Agarwal and Mishra (2010) who stated that *B. correcta* was the smallest species among the observed fruit flies, with 6.77 mm body length and 8.86 mm width with expanded wings. Similarly, Kumar (2023) [10] found that the average body length of male and female *B. correcta* was 4.71 ± 0.27 and 5.61 ± 0.35 mm, respectively, while the average body width was 10.08 ± 0.92 mm for males and 11.54 ± 0.77 mm for females. These findings are in alignment with the results of the present study. The observations on head length measured as 1.41 ± 0.04 mm, while in female 1.42 ± 0.04 mm, with a width of 1.54 ± 0.05 mm. Regarding thorax measurements, male exhibited a thorax length of 2.57 ± 0.07 mm, whereas female length was 2.59 ± 0.06 mm. The abdomen measurements displayed notable differences between sexes, with male having an

abdomen length of 2.75 ± 0.09 mm, while female exhibited an abdomen length of 3.18 ± 0.08 mm (Table 3).

Regarding leg measurements, the average fore leg length for male and female fruit flies was recorded as 4.56 ± 0.04 and 4.57 ± 0.06 mm, respectively. The mid-leg length was observed as 5.28 ± 0.04 mm in male and 5.27 ± 0.03 mm in female. For hind legs, male exhibited an average length of 4.94 ± 0.08 mm, while for female measurement of 4.92 ± 0.10 mm (Table 3).

This fruit fly has a dark brown body. The black band along the anterior margin of the wing was incomplete, while the posterior margin lacks bands. The T-shaped marking was present on the abdomen. These findings are similar to description given by Drew and Raghu (2002)^[2]; White and Elson-Harris (1992)^[19]. Also, Weems and Fasulo (2004)^[18] depicted that *B. correcta* was brightly colored little fly, predominately black with lateral yellow stripes.

***Zeugodacus cucurbitae* (Coquillett)**

The observations on body length of adults of *Z. cucurbitae* collected from different locations of North Gujarat. The average body length for male and female fruit flies was 8.34 ± 0.22 and 9.21 ± 0.12 mm, respectively. Also average body width was 13.24 ± 0.28 and 13.28 ± 0.23 mm for male and female fruit flies, respectively (Table 4). The above findings on body length and width of *Z. cucurbitae* are in close conformity with Agarwal and Mishra (2010) who stated *Z. cucurbitae* was the largest fly in all observed fruit flies. The body measured about 8.75 mm long and width with expanded wings was 15.26 mm. Moreover it was close conformity with Laskar (2013) who found that adult female length and breadth (wing expanse) were vary from 7.45 to 9.50 and 12.20 to 16.50 mm, respectively when reared on bitter gourd. The morphometric analysis of *Z. cucurbitae* revealed notable sexual dimorphism. More pronounced differences were observed in abdominal dimensions, with males possessing an abdomen length of 3.56 ± 0.07 mm, whereas females exhibited a significantly longer abdomen measuring 4.45 ± 0.13 mm in length (Table 4).

The observations on wing dimensions indicated that the total wing length measured 5.73 ± 0.08 mm in male and 5.75 ± 0.07 mm in female. The wing width was recorded as 1.84 ± 0.08 mm for male and 1.85 ± 0.09 mm for female. Leg measurements showed, the average fore leg length for male and female fruit flies was 5.32 ± 0.10 and 5.35 ± 0.08 mm, respectively. The mid- leg length was observed as 6.03 ± 0.10 mm in male and 6.04 ± 0.10 mm in female. For hind legs, males exhibited an average length of 5.61 ± 0.09 mm, while for females it was 5.62 ± 0.06 mm.

The fruit fly has yellow-striped markings on the thorax and two black spots along the anterior margin of the wings. The wings also feature a dark-colored band. The abdomen clearly displays a black T-shaped marking. Similar observations have been documented by Drew and Raghu (2002)^[2] and Agarwal and Sueyoshi (2005). Furthermore, Weems *et al.* (2004)^[18] reported that the adult exhibits a distinct wing pattern, an elongated third antennal segment, a reddish-yellow dorsum with light yellow markings and absence of black markings and a yellowish head bearing black spots. These morphological characteristics are in agreement with the aforementioned findings.

***Dacus ciliatus* Loew**

The observations on body length of adults of *D. ciliatus* collected from different locations of North Gujarat indicated that the average body length for male and female fruit flies was 6.37 ± 0.22 and 6.87 ± 0.19 mm, respectively while the average body width was 9.56 ± 0.27 and 9.57 ± 0.23 mm for male and female fruit flies, respectively (Table 5). The head measurements revealed that male had a length of 1.35 ± 0.04 mm and female measured 1.36 ± 0.04 mm. The thorax of male exhibiting a length of 2.41 ± 0.02 mm, while female measured 2.42 ± 0.03 mm. Differences in abdomen size were more pronounced, with male registering an abdomen length of 2.62 ± 0.03 mm, whereas female displayed a notably longer abdomen of 3.01 ± 0.33 mm (Table 5).

In terms of leg measurements, the average fore leg length was found to be 4.47 ± 0.13 mm in male and 4.49 ± 0.13 mm in female. The mid-leg length was observed as 5.09 ± 0.16 mm for male and 5.09 ± 0.18 mm for female. Similarly, hind legs of male measured as 4.74 ± 0.09 mm and female as 4.75 ± 0.13 mm (Table 5).

Compared to the melon fruit fly, this fly does not have yellow-striped markings on the thorax or two black spots along the anterior margin of the wings. Instead, the wings feature a dark-colored band along the margin.

***Carpomya vesuviana* Costa**

The observations on body length of adults of *C. vesuviana* collected from different locations of North Gujarat indicated that the average body length for male and female fruit flies was 4.59 ± 0.09 and 4.92 ± 0.09 mm, respectively, whereas the average body width was 9.83 ± 0.13 and 9.85 ± 0.13 mm for male and female fruit flies, respectively (Table 6). The above findings on body length and width of *C. vesuviana* are in close conformity with Haldhar (2021)^[4] who found that the body length of female measured up to 4.82 mm while in male it was 4.44 mm. The abdomen showed more noticeable variation, with males recording a length of 2.01 ± 0.10 mm, whereas females displayed a longer abdomen of 2.27 ± 0.06 mm (Table 6).

The morphometric assessment of *C. vesuviana* indicated minor variations in wing and leg dimensions between sexes. The mean wing length was recorded as 3.95 ± 0.07 mm in males while 3.97 ± 0.13 mm for female. Also the wing width was recorded as 1.38 ± 0.06 mm for male and 1.39 ± 0.05 mm for female. The average foreleg length was 4.39 ± 0.04 mm in males and 4.41 ± 0.06 mm in females. Mid-leg length was observed as 4.71 ± 0.05 mm in males and 4.69 ± 0.09 mm in females. Similarly, the hind legs measured as 4.48 ± 0.04 mm in males and 4.49 ± 0.06 mm in females (Table 6). These findings are in close agreement with those reported by Haldhar (2021)^[4], who documented wing expanse and width in females as 3.91 mm and 1.33 mm, respectively, while in males these parameters measured as 3.83 mm and 1.21 mm. This supports the consistency of morphometric traits within the species across different studies.

This fruit fly was yellow in color and very small in size. The thorax features black and white spots. The wing markings have a distinctive pattern, with thick brownish-yellow bands on the wings.

***Zeugodacus caudatus* (Fabricius)**

Observations on the body length of adult *Z. caudatus* collected from Banaskantha district revealed that the mean body length was recorded as 7.55 ± 0.27 mm for males and 8.11 ± 0.20 mm for females. Observations on the mean body width was recorded as 11.51 ± 0.23 mm for males and 11.54 ± 0.18 mm for females (Table 7). Head measurements revealed that males had an average head length of 1.51 ± 0.08 mm, whereas females measured 1.53 ± 0.07 mm. The thorax length was recorded as 2.81 ± 0.06 mm, while in females 2.82 ± 0.06 mm. Notable differences were observed in

abdominal dimensions, with males exhibiting an abdomen length of 3.21 ± 0.06 mm, whereas females showed a significantly longer abdomen measuring 3.75 ± 0.05 mm (Table 7). The total wing length was measured as 4.73 ± 0.07 mm in males and 4.75 ± 0.06 mm in females, while the wing width was recorded as 1.79 ± 0.04 mm for males and 1.81 ± 0.05 mm for females (Table 7).

The fruit fly was medium large in size with a black colored body and yellow-striped thorax. The transparent wings are characterized by a visible costal band. The abdomen region features clearly visible black T-shaped markings.

Table 1: Morphometric characters of *Bactrocera dorsalis* (Hendel)

Sr. no.	Characters	Adult male (mm)			Adult female (mm)		
		Min.	Max.	Avg. $\pm$ SD	Min.	Max.	Avg. $\pm$ SD
1	Length of body	7.57	8.61	8.09 ± 0.27	8.84	9.58	9.14 ± 0.29
2	Width of body	12.29	13.11	12.55 ± 0.27	11.99	13.06	12.65 ± 0.35
3	Length of head	1.43	1.83	1.64 ± 0.10	1.57	1.79	1.67 ± 0.07
4	Length of thorax	2.80	3.06	2.96 ± 0.08	2.88	3.17	2.98 ± 0.09
5	Length of abdomen	3.40	3.65	3.54 ± 0.07	4.30	4.59	4.53 ± 0.09
6	Length of fore leg	5.21	5.53	5.43 ± 0.10	5.20	5.60	5.35 ± 0.12
7	Length of middle leg	5.89	6.19	6.02 ± 0.11	5.90	6.17	6.03 ± 0.08
8	Length of hind leg	5.50	5.79	5.56 ± 0.10	5.55	5.89	5.57 ± 0.09
9	Length of forewing	5.44	5.79	5.58 ± 0.10	5.39	5.78	5.58 ± 0.12
10	Width of forewing	1.70	1.99	1.86 ± 0.11	1.70	1.99	1.89 ± 0.08

Note: Mean $\pm$ SD (mm)

Table 2: Morphometric characters of *Bactrocera zonata* (Saunders)

Sr. no.	Characters	Adult male (mm)			Adult female (mm)		
		Min.	Max.	Avg. $\pm$ SD	Min.	Max.	Avg. $\pm$ SD
1	Length of body	7.04	7.60	7.45 ± 0.21	7.83	8.30	8.06 ± 0.15
2	Width of body	11.03	11.77	11.41 ± 0.25	11.03	11.90	11.98 ± 0.26
3	Length of head	1.40	1.57	1.51 ± 0.06	1.40	1.67	1.52 ± 0.08
4	Length of thorax	2.70	2.85	2.78 ± 0.06	2.69	2.89	2.80 ± 0.06
5	Length of abdomen	2.99	3.20	3.09 ± 0.07	3.57	3.78	3.68 ± 0.08
6	Length of fore leg	5.11	5.38	5.26 ± 0.07	5.10	5.39	5.26 ± 0.09
7	Length of middle leg	5.70	6.02	5.87 ± 0.12	5.67	6.01	5.86 ± 0.11
8	Length of hind leg	5.32	5.59	5.48 ± 0.10	5.39	5.69	5.50 ± 0.12
9	Length of forewing	4.58	4.87	4.75 ± 0.08	4.54	4.89	4.77 ± 0.09
10	Width of forewing	1.61	1.87	1.77 ± 0.08	1.61	1.89	1.78 ± 0.10

Note: Mean $\pm$ SD (mm)

Table 3: Morphometric characters of *Bactrocera correcta* (Bezzi)

Sr. no.	Characters	Adult male (mm)			Adult female (mm)		
		Min.	Max.	Avg. $\pm$ SD	Min.	Max.	Avg. $\pm$ SD
1	Length of body	6.50	6.95	6.74 ± 0.16	6.80	7.36	7.12 ± 0.18
2	Width of body	9.67	9.99	9.81 ± 0.11	9.69	9.99	9.83 ± 0.10
3	Length of head	1.35	1.48	1.41 ± 0.04	1.34	1.49	1.42 ± 0.04
4	Length of thorax	2.47	2.70	2.57 ± 0.07	2.49	2.67	2.59 ± 0.06
5	Length of abdomen	2.61	2.90	2.75 ± 0.09	3.10	3.30	3.18 ± 0.08
6	Length of fore leg	4.49	4.60	4.56 ± 0.04	4.44	4.61	4.57 ± 0.06
7	Length of middle leg	5.21	5.35	5.28 ± 0.04	5.23	5.31	5.27 ± 0.03
8	Length of hind leg	4.80	5.05	4.94 ± 0.08	4.80	5.10	4.92 ± 0.10
9	Length of forewing	3.88	4.24	4.05 ± 0.12	3.82	4.22	4.04 ± 0.12
10	Width of forewing	1.50	1.61	1.57 ± 0.04	1.50	1.61	1.57 ± 0.04

Note: Mean $\pm$ SD (mm)

Table 4: Morphometric characters of *Zeugodacus cucurbitae* (Coquillett)

Sr. no.	Characters	Adult male (mm)			Adult female (mm)		
		Min.	Max.	Avg.±SD	Min.	Max.	Avg.±SD
1	Length of body	7.97	8.71	8.34±0.22	8.96	9.37	9.21±0.12
2	Width of body	12.90	13.75	13.24±0.28	13.00	13.69	13.28±0.23
3	Length of head	1.60	1.80	1.71±0.08	1.60	1.97	1.73±0.11
4	Length of thorax	2.90	3.19	3.04±0.10	2.89	3.19	3.05±0.09
5	Length of abdomen	3.40	3.67	3.56±0.07	4.13	4.59	4.45±0.13
6	Length of fore leg	5.10	5.41	5.32±0.10	5.24	5.49	5.35±0.08
7	Length of middle leg	5.83	6.24	6.03±0.10	5.80	6.19	6.04±0.10
8	Length of hind leg	5.41	5.69	5.61±0.09	5.49	5.71	5.62±0.06
9	Length of forewing	5.61	5.85	5.73±0.08	5.64	5.88	5.75±0.07
10	Width of forewing	1.70	1.98	1.84±0.08	1.74	1.99	1.85±0.09

Note: Mean ± SD (mm)**Table 5:** Morphometric characters of *Dacus ciliatus* Loew

Sr. no.	Characters	Adult male (mm)			Adult female (mm)		
		Min.	Max.	Avg.±SD	Min.	Max.	Avg.±SD
1	Length of body	6.10	6.66	6.37±0.22	6.50	7.11	6.87±0.19
2	Width of body	8.99	9.90	9.56±0.27	9.20	9.90	9.57±0.23
3	Length of head	1.30	1.41	1.35±0.04	1.30	1.40	1.36±0.04
4	Length of thorax	2.36	2.46	2.41±0.02	2.37	2.46	2.42±0.03
5	Length of abdomen	2.59	2.67	2.62±0.03	2.12	3.28	3.01±0.33
6	Length of fore leg	4.20	4.60	4.47±0.13	4.22	4.63	4.49±0.13
7	Length of middle leg	4.89	5.30	5.09±0.16	4.80	5.28	5.09±0.18
8	Length of hind leg	4.60	4.90	4.74±0.09	4.50	4.90	4.75±0.13
9	Length of forewing	3.60	4.03	3.86±0.16	3.60	4.02	3.85±0.14
10	Width of forewing	1.40	1.66	1.56±0.08	1.49	1.62	1.57±0.04

Note: Mean ± SD (mm)**Table 6:** Morphometric characters of *Carpomya vesuviana* Costa

Sr. no.	Characters	Adult male (mm)			Adult female (mm)		
		Min.	Max.	Avg.±SD	Min.	Max.	Avg.±SD
1	Length of body	4.44	4.70	4.59±0.09	4.78	5.02	4.92±0.09
2	Width of body	9.57	9.95	9.83±0.13	9.65	9.99	9.85±0.13
3	Length of head	0.89	1.11	1.01±0.07	0.89	1.11	1.02±0.07
4	Length of thorax	1.50	1.69	1.59±0.06	1.50	1.66	1.60±0.05
5	Length of abdomen	1.90	2.22	2.01±0.10	2.18	2.38	2.27±0.06
6	Length of fore leg	4.30	4.44	4.39±0.04	4.30	4.47	4.41±0.06
7	Length of middle leg	4.60	4.77	4.71±0.05	4.50	4.77	4.69±0.09
8	Length of hind leg	4.38	4.52	4.48±0.04	4.40	4.59	4.49±0.06
9	Length of forewing	3.89	4.10	3.95±0.07	3.80	4.19	3.97±0.13
10	Width of forewing	1.23	1.44	1.38±0.06	1.27	1.44	1.39±0.05

Note: Mean ± SD (mm)**Table 7:** Morphometric characters of *Zeugodacus caudatus* (Fabricius)

Sr. no.	Characters	Adult male (mm)			Adult female (mm)		
		Min.	Max.	Avg.±SD	Min.	Max.	Avg.±SD
1	Length of body	7.12	7.91	7.55±0.27	7.82	8.47	8.11±0.20
2	Width of body	11.06	11.79	11.51±0.23	11.32	11.78	11.54±0.18
3	Length of head	1.41	1.67	1.51±0.08	1.42	1.67	1.53±0.07
4	Length of thorax	2.72	2.89	2.81±0.06	2.69	2.89	2.82±0.06
5	Length of abdomen	3.11	3.28	3.21±0.06	3.68	3.83	3.75±0.05
6	Length of fore leg	5.20	5.39	5.30±0.06	5.20	5.39	5.31±0.06
7	Length of middle leg	5.83	5.95	5.89±0.04	5.82	5.97	5.90±0.05
8	Length of hind leg	5.48	5.67	5.57±0.06	5.42	5.67	5.57±0.07
9	Length of forewing	4.62	4.85	4.73±0.07	4.62	4.82	4.75±0.06
10	Width of forewing	1.72	1.84	1.79±0.04	1.74	1.89	1.81±0.05

Note: Mean ± SD (mm)

Conclusions

Morphometric analysis of adult fruit flies revealed significant variation in body size among species, with *Z. cucurbitae* exhibiting greater body length and width compared to *B. dorsalis* and *Z. caudatus*. In all species examined, females were consistently larger than males, primarily due to the presence of the ovipositor. Comparative measurements of leg segments indicated that the midleg was longer than both the foreleg and hind leg across all species studied. Furthermore, *Z. cucurbitae*, *B. dorsalis* and *B. correcta* could be distinctly identified by the presence of characteristic T-shaped markings on the abdomen.

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