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Biology and Morphometric Characteristics of *Bactrocera dorsalis* (Hendel) on Mango fruit at room temperature.

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ABSTRACT

The present investigation entitled **"Biology and Morphometric Characteristics of *Bactrocera dorsalis* (Hendel) on Mango fruit at room temperature.**". The experiments were undertaken at the Department of Agricultural Entomology, College of Agriculture, SVPUA&T Meerut, Uttar Pradesh. (India). Morphometric study exposed that the size of egg, such as length of egg, varied from 0.5 to 0.6 mm with mean and standard deviation of 0.53±0.02 mm and width 0.1 to 0.3 mm with mean and standard deviation 0.18±0.01 mm, respectively. The size of pre-pupae varied from 2 to 3 mm as average and standard deviation 2.81±0.08 mm and Width varied from 2 to 4 mm with average and standard deviation 9.96±0.30 mm, respectively. The length of female of *Bactrocera dorsalis* varied from 8 to 9 mm (8.69±0.26 mm) and width 12 to 13 mm (12.59±0.38 mm**).** The mature larvae of 3rd instar was slightly curved in position, became slothful and stopped feeding and remain inactive for different activities except metabolically. The female length varied from 7 to 8 mm (7.69±0.23 mm) and width 9 to 11 mm with average (8.49±0.25 mm), respectively.

Key word: Biology, *Mangifera indica, Bactrocera dorsalis*

Introduction

Mango, *Mangifera indica* is the national fruit of India that's popularly called the 'King of Fruits' belonging to family *Anacardiaceae* is one of the maximum famous tropical fruits

in the world **(Majumdar, 1990 and Sharma, 1998, Scherrer, 2007).** It is a major fruit crop with a high potential for exports. As of April 3, 2024, India's mango production for the 2023-2024 crop year is expected to increase by 14% to 24 million tonnes, up from 21 million tonnes in 2022-2023. South India, which produces 50% of the country's total mango output, is expected to have a bumper crop this year. In India according to the National Horticulture Board (NHB), India's mango production in 2023-24 is estimated to be 21.79 million metric tons (MT) across 2,400,000 hectares (**Anonymous, 2023**).The rapid human population growth of sub-Saharan Africa and the progressive urbanization has resulted in increasing rates of malnutrition and vitamin deficiency without flies control, direct damage has been reported from 30 to 80% depending on the fruit, variety, location and fruit season **(Mwatawala *et al.*, 2006)**. Fruit flies (Diptera:Tephtritidae) are recognised worldwide as the most important insect pests to fruits, especially mangos **(Drew *et al.*, 2005).** The fruit flies (Diptera: Tephritidae) are a group of serious species causing direct and indirect economic losses, all over the world. Infestations by fruit flies have been annually estimated at thousands of millions of US dollars of crop losses worldwide each year **(Sarwar, 2006).**

MATERIALS AND METHODS

The present investigation "**Biology and Morphometric Characteristics of *Bactrocera dorsalis* (Hendel) on Mango fruit at room temperature.**". The experiments were undertaken at the Department of Entomology, College of Agriculture, SVPUA&T, Meerut, Uttar Pradesh. (India).

1. To study the biology of *Bactocera dorsalis* (Hendel) at room temperature.

The biology of *B. dorsalis* on mango were studied under room temperature in the laboratory. The nucleus culture was obtained by collecting infested fruits from collected from the horticulture research centres (HRC) field. Sexually matured ten day old flies were introduced into cages. Fresh fruit pieces of 5 cm length split into two halves were

kept in petri dishes and placed inside the cage for the adult female flies to lay eggs. The females were removed from the cage 24 h after introduction.

2 Preparation of rearing cage for study of Biology of *B. dorsalis* (Hendel).

Time taken for hatching of eggs was recorded. The egg period was recorded as number of days from date of egg laying to the date of larval emergence. Ten maggots were selected for the study. Maggots were reared separately in respective fruit pieces in plastic containers and covered with muslin cloth. Fruit pieces were replaced with fresh ones at two days interval. The maggots were carefully transferred using a soft and fine bristled brush into the fresh fruit pieces. The larval period was recorded as number of days from date of larval emergence to the date of pupation. When the larvae became full grown they were transferred to glass troughs provided with soil at for pupation. The pupal period was recorded as number of days from the date of pupation till the date of adult emergence.

The emerged adults were fed with artificial diet. The adult longevity was recorded as the days taken for adult emergence to the death of the adult.

Rearing of *B. dorsalis* in Laboratory evaluation was conducted to select the most promising different mango fruits as a treatments for the Biology of mango fruit fly.

Design	:	CRD
Treatments	:	10
Replication	:	3

RESULTS AND DISCUSSION

Results obtained during the present investigation entitled **"Biology and Morphometric Characteristics of *Bactrocera dorsalis* (Hendel) on Mango fruit at room temperature "** are presented here as well discussion. The data are presented in tables and depicted graphically wherever necessary

The morphometric characteristics of different life stages *Bactrocera dorsalis* (Hendel) on mango.

The biology of *Bactrocera dorsalis* was presented in on mango pulp, in which morphological characters, developmental time and morphometric characteristics of eggs, larvae, and pupae were observed. Furthermore, the developmental time of life stages on mango pulp under room temperature conditions were also monitored. The fruit fly biology data was presented in **Table 1 and Figure 1.** Eggs were form in cluster (6-7 eggs /cluster). While three larval instars were found (1^{st} , 2^{nd} and 3^{rd} instar), which not only have difference in size and color, but the visibility of alimentary canal in 2^{nd} instar and presence of black moles on anterior and caudal side of 3rd instar are very distinguish characteristics of the *Bactrocera dorsalis* larvae.

1. Egg

The eggs of *Bactrocera dorsalis* were white, shiny, rice shaped, slightly curved in to elongate tapering at anterior and posterior end. The eggs lay in cluster form, which are embedded in the pulp of fruit vertically or slightly angled and twisting with each other. Morphometric study exposed that the size of egg, such as length of egg, varied from 0.5 to 0.6 mm with mean and standard deviation of 0.53±0.02 mm and width 0.1 to 0.3 mm with mean and standard deviation 0.18±0.01 mm, respectively.

2. Larvae (1^{st}, 2^{nd} and 3^{rd} instars)

The larvae of *B. dorsalis* passes three instars, The 1^{st} instar was emerged transparent and creamy/ white in color with length varied from 1 to 2 mm (1.89±0.06 mm) and width varied from 0.2 to 0.4 mm (0.29±0.01 mm. The 2^{nd} instar was elongated in shape and creamy in color, the distinguishing characteristic of 2^{nd} instar was the presence of externally visible alimentary canal. The 2^{nd} instar length varied from 5 to 6 mm (5.56±0.17 mm), and width varied from 2 to 3 (2.39±0.07 mm). The fully grown 3^{rd}

instar larvae had some visible characters like the head was pointed anteriorly with well-developed mandibles, hooks, spiracles on both anterior and posterior side of body and black mole on anterior and caudal side. The 3rd instars' larvae length varied from 7 to 8 mm (7.73±0.23 mm) and width varied from 3 to 4 mm (2.98±0.09 mm), respectively.

3. Pre-Pupae

The mature larvae of 3rd instar was slightly curved in position, became slothful and stopped feeding and remain inactive for different activities except metabolically. According to morph these are yellowish in color and ring structure appearance. The size of pre-pupae varied from 2 to 3 mm as average and standard deviation 2.81±0.08 mm and Width varied from 2 to 4 mm with average and standard deviation 9.96±0.30 mm, respectively .

4. Pupae

The Pupae emerged segmented and cylindrical hard, dark brown capsule. The length varied from 4 to 5 mm with average and standard deviation (4.79±0.14 mm) and width varied from 2 to 3 mm with average and standard deviation (2.89±0.09 mm), respectively .

5. Adult

The Adult flies were emerged from pupae within 8.9 days in early morning from 7.00 to 10.00 A. M. The females were easily recognized by its head with black dot, scutilium was black and yellow stripe, wings with black color, brown black thorax, the abdomen tapered shape have yellow stripes, distinct black 'T'-shaped mark and most distinguish morph character. The length of female of *Bactrocera dorsalis* varied from 8 to 9 mm (8.69±0.26 mm) and width 12 to 13 mm

Table: 1. The morphometric characteristics of different life stages *Bactrocera dorsalis* (Hendel) on mango.

Development stages	Length (mm)			Width (mm)		
	Range		Mean±SD	Range		Mean±SD
Length (mm)	Minimum	Maximum		Minimum	Maximum	
Egg (incubation period)(days)	0.5	0.6	0.53±0.02	0.1	0.3	0.18±0.01
1st instar (days)	1	2	1.89±0.06	0.2	0.4	0.29±0.01
2nd instar (days)	5	6	5.56±0.17	2	3	2.39±0.07
3rd instar (days)	7	8	7.73±0.23	3	4	2.98±0.09
Pre-pupae (days)	2	3	2.81±0.08	2	4	9.96±0.30
Pupa (days)	4	5	4.79±0.14	2	3	2.89±0.09
Male ♂	7	8	7.69±0.23	9	11	8.49±0.25
Female ♀	8	9	8.69±0.26	12	13	12.59±0.38
CD (0.05%)			0.34		0.35	

*All measurements was observed from 10 specimens

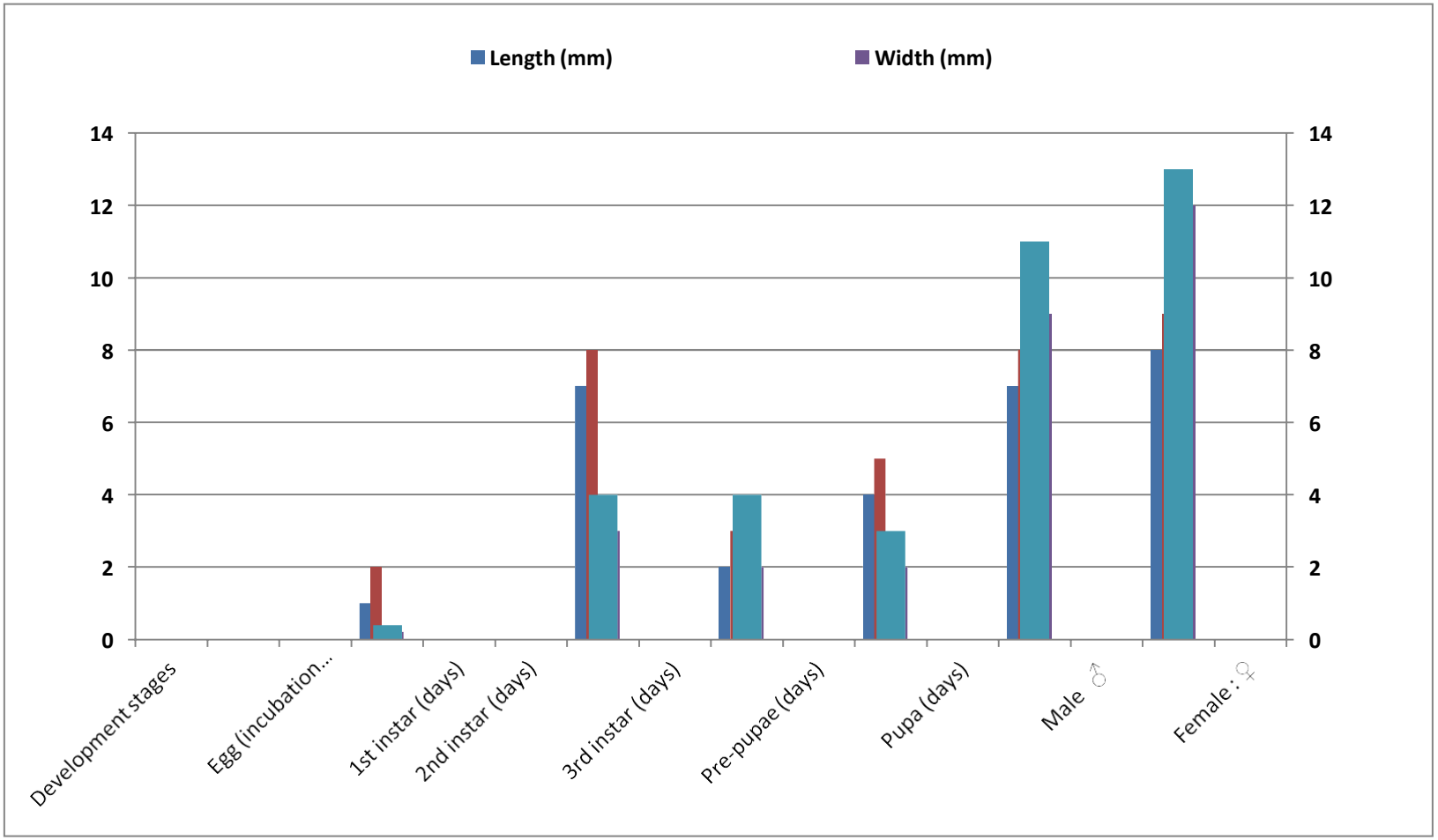

Figure No. 01. The morphometric characteristics of different life stages *Bactrocera dorsalis* (hendel) on mango

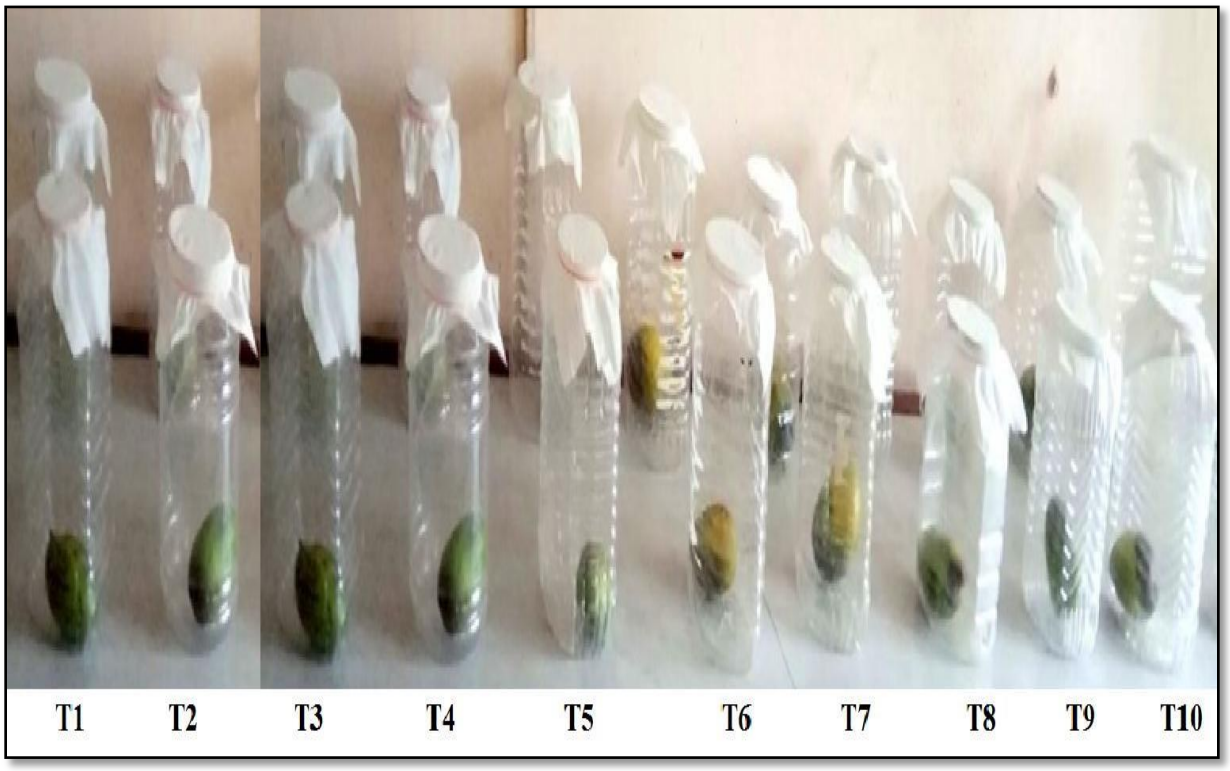

Plate No.- 1. Rearing of B. dorsalis on natural diet (Mango pulp)

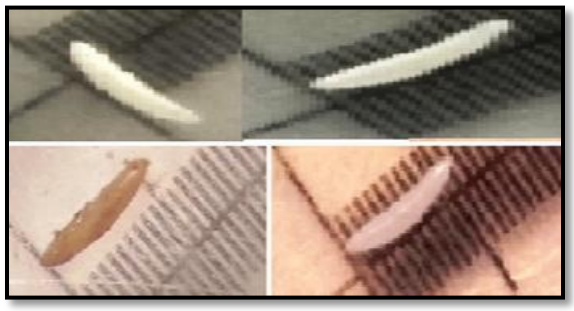

Plate No.- 2. Fruit fly Eggs

Plate No.- 3. Fruit fly 1st instar larva

Plate No.-4. Fruit fly 2nd instar larva

Plate No.- 5. Fruit fly 3rd instar larva

Plate No.- 6. Fruit fly Pupa

Plate No.- 07. Adult of *B. Dorsalis*.

(12.59±0.38 mm**)**. The male was dark brown with black stripes on abdomen. The scutellum is whole black and male is slightly shorter than female length varied from 7 to 8 mm (7.69±0.23 mm) and width 9 to 11 mm with average (8.49±0.25 mm), respectively.

The present study shows the biology, morphometric characteristics and developmental at room temperature. The present results shows the morphometric study such as that the size of egg (0.5 to 0.6 mm) laying and hatching period, similar result was reported by **(Hill, 1983)** for *B. cucurbitae* and **(Zahan *et al.*, 2014)** on *B. dorsalis*. They observed that the eggs hatched within 12 to 24 hrs. **(Amur *et al.*, 2017)** reported similar results on *B. dorsalis* and *B. zonata* which shows that in general hatching period of *Bactrocera* species is 1- 2 days on different fruits. The larvae of *B. dorsalis* pass three larval instars with different size and morphology. The 1st instar was inactive and small in size as compare to two other instars. The 2nd instar had a distinguishing characteristic *i.e*. presence of externally visible alimentary canal, which was not described by **(White and Elson- Harris, 1992).** The fully grown 3rd instar larvae had visible characters. Third instar feed rapidly in the pulp of mango, formed the tunnels and holes in the fruit pulp and peel, come outside the fruit by holes of peel, fast move and Jump. Black mole on anterior and caudal side, this distinguishing character was not noted by **(White and Elson-Harris, 1992).** According to my findings the development period was 8-10 days, these findings similar to **(Amur et al., 2017).**

The time period of different developmental stages of *Bactrocera dorsalis* (Hendel) on mango under room temperature during year 2019

The data of different developmental stages egg to adult of mango fruit fly was presented in **Table 10**

4.2.2.1 Egg

The time period of egg development, such as varied from 1 to 3 days with mean and standard deviation of 1.65±0.05 days.

4.2.2.2 Larvae (1^{st}, 2^{nd}, 3^{rd} instars)

The time period of 1^{st}, 2^{nd} and 3^{rd} instars larvae development, in 1^{st} instars larva ranged from 2 to 3 days with mean and standard deviation of 2.67±0.08 days, in 2^{nd} instar larva development period ranged from 2 to 4 day with mean and standard deviation of 4.7±0.14 days, and 3^{rd} instars larva development period ranged from 2 to 3 days with mean and standard deviation of 2.79±0.08 days. The complete larval development period such ranged from 8 to 10 days with mean and standard deviation of 9.96±0.30.

4.2.2.3 Pre-Pupae

The pre-pupal development period such ranged from 1 to 2 days with mean and standard deviation of 1.86±0.06 days.

4.2.2.4 Pupae

The pupal development period such ranged from 8 to 9 days with mean and standard deviation of 8.49±0.25 days.

4.2.2.5. Mating period

The mating period such range 9 to 10 hour with mean and standard deviation of 9.37±0.28 days .

4.2.2.6 Pre-oviposition and oviposition period

The preoviposition period varied from 13 to 14 days (13.49±0.40 days). The oviposition period ranged from 20 to 22 days (21.25±0.64 days) (Table 10). The variations in oviposition rate may be affected due to different varieties of mango, or due to some physical parameters such as ripened and ripened fruits as well as the size of peel thickness and color.

4.2.2.7 Fecundity

The egg laying capacity of a sexually mature adult female is 14-15 per day (14.51±0.44) and hatching percentage was 75 to 80 percent with average (76.31±2.29 days).

4.2.2.8 Sex ratio

The newly emerged adults were examined by presence and absence of ovipositor. The sex ratio ranged from 1 to 3 with average 1.19±0.04 (male: female) (Table 10).

4.2.2.9 Adult longevity

At room temperature were provided natural diet (mango pulp), the longevity ranged from 30 to 45 days with average (41.25±1.24 days**).**

4.2.2.10 Temperature and humidity

At room temperature ranged from 26 to 31°C with average (29.63±0.89°C **)** and humidity 55 to 65 percent with average (59.68±1.79 %**).**

Samilarly observation way made under room temperature, were observed by **(Back and Pemberton, 1918 and Hill, 1983)** copulation period was prolonged. ery close results were found by **(Singh 1960)** rearing the pre-oviposition period of *Bactrocera dorsalis* 18-22 days and same findings were also recorded on fruit flies by **(White and Elson- Harris, 1992).** The variations in oviposition rate may be affected due to different cultivars of mango, or due to some physical parameters such as ripened and ripened fruits as well as the size of peel thickness and color. Related results were also found by **(Amur *et al.*, 2017)** fecundity rate of *Bactrocera dorsalis* per day, per female were 15.0-16.0 eggs. Sex ratio may be affected by environmental fluctuations or food availability, and may be its natural phenomena. Sex ratio (♂: ♀) of *Bactrocera dorsalis* on different host such as Bannana, guava, papaya and sapota and mango 1:1.22, 1:1.1 and 1:1.06 and 1:1 respectively was reported by **(Amur *et al.*, 2017).**

4.2.3. Effect of different varieties on developmental attributes and life cycle of *B. dorsalis* under room temperature during year 2019.

The data was presented in **Table-2.** The time between eggs laying and hatching (incubation period) varied from variety to variety. On Dashhari variety 2.38±0.08 day, and these two varieties like Chaunsa 1.60±0.06 day**s** and Langara 2.34±0.07 days. The larval development duration on Dashhari variety was 7.30±0.2 days, Chaunsa variety 6.53±0.13 and Langara variety is higher compared both variety 7.60±0.14 days. This variation in development of larvae on variety was due to rich nutrients. Moreover, it was the most sugary in all varieties, which provided the favorable medium of development to the larvae. During the present study, pupae period ranged from 8 to 9 days.

Table: 2. The time period of different developmental stages of *Bactrocera dorsalis* (Hendel) on mango under room temperature

	Range (Min. & Max.)	**Mean±SD**
Egg (incubation period)(days)	1-3	1.65±0.05
1st instar (days)	2-3	2.67±0.08
2nd instar (days)	4-5	4.7±0.14
3rd instar (days)	2-3	2.79±0.08
Complete larval period (days)	8-10	9.96±0.30
Pre-pupae (days)	1-2	1.86±0.06
Pupae period (days)	8-9	8.49±0.25
Mating Period (Hours)	9-10	9.37±0.28
Pre-oviposition (days)	13-14	13.49±0.40
oviposition (days)	20-22	21.25±0.64
Fecundity	14-15	14.51±0.44
Hatching %	75-80	76.31±2.29
Sex ratio(♂ : ♀)	1-3	1.19±0.04
Adult longevity	30-45	41.25±1.24
Temperature °c	26-31	29.63±0.89
Humidity %	55-65	59.68±1.79
CD (0.05%)		0.94

S. D. = Standard deviation, C.D. = Critical Difference

The pupal development duration on Dashhari variety was 8.80±0.15 days, on Chaunsa variety was higher compared both variety 8.90±0.15 days and on Langara variety 8.70±0.15 days. The total life cycle egg to pupa were ranged 2-19 days and average on Dashhari variety 18.48±0.23 days, on Chaunsa variety 17.03±022 days and on Langara variety was higher compared both variety 18.64±0.23 days. The newly emerged adults were examined by presence and absence of ovipositor The sex ratio was 1:3 (male: female).

This variation in larval developmental time may be because nature of variety of mango. The morphometric characters like color, length and width of all developmental stages of *Bactrocera dorsalis* on three mango varieties, Dashahari,Chaunsa and Langara as we have observed in 10 specimens of each developmentalstage randomly, small variation may be occurred but no significant changes werefound

in measurement and physical appearance in each developmental stage. Present results were very close to earlier study work of **(White and Elson- Harris**,**1992)** on *Bactrocera dorsalis.* The Pupal period recorded on melon fruit fly by**(Zahan *et al.*, 2014). (Hill, 1983)** worked on pupae of the *B.cucurbitae,* As hementioned that the black dot on the posterior portion was the distinguishingcharacteristic of *B. cucurbitae,* However according to my findings, that same blackdot was on the posterior side of pupae of *Bactrocera dorsalis,* also present, there is not a distinguishing characteristic which shows cucurbit but in fact a genericcharacteristic. Results were found by **(Amur *et al.*, 2017)** on different varieties ofmango and also **(Singh, 1960)** work generally on mango as compared to otherfruits, noted that adult size (8.1mm) was maximum length of adults.

Table: 3. Effect of different varieties on developmental attributes and life cycle of *B. dorsalis* under room temperature

Varieties name	**Incubation period (days± SE)**	**Larval period (days± SE)**	**Pupal period (days± SE)**	**Total life cycle (days± SE)**	**Sex ratio ♂ : ♀**	**CD (0.05%)**
Dashahari	2.38±0.08	7.30±0.14	8.80±0.15	18.48±0.23	1:3	0.53
Chaunsa	1.60±0.06	6.53±0.13	8.90±0.15	17.03±0.22	1:3	0.51
Langara	2.34±0.07	7.60±0.14	8.70±0.15	18.64±0.23	1:3	0.54

SUMMARY AND CONCLUSION

The present concluded all about the research topic **"Biology and Morphometric Characteristics of *Bactrocera dorsalis* (Hendel) on Mango fruit at room temperature**". The experiments were undertaken at the Department of Agricultural Entomology, College of Agriculture, SVPUA&T Meerut, Uttar Pradesh. (India). The experimental findings are summarized as given below-

Morphometric study exposed that the size of egg, such as length of egg, varied from 0.5 to 0.6 mm with mean and standard deviation of 0.53±0.02 mm and width 0.1 to 0.3 mm with mean and standard deviation 0.18±0.01 mm, respectively. The fully grown 3rd instar larvae had some visible characters like the head was pointed anteriorly with well-developed mandibles, hooks, spiracles on both anterior and posterior side of body and black mole on anterior and caudal side. The size of pre-pupae varied from 2 to 3 mm as average and standard deviation 2.81±0.08 mm and Width varied from 2 to 4 mm with average and standard deviation 9.96±0.30 mm, respectively. The length of female of *Bactrocera dorsalis* varied from 8 to 9 mm (8.69±0.26 mm) and width 12 to 13 mm (12.59±0.38 mm**)**. The male was dark brown with black stripes on abdomen. The scutellum is whole black and male is slightly shorter than female length varied from 7 to 8 mm (7.69±0.23 mm) and width 9 to 11 mm with average (8.49±0.25 mm), respectively. The time between eggs laying and hatching (incubation period) varied from variety to variety. On Dashhari variety 2.38±0.08 day, and these two varieties like Chaunsa 1.60±0.06 day**s** and Langara 2.34±0.07 days. The larval

development duration on Dashhari variety was 7.30±0.2 days, Chaunsa variety 6.53±0.13 and Langara variety is higher compared both variety 7.60±0.14 days, respectively.

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