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## Morphometry of *Bactrocera dorsalis* and *B. zonata* on mango (*Mangifera indica*), guava (*Psidium guajava*) and peach (*Prunus persica*)

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### Abstract

The results on the morphometric studies of *B. dorsalis* and *B. zonata* carried out on mango, guava and peach revealed that the mean egg length was in the range of 1.08 to 1.15 mm and 1.06 to 1.14 mm, for *B. dorsalis* and *B. zonata*, respectively. The maximum and minimum mean larval length of the third instar larva of *B. dorsalis* was  $8.38 \pm 0.09$  mm on mango and  $8.04 \pm 0.07$  mm on peach, respectively. In *B. zonata* the mean larval length of  $8.07 \pm 0.08$  mm on mango was at par with guava ( $7.83 \pm 0.09$  mm). The pupal length of *B. dorsalis* and *B. zonata* on mango ( $4.81 \pm 0.03$  mm and  $4.61 \pm 0.04$  mm) was at par with guava ( $4.76 \pm 0.02$  and  $4.58 \pm 0.05$  mm) and superior to peach ( $4.65 \pm 0.03$  and  $4.55 \pm 0.04$  mm). The length and wing span of female of *B. dorsalis* and *B. zonata* on mango and guava were at par and superior to peach. The maximum length of the male of *B. dorsalis* ( $8.18 \pm 0.06$  mm) and *B. zonata* ( $7.68 \pm 0.11$  mm) was recorded on mango.

**Keywords:** Morphometric, fruit fly, *Bactrocera dorsalis*, *B. zonata*

### Introduction

Fruit flies belong to the family Tephritidae of the order Diptera, containing more than 4,500 species<sup>[9]</sup>, out of which 325 species of fruit flies have been reported from the Indian subcontinent and 243 species in 79 genera are from India alone<sup>[8]</sup>. Several *Bactrocera* species are well documented as invaders of horticultural crops holding quarantine importance<sup>[6]</sup>, of which, Oriental fruit fly, *B. dorsalis*, guava fruit fly, *B. correcta* and peach fruit fly *B. zonata* are reported as major pests of fruit crops throughout India<sup>[11, 23, 10]</sup>. The fruit flies not only cause direct losses by damaging the fruits but are also responsible for the indirect losses in terms of quarantine restriction imposed by many countries for import of fruits and vegetables which has shattered the export market of fruits. An estimated loss of Rs. 29,460 million in India has been reported due to fruit flies<sup>[17]</sup>. Fruit cultivation in an area of 229.20 thousand ha and with production of 611.88 thousand metric tones<sup>[2]</sup> is the main source of income of farmers of Himachal Pradesh. Fruit fly infestation in guava, mango and peach is a major bottleneck in the production of fruits<sup>[4, 19]</sup>. The females of fruit flies puncture the soft fruits (near ripening) with the help of its sharp ovipositor and lay eggs under the fruit skin. The maggots which hatch from these eggs bore further into the fruit causing rotting and fruit fall. There may be a direct affect of host plants on the survivorship, fitness and fecundity of herbivorous insects<sup>[22, 3]</sup>. A positive relationship has been observed between the size of the herbivorous insects and performance of the insects and is also influenced by the genetic and environmental factors including the host plants they are feeding on<sup>[12]</sup>. Therefore, the effect of different fruit hosts on the morphometrics of *B. dorsalis* and *B. zonata* was carried out in the present study, to find out the effect of host plants on them.

### Materials and Methods

The infested samples of mango, peach and guava were brought to the laboratory for maintaining the initial culture of fruit flies. The fruit samples were placed in rearing cages measuring (90 x 45 x 45 cm) each, fitted with a 30cm removable tray at the base, which is filled with sieved and sterilized sand. The adults that emerged from the infested samples were identified and the adults of *B. dorsalis* and *B. zonata* were reared separately. The adults were kept in glass jars (10 x 14.5 cm) with adult food (protein hydrolysate), water and fresh fruit slices (approximately 0.2 cm thick) of the respective host plants for oviposition.

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Eggs laid within 24 h were collected and placed on black paper for observing the egg hatch. The maggots which hatched from the eggs were transferred to fresh fruit slices which were renewed until the maggots became full fed. The third instar maggots were identified by their peculiar habit of jumping. The full fed maggots were transferred to moist sterilized sand for pupation in a glass jar, whose mouth was covered with muslin cloth. The adults which emerged from these pupae were sexed and utilized for the morphometric analysis. For morphometric studies, 10 replicates of each stage, viz., egg, full fed larva, pupa and adult (male and female) were used. The measurements were carried out under Stereo Zoom Microscope (Olympus SZ61), fitted with an Ocular micrometer, which were later subjected to analysis with the help of SPSS.

## Results and Discussion

### Comparative Morphometrics of fruit flies on different fruit hosts.

#### A. *B. dorsalis*

The perusal of the data presented in Table 1 reveal that the mean egg length of *B. dorsalis* reared on mango ( $1.15 \pm 0.009$  mm) and guava ( $1.12 \pm 0.01$  mm) were at par and superior to the mean egg length in peach ( $1.08 \pm 0.01$ ), however, no

statistical difference was observed in the mean egg width recorded on mango ( $0.23 \pm 0.008$  mm), guava ( $0.22 \pm 0.005$  mm) and peach ( $0.21 \pm 0.007$  mm). Significant difference was observed in the mean larval length and width on mango ( $8.38 \pm 0.09$  and  $1.84 \pm 0.090$  mm, respectively), guava ( $8.23 \pm 0.07$  and  $1.78 \pm 0.03$  mm, respectively) and peach ( $8.04 \pm 0.07$  and  $1.69 \pm 0.04$  mm, respectively) (Table 1). The mean pupal length and width of  $4.81 \pm 0.03$  and  $2.15 \pm 0.03$  mm, respectively, was recorded on mango, which was at par with guava ( $4.76 \pm 0.02$  and  $2.12 \pm 0.03$  mm, respectively) and superior to peach ( $4.65 \pm 0.03$  and  $2.01 \pm 0.02$ , respectively), however the mean pupal length and width on guava and peach were at par. The adult female mean length and wing expanse of  $8.21 \pm 0.07$  and  $13.13 \pm 0.10$  mm on mango and  $7.95 \pm 0.07$  and  $12.97 \pm 0.09$  mm on guava being at par were superior to the adult female mean length and wing span of  $7.56 \pm 0.08$  and  $12.14 \pm 0.07$  mm, respectively, on peach. The adult male mean length was significantly different in mango ( $8.18 \pm 0.06$  mm), guava ( $7.79 \pm 0.10$  mm) and peach ( $7.12 \pm 0.07$  mm), whereas, the adult male mean wing span on mango ( $12.40 \pm 0.07$  mm) and guava ( $12.27 \pm 0.08$  mm) were at par and superior to peach ( $11.81 \pm 0.06$  mm). The results revealed that the morphometric parameters were better on mango in comparison to guava and peach.

**Table 1:** Morphometrics of *Bactrocera dorsalis* on different fruit hosts

Host	Morphometric parameter of the stage (Mean± SE)									
	Egg (mm)		Larva (mm)		Pupa (mm)		Adult (female) (mm)		Adult (male) (mm)	
	Length	Width	Length	Width	Length	Width	Length	Wing span	Length	Wing span
Mango	1.15±0.009	0.23±0.008	8.38±0.09	1.84±0.09	4.81±0.03	2.15±0.03	8.21±0.07	13.13±0.10	8.18±0.06	12.40±0.07
Guava	1.12±0.01	0.22±0.005	8.23±0.07	1.78±0.03	4.76±0.02	2.12±0.03	7.95±0.07	12.97±0.09	7.79±0.10	12.27±0.08
Peach	1.08±0.01	0.21±0.007	8.04±0.07	1.69±0.04	4.65±0.03	2.01±0.02	7.56±0.08	12.14±0.07	7.12±0.07	11.81±0.06
CDp <sub>0.05</sub>	0.03	N/A	0.08	0.11	0.08	0.07	0.22	0.26	0.23	0.21

**Table 2:** Morphometrics of *Bactrocera zonata* on different fruit hosts

Host	Morphometric parameter of the stage (Mean± SE)									
	Egg (mm)		Larva (mm)		Pupa (mm)		Adult (female) (mm)		Adult (male) (mm)	
	Length	Width	Length	Width	Length	Width	Length	Wing span	Length	Wing span
Mango	1.14±0.009	0.22±0.005	8.07±0.08	1.81±0.05	4.61±0.04	2.05±0.02	8.05±0.07	12.65±0.05	7.68±0.11	12.36±0.10
Guava	1.10±0.01	0.21±0.02	7.83±0.09	1.66±0.04	4.58±0.046	2.03±0.02	7.84±0.09	12.54±0.08	7.39±0.06	11.96±0.07
Peach	1.06±0.01	0.20±0.007	7.59±0.11	1.58±0.05	4.55±0.04	1.99±0.02	6.90±0.05	11.84±0.07	6.39±0.07	11.37±0.07
CDp <sub>0.05</sub>	0.03	N/A	0.28	0.14	0.04	N/A	0.21	0.20	0.24	0.24

#### A. *B. zonata*

The data on the morphometrics of the different stages presented in Table 2 revealed that significant difference was observed in the mean egg length on mango ( $1.14 \pm 0.009$  mm), guava ( $1.10 \pm 0.01$  mm) and peach ( $1.06 \pm 0.01$  mm), whereas, no significant difference in the mean egg width was recorded on mango ( $0.22 \pm 0.005$  mm), guava ( $0.21 \pm 0.02$  mm) and peach ( $0.20 \pm 0.007$  mm). The mean larval length on mango ( $8.07 \pm 0.08$  mm) was at par with guava ( $7.83 \pm 0.09$  mm) and superior to peach ( $7.59 \pm 0.11$  mm), however, the mean larval length in guava and peach were at par. The mean larval width of  $1.81 \pm 0.05$  mm on mango was superior to the mean larval width on guava ( $1.66 \pm 0.04$  mm) and peach ( $1.58 \pm 0.05$  mm), both being at par. The mean pupal length on mango ( $4.61 \pm 0.04$  mm) was at par with guava ( $4.58 \pm 0.05$  mm) and superior to peach ( $4.55 \pm 0.04$  mm), however, the mean pupal length on guava and peach were at par (Table 2). No significant difference among the mean pupal width was recorded on mango ( $2.05 \pm 0.02$  mm), guava ( $2.03 \pm 0.02$  mm) and peach ( $1.99 \pm 0.02$  mm). The mean length and wing span of the adult female on mango ( $8.05 \pm$

$0.07$  and  $12.65 \pm 0.05$  mm, respectively) was at par with guava ( $7.84 \pm 0.09$  and  $12.54 \pm 0.08$  mm, respectively), both being superior to peach ( $6.90 \pm 0.05$  and  $11.84 \pm 0.07$  mm, respectively). Significant difference was observed in the adult male length and wing span in mango ( $7.68 \pm 0.11$  and  $12.36 \pm 0.10$  mm, respectively), guava ( $7.39 \pm 0.06$  and  $11.96 \pm 0.07$  mm, respectively) and peach ( $6.39 \pm 0.07$  and  $11.37 \pm 0.07$  mm, respectively). All the parameters calculated for *B. zonata* were better on mango in comparison to guava and peach.

The mean length and breadth of eggs of *B. zonata* was  $1.0 \pm 0.04$  mm and  $0.2 \pm 0.00$  mm, respectively, when reared on peach [16] and slightly larger mean length and width of the eggs ( $1.36 \pm 0.12$  mm and  $0.25 \pm 0.13$  mm, respectively) of *B. dorsalis* was obtained when reared on custard apple [18], which is in agreement with the present study.

In the present study the mean larval length and width of *B. dorsalis* were  $8.04 \pm 0.07$  to  $8.38 \pm 0.09$  mm and  $1.69 \pm 0.04$  to  $1.94 \pm 0.09$  mm, respectively, and for *B. zonata* the mean larval length and width varied from  $7.59 \pm 0.11$  to  $8.07 \pm 0.08$  mm and  $1.58 \pm 0.05$  to  $1.81 \pm 0.05$  mm, respectively, when reared on mango, peach and guava, these results are in

agreement with those reported by Laskar (2013) [14], who recorded the mean larval length of *B. cucurbitae* was  $10.28 \pm 0.99$  mm and  $10.29 \pm 1.11$  mm, respectively, when reared on bitter gourd and pumpkin. Similarly, Mir *et al.* (2014) [15] reported the mean larval length and breadth of  $9.62 \pm 0.87$  mm and  $2.05 \pm 0.32$  mm, respectively, when reared on cucumber. The mean larval length and breadth of *B. tau* on pumpkin was  $8.02 \pm 1.02$  and  $1.52 \pm 0.17$  mm, respectively [21]. The length and width of the first, second and third instars of *B. dorsalis* were  $2.6 \pm 0.75$  mm and  $0.55 \pm 0.58$  mm,  $0.27 \pm 0.82$  mm and  $2.34 \pm 0.7$  mm and  $7.69 \pm 0.72$  mm and  $3.58 \pm 0.25$  mm, respectively, when reared on mango [1]. When *Bactrocera* sp. was reared on guava, the mean pupal length and width was in the range of 3.94 to 4.72 mm and 1.76 to 2.23 mm, respectively [5], which is in agreement with the results of pupal length and width obtained from the present study.

The mean length of adult for both the species (*B. dorsalis* and *B. zonata*) was minimum on peach, whereas, Costa *et al.* (2011) [7] recorded maximum ( $3.1 \pm 1.2$  mm) and minimum ( $2.6 \pm 0.09$  mm) adult length of *Ceratitidis capitata* in acerola and guava, respectively. The mean adult length of 8.16, 6.0, 6.2, 6.3 and 6.4 mm was observed when *B. dorsalis* was reared on mango, papaya, guava, sapota and banana, respectively, where the maximum adult length and wing span ( $8.16 \pm 0.09$  mm and  $14.42 \pm 0.08$  mm, respectively) was observed when *B. dorsalis* was reared on mango [13], which is in agreement with the present studies, where the maximum length and wing span was observed in mango for both the species.

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