

**Original Article****Morphometric Detection of Mango Fruit Fly Collected from Different Mango Growing Regions of Bangladesh**Roy JK¹, Rahman MM¹, Ali MR¹ and Hossain ME^{1*}¹Department of Entomology, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh**ABSTRACT****Article History**

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Corresponding Author**Hossain ME, E-mail: emam72@sau.edu.bd**Keywords**Fruit fly, Morphometric detection, *Bactrocera dorsalis*, *Zeugodacus cucurbitae*, *Zeugodacus tau*, *Bactrocera zonataHow to cite:** Roy JK, Rahman MM, Ali MR and Hossain ME (2022). Morphometric Detection of Mango Fruit Fly Collected from Different Mango Growing Regions of Bangladesh. J. Agric. Food Environ. 3(2): 23-28.

Adult fruit flies were collected from the farmer's orchard of Dinajpur and Thakurgaon districts during the period from April to June 2020 for morphometric detection of mango fruit fly collected from different mango growing regions of Bangladesh. Five locations of each Dinajpur and Thakurgaon district were selected and surveyed for collection of mango fruit fly. The samples were used in detecting the morphometric similarities/dissimilarities at the Entomology Laboratory of Sher-e-Bangla Agricultural University. The locations for collection of the samples in Dinajpur district were Biral, Bochagonj, Kaharole, Fulbari and Khanshama and in Thakurgaon were Sadar, Pirganj, Ranisankail, Baliadangi and Haripur. Data were collected on wing, head, thorax and abdomen of fruit flies and further study was ensured. The fruit fly samples were collected using pheromone trap (methyl-eugenol) at mango orchards. Four different species were morphometrically identified using stereomicroscope. Oriental fruit fly (*Bactrocera dorsalis*), melon fruit fly (*Zeugodacus cucurbitae*), pumpkin fruit fly (*Zeugodacus tau*), and peach fruit fly (*Bactrocera zonata*) were the four species of fruit flies that were identified. Total 85.41% of oriental fruit flies were found in pheromone trap which was the highest in number among the collected species. However, 2.44 % of peach fruit fly were identified which was the lowest number of fruit fly. Moreover, 8.81% and 3.34% percent of melon fruit fly and pumpkin fruit fly were collected from pheromone trap respectively. Therefore, number of oriental fruit flies were highest compared to others. The highest infestations were observed at Dinajpur district compared to Thakurgaon district in mango orchard. Dinajpur district's oriental fruit fly was larger compared to Thakurgaon district's oriental fruit flies.

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Introduction

Mango is an important major fruit crop in the tropical and subtropical region of Asia (Sial *et al.* 2015). 55.85 million tons of mangoes were produced worldwide in 2019 (FAO, 2020). 76.49 % of the world's mango production came from Asia with India being the largest producer of 42.25 % of the world's mango production (FAO, 2020). Bangladesh is the 7th highest country in mango production of Asia accounting as 19.80 % of global production in 2019 (FAO 2020). At present, Bangladesh produces 1222368 tons of mango annually from 95 thousand hectares of land at the rate of 12.83 tons per hectare (BBS, 2020). In Bangladesh, mango ranks 1st in terms of area and 3rd in terms of production (BBS, 2020). Fruit fly is one of the most serious pests of mango fruit production (Ekesi *et al.*, 2016). In recent years,

some taxonomists have reported on the Dacinae fruit fly fauna of countries such as India, Bangladesh and China around Myanmar (Leblanc *et al.* 2014). Tephritid fruit flies, including *Bactrocera dorsalis* (Hendel) and *Bactrocera correcta* Bezzi, are the main pests that reduce the yields of marketable mango fruits in India (Nath and Bhushan, 2006). Fruit flies of Tephritidae family are divided into four main genera, including *Bactrocera*, *Anastrepha*, *Ceratitis*, and *Rhagoletis* (Malacrida *et al.*, 2007). Fruit flies of the genus *Bactrocera* have over 75 species, and *B. dorsalis* is a major pest that causes significant damage globally (Wei *et al.*, 2017). Over the past ten years, the devastating polyphagous pest *B. dorsalis* has harmed more than 250 kinds of fruits and vegetables (Liu *et al.*, 2017). In Asia, the guava fruit fly, *B. correcta*, is likewise a damaging pest (Zhang *et al.*, 2019).

Fruit flies of the genus *Bactrocera* are very common pests in tropical Asia. Previous reports by Nakahara et al. (2018) provided information on the seasonal occurrence of harmful plant pest species such *B. correcta*, *B. dorsalis*, and *B. cucurbitae*, this study summarizes all the species collected in the survey under the view of a fauna of the fruit flies, which is the first comprehensive report of fruit fly species occurring in mango orchards in West Bengal, India.

Female fruit flies lay eggs beneath the fruit's skin, which hatch into larvae that feed on the crop's decomposing flesh. Infested fruits quickly rot and become inedible or drop off from the tree causing direct loss to the farmer. Fruit fly presence is linked to quarantine limitations imposed by countries that import fruits and vegetables, in addition to the direct harm to the fruit. Direct damage has ranged from 30 to 100 percent in the absence of management that depends on the fruit maturity stage, variety, region, and season (Vaysieres et al., 2009). Rahman (2005) reported 37.50 % infestation in mango due to fruit fly. The major portion of mango is damaged by these pests every year which reduce total production and market price of mango. The *Bactrocera dorsalis* complex of tropical fruit flies is one of the most important pest species complexes in world agriculture (Clarke et al., 2005). Due to attack of mango fruit fly, a large amount of loss occurs through the country. So, if we can identify the variation of mango fruit fly occurs due to different reasons like mutation, resistance and adaptation in definite region, then effective management can be taken.

Moreover, morphometric detection of fruit fly species/race(s) could offer the great opportunity as whole adoption of Integrated Pest Management (IMP) schedule in favor of mango cultivators of the country. Hence, the present experiment aimed for morphometric detection of mango flies collected from different mango growing regions of Bangladesh.

Materials and Methods

The methods which were adopted for morphometric detection of mango fruit fly collected from different mango growing regions of Bangladesh has been discussed under the following subheadings:

Location of the experiment

The experiment was conducted at the farmer's orchard of Dinajpur and Thakurgaon districts during the period from April to June 2020. Five locations of each Dinajpur and Thakurgaon districts were selected and surveyed for collection of species that were used in detecting the morphometric similarities/dissimilarities at the Entomology Laboratory of Sher-e-Bangla Agricultural University for further testing. Experimental site at Dinajpur and Thakurgaon districts and relevant information are given below:

Table 1. Locations for collecting adult fruit flies.

SI No.	Name of the district	Name of the Upazillas
1		Biral
2		Bochagonj
3	Dinajpur	Kaharole
4		Fulbari
5		Khanshama
6		Sadar
7		Pirganj
8	Thakurgaon	Ranisankail
9		Baliadangi
10		Haripur
Total	2	10

Trapping of fruit flies through Pheromone Trap (Plastic pot)

Methyl eugenol, sometimes known as "cuelure," is a pheromone that attracts male fruit flies and traps them in large numbers, disrupting mating. It mimics the aroma of female fruit flies. The BARI trap, often known as the "Magic trap" in popular culture, is a simple plastic container that BARI scientists designed was used in this experiment. The cylindrical plastic container having 3-liter capacity and 20–22 cm tall was used for this experiment. A triangular hole measuring 10–12 cm height and 10–12 cm base was cut in two opposite sides of the container. The base of the hole was 3 cm above the bottom. Water containing two-three drops of detergent was maintained inside the trap throughout the season. Pheromone-soaked cotton or lure was tied inside the trap with thin wire. Fruit fly adults entered the trap and fall into the water and died. To keep the trap from drying out, the water level was monitored on a regular basis. Throughout the cropping season, the pheromone dispenser was used. One pheromone trap was hanged from the lower branches in three distant selected mango trees starting from 15 April before coming full maturity and was continued up to last harvest. The distance between replicates being about 50 meters. The pheromone trap was setup in the mango orchard for 48 hours. After 48 hours the fruit fly sample were collected from trap.

Identification and study of the collected specimen

The specimens were kept in a dry state until observation. After the observation, the sample were washed and preserved with ethanol. A stereoscopic microscope was used for morphological identification. Male abdomens were treated with 10% KOH and then transferred to distilled water for dissection as needed to observe the terminalia. They were placed on double-sided tape and examined under a stereoscopic microscope. Wings were mounted on prepared slides using gum-chloral mounting media and the length was measured under stereoscopic a microscope.

Data Collection

Data were collected on different parameters such as Wing pattern, Wing venation, Wing coloration, Head, Thorax and Abdomen. Head, thorax, abdomen and wing were observed under stereomicroscope and photographs of individual samples were captured.

Statistical analysis of data

The data obtained for different characters were statistically analyzed for the significance of effects/impacts. The mean values of all the characters were evaluated, and analysis of variance (ANOVA) performed by the 'F' (variance ratio) test using STATISTIX-10 software program. The significance of the difference for different characters was estimated by the Least Significant Difference (LSD) test at 5% level of probability (Gomez and Gomez, 1984).

Results and Discussions

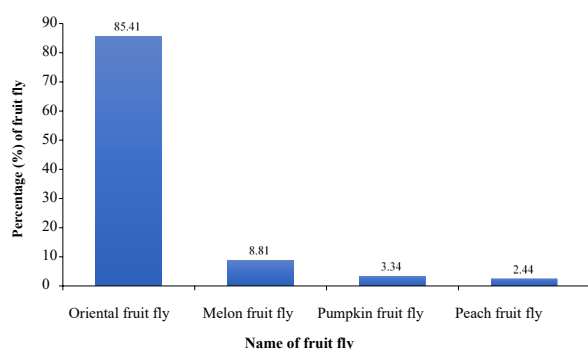
Incidence of fruit fly at different location

The fruit fly samples were collected at different location of Dinajpur and Thakurgaon districts of Bangladesh using pheromone trap (methyl-eugenol) at mango field. Four different species were identified using stereomicroscope. The name of the fruit flies was Oriental fruit fly (*Bactrocera dorsalis*), melon fruit fly (*Zeugodacus cucurbitae*), pumpkin fruit fly (*Zeugodacus tau*) and peach fruit fly (*Bactrocera zonata*). (Table 2).

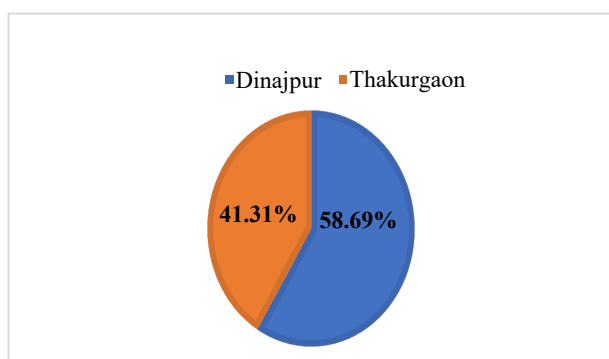
Table 2. Total number of different fruit fly were collected from pheromone trap at different location of Dinajpur and Thakurgaon districts of Bangladesh with percentage (%) value.

District	Upazilla	Total fly/trap	<i>Bactrocera dorsalis</i> (%)	<i>Zeugodacus cucurbitae</i> (%)	<i>Zeugodacus tau</i> (%)	<i>Bactrocera zonata</i> (%)
Dinajpur	Biral	182	63.19	15.93	8.24	12.64
	Bochagonj	118	66.95	12.71	7.63	12.71
	Kaharole	110	85.46	14.54	0.00	0.00
	Fulbari	258	88.76	7.75	3.49	0.00
	Khanshama	318	90.57	9.43	0.00	0.00
	Sadar	106	82.07	9.44	6.60	1.89
Thakurgaon	Pirganj	89	86.52	7.87	5.61	0.00
	Ranisankail	99	87.88	10.10	2.02	0.00
	Baliadangi	107	93.45	3.74	1.87	0.94
	Haripur	293	95.22	2.39	2.39	0.00

Total 85.41% of oriental fruit flies were found in total number of pheromone trap which was the highest in number among all the collected samples. However, 2.44 % of peach fruit fly were identified which was the lowest number of fruit fly. Moreover, 8.81 % and 3.34 % percent of melon fruit fly and pumpkin fruit fly were collected from pheromone trap, respectively (Figure 1). Therefore, numbers of oriental fruit fly were highest compared to other fruit fly.

**Figure 1. Total percent of different fruit fly were collected from pheromone trap at different location of Dinajpur and Thakurgaon districts of Bangladesh.**

The Dinajpur district covers around 22% of the mango land area. There is an occurrence of wide genetic variations in plants and insects, both in the wild and cultivated states. Highest 58.69 % of fruit flies were found in Dinajpur. On the contrary, 41.31 % fruit flies were found in Thakurgaon district which was lowest in number (Figure 2).

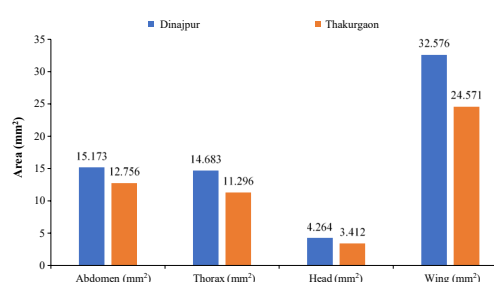
**Figure 2. Total percent of different fruit fly were collected from pheromone trap according to Dinajpur and Thakurgaon districts of Bangladesh.**

According to Drew et al. (2008), the *B. dorsalis* species complex is divided into the following categories: *Bactrocera*

spp. have a black scutellum with lateral vittae present but no medial vittae, and a yellow scutellum with a very narrow basal band (Figure 7). T3-T5 of the abdomen have a midline black band, while the sides are dark (but form of marking varies from species to species). A clear wing membrane with the exception of a little costal band (not extending to R4+5); cells bc and c that are colorless (apart from a few non-pests that have a very pale hue), with microtrichia confined to the cell c's outer corner (Figure 7).

Oriental fruit fly

Dinajpur district's oriental fruit fly was larger at four different variables compared to Thakurgaon district. 15.17 mm² areas were measured at abdominal part of the oriental fruit fly which was higher in contrast to Thakurgaon district and 12.76 mm² were respectively. According to thorax, 14.68 mm² areas were measured of the oriental fruit fly which was higher compare to Thakurgaon district and 11.30 mm² were respectively. Moreover, lowest 3.41 mm² head was measured at Thakurgaon district compare to Dinajpur district. Same observation was observed in case of wing and the 32.58 mm² were measured which was highest at Dinajpur district (Figure 3).

**Figure 3. Average area (length × width) of *Bactrocera dorsalis* collected from pheromone trap at Dinajpur and Thakurgaon districts of Bangladesh. (LSD = 2.25, 1.83, 0.56 and 5.92, respectively)**

Significant differences were observed in case of oriental fruit flies at two different districts of Bangladesh and Dinajpur district's oriental fruit fly was larger compared to Thakurgaon district's oriental fruit fly.

Melon fruit fly

Melon fruit fly heads, according to White and Hancock (1997), were similar to the Pedicel+1st flagellomere and were shorter than the ptilinal suture. Each antennal furrow on the face has a black spot; the facial spot is rounded and elongates (Figure 7). Thorax was predominant color of

scutum red-brown. Scutum with lateral post sutural vittae (yellow/orange stripes) that run parallel to the suture and back to the level of the intra-alar setae. There is a medial vitta present, however it is not extended anterior to the suture. Except for a thin basal band, Scutellum is yellow (Figure 7). The color of the abdomen was predominantly orange-brown. Tergites not fused. Abdomen not wasp waisted. Tergite 4 is dark laterally, while T3-5 has a medial longitudinal stripe. The pattern is distinct. Length of wing was 4.2-7.1 mm. With a full costal band; depth to R2+3 and perhaps R4+5. Costal band has grown into a point near the apex that stretches about half way to M. With a hint of analgia. Colorless cells bc and c (Figure 7). Legs were all femora pale basally, red-brown apically (Figure 7).

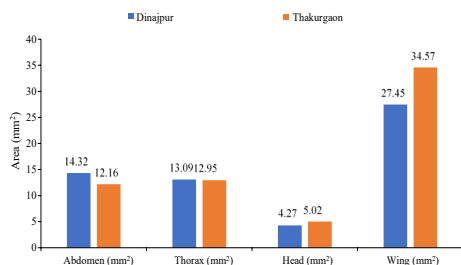


Figure 4. Average area (length × width) of *Zeugodacus cucurbitae* were collected from pheromone trap at Dinajpur and Thakurgaon districts of Bangladesh. (LSD = 1.35, 0.76, 3.57 and 3.26, respectively)

Dinajpur district's melon fruit flies were larger at abdomen area compared to Thakurgaon district. 14.32 mm² areas were measured at abdominal part of the melon fruit fly which was higher in contrast to Thakurgaon district and 12.16 mm² were respectively. According to thorax, 13.09 mm² areas were measured of the melon fruit fly which was higher compare to Thakurgaon district and 12.95 mm² were respectively. Moreover, lowest 4.27 mm² head was measured at Dinajpur district compare to Thakurgaon district and 5.02 mm² area were observed at Thakurgaon district which was the highest. Same observation was observed in case of wing and the 34.57 mm² were measured which was highest at Thakurgaon district (Figure 4). No significant differences were observed at two different district of Bangladesh melon fruit fly. Thakurgaon district's melon fruit fly was slightly larger compared to Dinajpur district and oriental fruit fly were slightly larger compare to melon fruit fly.

Pumpkin fruit fly

Pumpkin fruit fly adults have orange-brown scutum marked with black stripes contains lateral two and median and yellow stripes. Females have pointed abdomen and male have round and male was smaller than female insect (Figure 7).

12.56 mm² areas were measured at abdominal part of the pumpkin fruit fly which was higher at Dinajpur district compare to other district and the lowest value was 9.03 mm². According to thorax, 14.57 mm² areas were measured of the pumpkin fruit fly which was higher at Dinajpur district to Thakurgaon district and the value was 12.35 mm². Moreover, same trend was observed in case of head and wing of the pumpkin fruit fly (Figure 5).

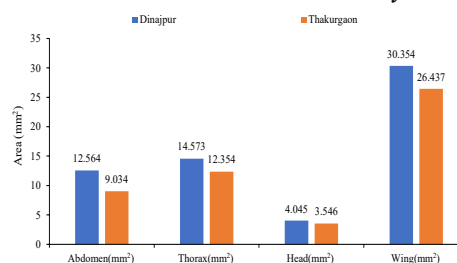


Figure 5. Average area (length × width) of pumpkin fly collected from pheromone trap at Dinajpur and Thakurgaon districts of Bangladesh. (LSD = 4.56, 2.56, 0.61 and 4.75, respectively)

No significant differences were observed at two different districts of Bangladesh in case of pumpkin fruit fly at abdominal body part. Dinajpur district's pumpkin fruit fly was moderately larger in size and shape compare to Thakurgaon district and pumpkin fruit fly were almost similar in size and shape compare to melon fruit fly. Adult *Bactrocera zonata* were 6 mm long, reddish brown in color, and had yellowish thoracic patterns. Head higher than long and chaetotaxy reduced. Dark round spots in each antennal furrow (Figure 7). In thorax, anterior supra-alar bristles present. Scutum orange brown, or red brown. Scutum has two lateral post sutural stripes (vittae) that run from pale yellowish to yellow and continue to intra-alar bristles or beyond. Without a blackish dorsoventral band, the scutum. Abdomen ovate or parallel sided and yellow to orange brown color. T5 abdominal tergites with a medial black stripe; not brown with a T-shaped yellow mark in the middle (Figure 7). Wings are yellowish and brownish in color and have a sub-costal vein (Sc) that abruptly bends to the wing edge. They also have setulae along the dorsal side of vein R1. Femora legs of *Bactrocera zonata* are slender. Regular hairs on the forefemur, but no spine bristles on the mid femur or the hind femur. Male middle leg without feathers. All-yellow femora without a dark mark (Figure 7).

Peach fruit fly

11.55 mm² area were measured at abdominal part of the peach fruit fly which was higher at Dinajpur district compare to Thakurgaon district and the lowest value was 9.95 mm². According to thorax, 14.07 mm² area were measured of the peach fruit fly which was higher at Dinajpur district compare to Thakurgaon district and the value was 11.29 mm². Moreover, same trend was observed in case of head and wing of the peach fruit fly of Bangladesh (Figure 6).

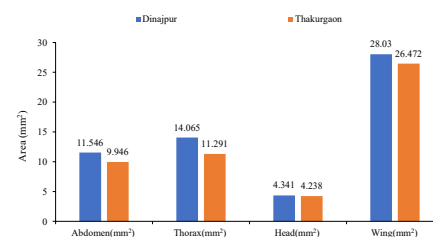


Figure 6. Average area (length × width) of *Bactrocera zonata* collected from pheromone trap at Dinajpur and Thakurgaon districts of Bangladesh. (LSD = 0.93, 2.05, 0.35 and 1.41, respectively)

Significant difference was observed at two different districts of Bangladesh in case of peach fruit fly at abdominal body part and Dinajpur district's peach fruit fly was prominent

compared to other district and peach fruit fly were almost same in size and shape with melon fruit fly.

Table 3. Length and width (mm²) of different fruit flies collected from pheromone trap at Dinajpur and Thakurgaon districts of Bangladesh with (\pm SE) value.

Species	Abdomen (\pm SE)	Scutum (\pm SE)	Head (\pm SE)	Wing (\pm SE)
<i>Bactrocera dorsalis</i>	L = 4.97 \pm 0.46 W = 4.77 \pm 0.29	L = 4.51 \pm 0.08 W = 3.23 \pm 0.15	L = 1.70 \pm 0.23 W = 2.94 \pm 0.16	L = 9.33 \pm 0.37 W = 3.57 \pm 0.47
<i>Zeugodacus cucurbitae</i>	L = 4.36 \pm 0.05 W = 3.85 \pm 0.19	L = 3.95 \pm 0.09 W = 3.25 \pm 0.05	L = 1.56 \pm 0.05 W = 2.57 \pm 0.04	L = 9.53 \pm 0.11 W = 3.65 \pm 0.01
<i>Zeugodacus tau</i>	L = 2.97 \pm 0.37 W = 2.72 \pm 0.33	L = 4.46 \pm 0.26 W = 2.81 \pm 0.06	L = 1.26 \pm 0.05 W = 2.46 \pm 0.03	L = 8.26 \pm 0.42 W = 3.05 \pm 0.04
<i>Bactrocera zonata</i>	L = 3.72 \pm 0.04 W = 3.54 \pm 0.03	L = 4.23 \pm 0.15 W = 3.11 \pm 0.15	L = 1.60 \pm 0.3 W = 2.69 \pm 0.17	L = 9.35 \pm 0.04 W = 3.47 \pm 0.03

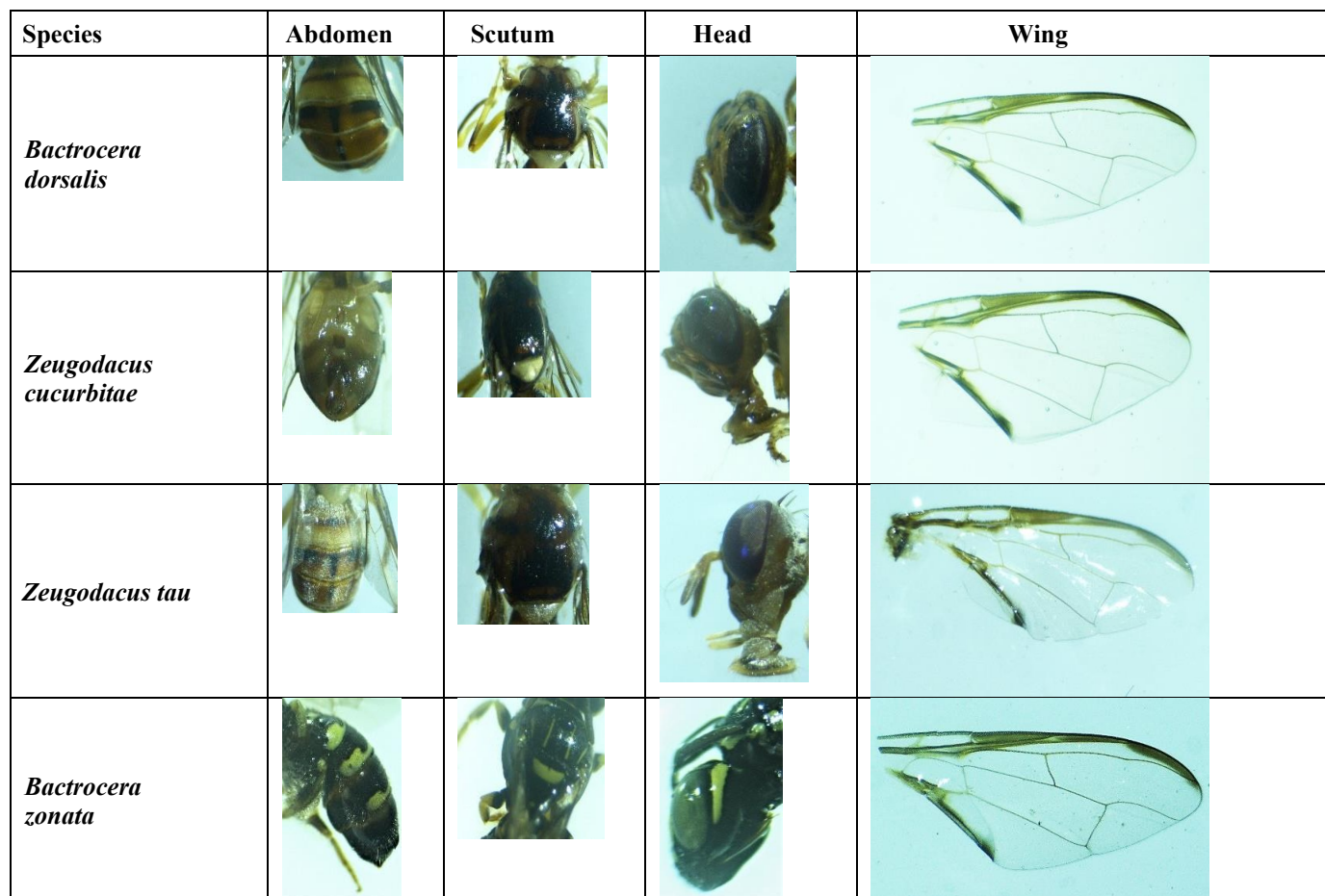


Figure 7. Abdomen, scutum, head and wing of different fruit fly collected from pheromone trap at Dinajpur and Thakurgaon districts of Bangladesh.

Conclusion

The fruit flies those were collected from Dinajpur and Thakurgaon districts were morphometrically identified into 4 species viz. oriental fruit fly (*Bactrocera dorsalis*), melon fruit fly (*Zeugodacus cucurbitae*), pumpkin fruit fly (*Zeugodacus tau*) and peach fruit fly (*Bactrocera zonata*). The numbers of oriental fruit fly were the highest compared to other fruit flies. The highest infestations were observed at Dinajpur district compared to Thakurgaon district in mango orchard. Dinajpur district's oriental fruit fly was larger compared to Thakurgaon district's oriental fruit fly. Thakurgaon district's melon fruit fly was slightly larger compared to Dinajpur district's melon fruit fly and oriental fruit flies were slightly larger compared to melon fruit flies.

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Competing interests

There are no competing interests stated by the authors.

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