

## STUDY ON THE BIOLOGY OF CUCURBIT FRUIT FLY, *BACTROCERA CUCURBITAE*

(COQUILLET)

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### Abstract

Biology of fruit fly was examined in MCC Bangladesh field laboratory at Bogra from July to October 2009 as a part of development of the management strategies for cucurbit fruit fly (CFF), *Bactrocera cucurbitae* (Coquillett) on bitter melon. Biology of melon fruit fly, *B. cucurbitae* revealed that eggs laid by female were creamy white, slightly curved, elongated and tapering towards the ends. Surface of egg was sculptured with numerous longitudinal ridges and grooves. On an average, freshly laid eggs measured 0.78 mm in length and 0.16 mm in width; the average length of larva was 8.8 mm and width was 1.52 mm; the average length of pupa was 4.22 mm and width was 1.76 mm; the average length of the adult male was 13.78 mm and width was 7.06 mm, where the average length of the adult female was 15.62 mm and width was 8.86 mm. The mean incubation period of the fruit fly was 6.98 days. The average larval developmental period was 18.66 days. The average pupal period was 21.3 days. The mean duration of adult stage was 27.67 days. The mean duration of egg to adult was 40.34 days.

**Keywords:** *Bactrocera cucurbitae*, biology, cucurbit fruit fly, morphometric and incubation period.

### Introduction

The cucurbit fruit fly, *B. cucurbitae* is distributed widely in temperate, tropical and sub-tropical regions of the world. It has been reported to damage 81 host plants and is a major pest of cucurbitaceous vegetables. The extent of damage varies between 30% and 100%, depending on the cucurbit species and season. Its abundance increases when the temperature falls below 32 °C and the relative humidity ranges from 60% to 70% (Dhillon *et al.*, 2005 and Sapkota *et al.*, 2010). Among different cucurbit fruit fly, *B. cucurbitae* is a major threat to cucurbits (Shah *et al.*, 1948; Fletcher, 1987). To develop good management strategies knowledge about its biology is important.

According to Kapoor and Agarwal (1983) and Mathew *et al.* (1999) fruit fly, *Bactrocera cucurbitae* (Coq.) is a major pest of bitter melon. The female lays eggs in groups under the pericarp of young fruits and after hatching maggots bore into the tissues making cavities and feeding on it. Subsequently, fruit rots and maggots jump out making big exit holes.

According to Narayanan (1953) cucurbit fruit fly prefers young, green and tender fruits for egg laying. The females lay the eggs at 2 to 4 mm deep in the fruit pulp, and the maggots feed inside the developing fruits. The eggs are also laid in the corolla of the flower, and the maggots feed on the flowers. A few maggots have also been observed to feed on the stems.

The full-grown larvae come out of the fruit by making one or two exit holes for pupation in the soil. The larvae pupate in the soil at a depth of 0.5 to 15 cm. The depth up to which the larvae move in the soil for pupation, and survival depend on soil texture and moisture (Jackson *et al.*, 1998; Pandey and Misra, 1999). Depending on temperature and the host, the pupal period may vary from 7 to 13 days (Hollingsworth *et al.*, 1997). On different

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hosts, the pupal period varies from 7.7 to 9.4 days on bitter gourd, cucumber and sponge gourd (Gupta and Verma, 1995), and 6.5 to 21.8 days on bottle gourd (Koul and Bhagat, 1994; Khan *et al.*, 1993).

For better management of this destructive pest, knowledge of its biology is essential. In view of above facts and scarcity of related information on *B. cucurbitae* with special reference to bitter gourd, the present investigations were undertaken with the following objective: To know the morphometric parameters of *B. cucurbitae* on bitter gourd.

## Materials and Methods

The experiment on the biology of fruit fly was conducted in MCC Bangladesh field laboratory at Bogra, from July to October 2009. The fruit fly was reared under mosquito net earthen cages of 25cm diameter. The tops of the cages were covered with fine mosquito net and all sides of the cages were covered with moist detachable cloth for maintaining humidity and partial darkness. The adult flies were fed on sugar solution (water, sugar, glucose and yeast in the ratio of 3: 1: 1: 1, respectively). For egg laying the fruits of bitter gourd were hollowed keeping 2 mm thick peri-carp. The cavity was filled with wet cotton covered with black cloth to make the eggs easily detectable.

Larvae were directly used for experiments one day after hatching. To obtain third instar larva, some larvae were reared on an artificial diet. The diet containing vials were then covered with a clean white cloth and left overnight in the laboratory at normal temperature. The vials were then stoppard using a cotton wool and larvae were allowed to feed and grow in a controlled temperature room until third stadium.



Plate 1. Rearing of cucurbit fruit fly at field laboratory.

### Rearing solution for *B. cucurbitae*

Table 1. Amount of ingredients used to prepare artificial diet used to rear *B. cucurbitae*.

Ingredients	Quantity (g liter <sup>-1</sup> ) diet
Distilled water	500
Sugar	167
Glucose	167
Yeast	166

Morphometric study of different life stages of *B. cucurbitae* was carried out by taking 5 replicates of each stage, viz., egg, freshly 1st instar, 2nd instar, 3rd instar (fully grown larvae), pupae and adults for linear measurements. In addition to the above parameters color, shape, size and periods of eggs, maggots, pupa and adults were also recorded.

## Results and Discussion

## Results

Morphometric parameters of egg, larvae, pupa and adults were observed in the study presented in Table 2.

**Egg:** From the study it was found that the eggs were laid singly or in cluster. The deposited eggs were creamy white, slightly curved, elongated and tapering towards the ends. Surface of egg was sculptured with numerous longitudinal ridges and grooves. Freshly laid eggs measured on an average 0.78 mm in length and 0.16 mm in width.

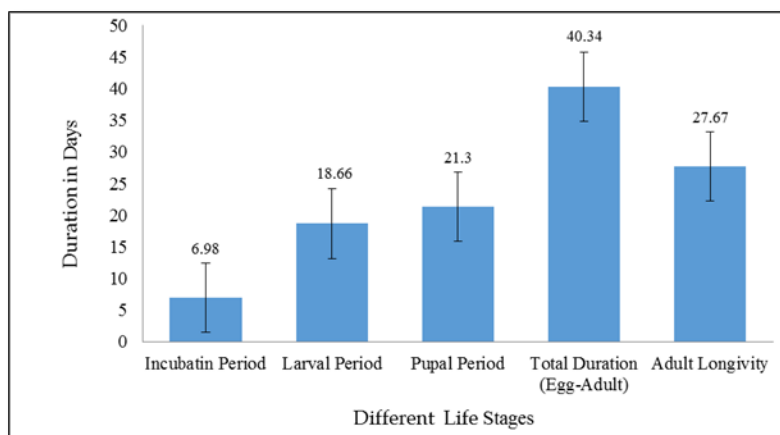
**Table 2. Morphometric measurement of different life stages of *B. cucurbitae*.**

Life stage	Mean Length (mm)	Mean Width (mm)
Egg	0.78	0.16
Maggot		
a Instar I	1.48	0.26
b Instar II	5.2	0.84
c Instar III	8.8	1.52
Pupae	4.22	1.76
Adult Male	13.78	7.06
Adult Female	15.62	8.86

**Larva:** The first instar larvae were apodus, white translucent, a bit flattened dorsoventrally at both ends. The average length of first instar larva was 1.48 mm and width was 0.26 mm. The second instar larvae were broad tapering at both ends. The average length of full grown second instar larva was 5.2 mm and width was 0.84 mm. The third instar larvae were yellowish in color due to reserve food materials. Its average length was 8.8 mm and width was 1.52 mm.

**Pupa:** The pupae were somewhat barrel shaped, anterior being narrower, freshly formed ones were yellowish and turned reddish brown later on. The average length was 4.22 mm and width was 1.76 mm.

**Adult:** The average length of the adult male was 13.78 mm and width was 7.06 mm, where the average length of the adult female was 15.62 mm and width was 8.86 mm. The average duration for different life stages of CFF is presented in Fig. 1. The mean incubation period of the fruit fly was 6.98 days. The average larval developmental period was 18.66 days. The average pupal period was 21.3 days. The mean duration of adult stage was 27.67 days. The mean duration of egg to adult was 40.34 days.



**Fig. 1: Duration of various stages of the life history of *B. cucurbitae* in days.**

## Discussion

### Morphometric description:

**Egg:** From the experiment, freshly laid eggs were measured and found on an average 0.78 mm in length and 0.16 mm in width. It was found that the eggs were laid singly or some were in cluster or in batches and it was slightly curved, elongated and tapering towards the ends. The color was creamy white. Surface of the egg was sculptured with numerous longitudinal ridges and grooves. The eggs laid by *B. cucurbitae* were creamy white, oblong, banana shaped and were about 1.3 mm in length (Anon., 1987). Weems and Heppner (2001) stated that the eggs were laid into unopened flowers, and the larvae successfully develop in the tap roots, stems, and leaf stalks. The result of the present study and the finding of the above author clearly indicate that the size and other characters of egg of cucurbit fruit fly have similarity with the findings of present study. Results of Anon. (1987) indicated that length of eggs is somewhat bigger than the results of present study, but it may be due to the fruit type or egg laying season. According to Tan and Lee (1982), Kapoor and Agarwal (1983) and Mathew *et al.* (1999) fruit fly, *B. cucurbitae* (Coq.) lays eggs in groups under the pericarp of young fruits and after hatching maggot. In the present study nature of laying eggs was more or less similar with the result of the above authors.

**Larva:** The first instars larvae were legless, whitish in color, both ends of the larvae were somewhat flattened. The average length of first instar larva was 1.48 mm and width was 0.26 mm. The second instar larvae were broad tapering at both ends. The average lengths of second larvae were 5.2 mm and width was 0.84 mm. The third instar larvae were light brown in color. Its average length was 8.8 mm and width was 1.52 mm. In an experiment Barma (2011) stated that the first instar's larvae were apodous, white translucent, a bit flattened dorsoventrally at both ends. The length varied from 1.20 to 1.62 mm and width varied from 0.22 to 0.38 mm. The second instar's larvae were broad tapering at both ends. The length varied from 4.00 to 4.70 mm and width varied from 1.08 to 1.44 mm. The third instars larvae were yellowish in color due to reserve food materials. The length varied from 7.5 to 9.20 mm and width 1.88 to 2.48 mm. The similarity and difference were found in the present study with the results of other authors who studied the biology of cucurbit fruit fly. In the third instar there was color difference with larval color of the present study and it might be due to the source of food that provided during rearing in the laboratory.

**Pupa:** For pupation all larvae were moved under the soil surface. After few days, after removing the loose soil the pupae were found as somewhat round or barreled in shape, its anterior portion was narrower; the newly formed pupae were brownish in color and finally it turned into deep brown in color. All the pupae were found within 10 cm of soil surface. The average length of the pupa was 4.22 mm and width was 1.76 mm. In different studies, Jackson *et al.* (1998); Pandey and Misra (1999) found that the larvae pupate in the soil at a depth of 0.5 to 15 cm. However, the data of pupal morphology was similar to the results of above reports that found in different times in different places.

**Adult:** From the study it was found that the average length of the adult male was 13.78 mm and width was 7.06 mm, where the average length of the adult female was 15.62 mm and width was 8.86 mm. According to Nripendra and Laskar (2013) length of the adult male may vary from 5.55 to 7.20 mm when reared on bitter melon. While in case of pumpkin it was found to vary from 5.50 to 7.00 mm. Breadth of the fly, i.e. the wing expanse varied from 10.10 to 12.65 mm and 10.10 to 12.60 mm in bitter melon and pumpkin, respectively. Nripendra and Laskar (2013) also stated that the adult females were easily distinguishable by the presence of tapering abdomen extending into an ovipositor. They are also comparatively larger than the males. Length and breadth (wing expanse) of the female adult were found to vary from 7.45 to 9.50 mm, respectively when reared on bitter melon. In case of pumpkin the length and breadth (wing expanse) varied from 7.40 to 9.45 mm and 12.00 to 16.00 mm, respectively.

#### **Development stage of cucurbit fruit fly, *B. cucurbitae***

**Incubation period:** Data from the present study showed that average range of incubation period was 6.98 days. Doharey (1983) reported that the egg incubation period on pumpkin, bitter melon, and squash melon is 4.0 to 4.2 days at  $27 \pm 1^\circ \text{C}$ , Gupta and Verma (1995) stated that 1.1 to 1.8 days on bitter melon, cucumber and sponge melon. The present findings are in agreement with the report of above authors. The incubation period was higher in the finding of above authors, but the variation is not too high and it might be for soil type where pupation is occurring, temperature or relative humidity. Reports from Koul and Bhagat (1994) and by Hollingsworth *et al.* (1997) also proved that this incubation period may vary from 1.0 to 5.1 days on bitter melon.

**Larval to adult period:** From the experiment the average of larval period was found 18.66 days. The larval period lasts for 3 to 21 days (Renjhan, 1949; Narayanan and Batra, 1960; Hollingsworth *et al.*, 1997), depending on temperature and the host. The result of the present study and the findings of the author have a similarity. On different cucurbit species, the larval period varies from 3 to 6 days (Chawla, 1966; Chelliah, 1970; Doharey, 1983;

Koul and Bhagat, 1994; Gupta and Verma, 1995). There was a minimal variation with the result of other authors, which supports the findings of above authors and it might be due to type of supplied food, temperature or relative humidity. In the case of pupa the average period was found 21.3 days. It was found by Doharey (1983) that the pupal period lasts for 7 days on bitter gourd and 7.2 days on pumpkin and squash gourd at  $27 \pm 1^\circ \text{C}$ . In general, the pupal period lasts for 6 to 9 days during the rainy season and 15 days during the winter (Narayanan and Batra, 1960). Depending on temperature and the host, the pupal period may vary from 7 to 13 days (Hollingsworth *et al.*, 1997). On different hosts, the pupal period varies from 7.7 to 9.4 days on bitter gourd, cucumber and sponge gourd (Gupta and Verma, 1995), and 6.5 to 21.8 days on bottle gourd (Koul and Bhagat, 1994; Khan *et al.*, 1993). From the present study the total duration from egg to adult stage was 40.34 days and the average longevity for the adult was 27.67 days. The adults survived from 27.5, 30.71 and 30.66 days at  $27 \pm 1^\circ \text{C}$  on pumpkin, squash gourd and bitter gourd, respectively (Doharey, 1983). Khan *et al.* (1993) reported that the males and females survived from 65 to 249 days and 27.5 to 133.5 days, respectively. The similarity and differences were found in the present study and reports on the above authors and that could be for the variation of environmental conditions.

The biology, especially the morphometric characters of cucurbit fruit fly were studied through an experiment. It was found that the CFF eggs laid singly or in cluster, they were creamy white, slightly curved, elongated and tapering towards the ends. Freshly laid eggs were on an average 0.78 mm in length and 0.16 mm in width. The average length of first instar larva was 1.48 mm and width was 0.26 mm and the average length of full grown second instar larva was 5.2 mm and width was 0.84 mm. The third instar larvae were yellowish in color due to reserve food materials and larval average length was 8.8 mm and width was 1.52 mm. The average length of pupa was 4.22 mm and width was 1.76 mm, adult male was 13.78 mm long and width was 7.06 mm, where the average length of the adult female was 15.62 mm and width was 8.86 mm. The mean incubation period was 6.98 days, larval period was 18.66 days and pupal period was 21.3 days. The mean duration of adult stage was 27.67 days and the mean range of egg to adult was 40.34 days.

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