

Original Research Article

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Bionomics of Fruit Fly, *Bectrocera cucurbitae* (Coquillet) on Cucumber under Laboratory Condition

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ABSTRACT

Investigations were carried out on “Bionomics of fruit fly, *Bectrocera cucurbitae* (Coquillet) on cucumber under laboratory condition” at Department of Entomology, College of Agriculture, Junagadh Agricultural University, Junagadh during *kharif*-2015 on cucumber variety dharwad green. Observations on various life stages were made at a 17.7 °C to 33.4 °C temperature (Av. 26.87 0C ± 5.66) and 57.8 to 89.7 per cent relative humidity (Av. 81.54 ± 6.67 % RH). The eggs were laid in the fruit tissues. The average incubation period was found to be 19.6 ± 4.72 hours. The average length and width of egg 1.12 ± 0.07 mm and 0.28 ± 0.03 mm, respectively. The maggot passed through three distinct instars and average duration of each instar was 0.81 ± 0.14, 1.60 ± 0.40 and 2.61 ± 0.29 days, respectively. The total maggot period was on an average 5.02 ± 0.83 days. The average length and width of first instar maggot was 1.52 ± 0.20 mm and 0.31 ± 0.05 mm. The average length and width of second instar maggot was 6.26 ± 0.78 mm and 1.23 ± 0.06 mm. The average length and width of third instar maggot was 9.56 ± 0.66 mm and 2.19 ± 0.22 mm. The prepupal and pupal period had an average of 0.77 ± 0.42 and 8.55 ± 0.31 days, respectively. The total pupal period was an average of 9.32 ± 0.73 days. The average length and width of prepupa was 5.68 ± 0.11 mm and 2.57 ± 0.05 mm and pupal length and width was 5.68 ± 0.11 mm and 2.57 ± 0.05mm, respectively. The male and female fruit fly lived for an average of 27.7 ± 1.42 days and 34.12 ± 1.50 days, respectively. The average length and width of the male fruit fly 8.18 ± 1.70 mm and 11.16 ± 5.70 mm whereas the female fruit fly measured 9.34 ± 1.90 mm and 15.43 ± 3.24 mm, respectively. The pre-oviposition and oviposition periods was varied an average of 12.56 ± 1.62 and 21.44 ± 4.89 days, respectively. Fecundity of female of *B. cucurbitae* was an average of 74.84 ± 11.69 at 16.8°C to 32.6°C temperature (Av. 27.62 ± 4.60°C) and 60.6 to 90.5 per cent relative humidity (Av. 80.18 ± 5.85 % RH). Sex ratio of male and female *B. cucurbitae* at 16.8°C to 32.6°C temperature (Av. 27.62 °C ± 4.60°C) and relative humidity 60.6 to 90.5 per cent (Av. 80.18 ± 5.85 % RH) was 1: 1.12. The entire life span of male was an average of 21.92 ± 5.83 days and that of female was an average of 25.28 ± 5.96 days. Thus, the life span of male was shorter than female.

Keywords

Cucumber, *Bectrocera cucurbitae* (Coquillet), bionomics

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Introduction

Cucumber, *Cucumis sativus* (Linnaeus) is one of the oldest vegetable amongst the cultivated vegetable crops belonging to the family cucurbitaceae and has been in cultivation since 3000 to 4000 years. It is originated in India from where it spread to Asia, Africa and Europe.

It is one of the most popularly grown during kharif, rabi and summer seasons. The immature fruits of cucumber are used as salad and for pickling. It also consumed as raw and used as astringent and antipyretic (Thamburaj and Singh, 2003).

The area, production and productivity of cucumber in country are 25 lakh hectares, 106 lakh tonnes and 6000 kg/ha, respectively during 2011 (Vanitha *et al.*, 2013). The cucumber is produced in the states of India including Gujarat, Andhra Pradesh, Karnataka and hilly parts of North India. The Andhra Pradesh ranks first among all the major cucumber growing states (Bose *et al.*, 2002).

Fruit fly, *B. cucurbitae* is one of the important insect pests of cucurbit vegetables throughout the India. It has been found to cause about 30 to 100 per cent yield loss. Cucurbitaceous fruits are severely damaged either partially or totally rendering them unfit for human consumption by this pest (Pareek and Kavadia, 1974).

Basic studies on the bionomics of fruit fly include the development of immature stages, *i.e.*, eggs, maggots and pupae as well as the life of the adults under the influences exercised by the environmental conditions and genetic factors, which govern the basic lines of behaviour and ecological factors, which may produce different type of reaction in a population having the same genetic characteristics. So, an experiment was carried

out at Department of Entomology, Junagadh Agricultural University, Junagadh during the year 2015.

Materials and Methods

The experiment was conducted at Department of Entomology, College of Agriculture, Junagadh Agricultural University, Junagadh, during kharif season of the year 2015.

Rearing technique

To initiate the culture of *B. cucurbitae* in the laboratory, infested fruits (with maggot inside) of cucumber grown in the Instructional Farm, College of Agriculture, JAU, Junagadh were collected and kept in 20 × 20 × 8 cm plastic trays on a 5 cm-thick layer of sieved moist sand to facilitate pupation. After every 3-4 days, sand was sieved and newly formed pupae were collected. The pupae were kept in 10 cm diameter petri dishes (25 pupae/petri dish) lined with moist filter paper. The newly emerged adult flies were collected and placed inside the rearing cages (75 × 30 × 30 cm). Each rearing cage had wire mesh on 5 sides and a wooden door at one side. The male and female flies were identified by visual examination under microscope. In male the abdomen was blunt, ovipositor became absent. They were also smaller in size than that of the females.

A honey solution (10% W/V) was provided inside the cage for adult feeding. This honey solution was kept in a 10 ml beaker and a thumb sized water-soaked cotton swab was laid in such a way that half of it was immersed in honey solution and remaining half stayed above rim of the beaker to keep the solution in reach of adult fruit flies. Slices of cucumber were kept inside each breeding cage for oviposition. These slices were replaced by fresh ones daily to avoid decay. Entire fruit culture was maintained at room temperature.

Method of observations on life stages

Egg

The eggs were observed under microscope daily in the morning and evening till hatching. The egg was considered as hatched when tiny maggot came out from it. The eggs were examined for incubation period, hatching percentage, length and width. Incubation period was calculated from the date of egg laying to the date of hatching. Hatching percentage was calculated from the data on number of eggs hatched out of total number of eggs under observation.

Maggot

The maggots were examined for number of instars, total maggot period, length and width. The total maggot period was calculated from the date of egg hatching to the date of formation of prepupa.

Pupa

When fully grown maggot stopped feeding and became inactive, it was considered as prepupal stage. The prepupal period was recorded from the date of inactivation of fully grown maggot to date of formation of pupa. Pupal period was calculated from the date of formation of pupa to the date of emergence of the adult from the pupa.

Adult

In adult both the sexes were separated by visual observation under microscope. In male the abdomen was blunt, ovipositor became absent. Male was smaller in size than that of the female. Five pair of male and female was released in the oviposition cage individually. Cotton swab soaked in fruit juice of respective host was provided to the adults as food source. The tender fruit slices were also placed inside

the oviposition cage for egg laying. The data on duration of pre-oviposition, oviposition, total longevity of male and female, sex ratio and fecundity were recorded. Pre-oviposition period was calculated from the date of emergence to the date of starting of laying egg. Oviposition period was calculated from date of starting laying egg to the date of stopping laying egg. Longevity of male and female was calculated from the date of emergence to the date of death of adults.

The length and width was measured with help of Leica microscope and measuring software.

Results and Discussion

Egg

The female of cucumber fruit fly inserted their eggs, partially or completely, into tissue of fruits by making incision with the help of saw like ovipositor.

Freshly laid eggs (Plate 2) were glistening white, slightly curved, pointed at one end while, rounded at the other end. However, the number of eggs laid by a female, incubation period and ovipositional periods were derived on the basis of number of maggot emerged out from the eggs.

The data on length and width of egg varied from 1.00 to 1.27 mm with a mean of 1.12 ± 0.07 mm and 0.23 to 0.35 mm with a mean of 0.28 ± 0.03 mm, respectively (Table 1). Similar results were reported by Mir *et al.*, (2014) when reared on cucumber.

Incubation period

A pair of male and female was enclosed in a glass vial containing a slice of cucumber fruit for oviposition (Plate 1). The fruit slice were collected after 24 hour from the vial and kept individually into a separate vial for hatching

of the eggs. As soon as the larvae emerged out from the fruit slice, the incubation period was recorded. The data thus obtained are summarized in Table 2 revealed that the incubation period varied from 13 to 29 hours with an average of 19.6 ± 4.72 day.

These results are in the close agreement with those of Waseem *et al.*, (2012) who reported that incubation period on cucumber lasted from 24.4 to 38 hr. Thus, the observations obtained through present investigations are in close confirmation with the earlier findings.

Maggot

An investigation was carried out to study the distinct maggot instars, instar durations and entire maggot period of this pest. Newly hatched maggot was reared individually up to pupation in separate glass vials containing fresh cucumber fruit (Plate 1). The data on body length and width, instar duration and total maggot period are presented in Table 1 and 2.

First instar

First instar maggot was apodous, translucent, elongate and white in colour. The measurement of first instar revealed that the body length and width (Table 1) varied from 1.23 to 1.90 mm with an average of 1.52 ± 0.20 mm and 0.22 to 0.39 mm with an average of 0.31 ± 0.05 mm. Similar observations were reported by Mir *et al.*, (2014) when reared on cucumber.

Second instar

The second instars were elongate, translucent and creamy white in colour. The second instar body length and width (Table 1) ranged from 4.92 to 7.35 mm with an average of 6.26 ± 0.78 mm and 1.09 to 1.33 mm with an average of 1.23 ± 0.06 mm.

Third instar

The third instars having a pointed head with well-developed mandibular hooks and spiracles. It has the ability to curving and springing into the air by the relaxation of certain muscles. By this ability the maggot was transferred to pupation site from fruit.

The Third instar body length and width (Table 1) ranged from 8.34 to 10.53 mm with an average of 9.56 ± 0.66 mm and 1.84 to 2.55 mm with an average of 2.19 ± 0.22 mm. Similar observations were reported by Mir *et al.*, (2014) when reared on cucumber.

Number and duration of maggot instars of *B. cucurbitae*

Observation on number and duration of maggot instars are presented in Table 2. The data in Table 2 observed that the maggot passed through three instars before attaining the pupal stage. The duration of first, second and third instar maggots varied from 0.6 to 1.0 days, 1.1 to 2.0 days and 2.1 to 3.0 days with an average of 0.81 ± 0.14 , 1.60 ± 0.40 and 2.61 ± 0.29 days, respectively. The present findings are in close confirmation with the results reported by Mir *et al.*, (2014).

Prepupa and pupa

In pupal stage of fruit fly, maggots of 3rd instar were stopped feeding, became sluggish and become stable and stationary, this stage is prepupal stage. The pupae were cylindrical and deep brownish to gray in colour. In pupa black dot is found on the posterior part. Normally pupation occurs in soil.

The prepupal stage was observed to be 0.6 to 1 day (Table 2). After prepupal development was completed, the insect goes into the pupal stage. Similar observations were recorded by Lanjar *et al.*, (2013).

Table.1 Bionomics of different life stages of *B. cucurbitae* reared on cucumber

Stage	Length(mm)			Breadth(mm)		
	Minimum	Maximum	Av. ± S.D.	Minimum	Maximum	Av. ± S.D.
Egg	1.00	1.27	1.12 ± 0.07	0.23	0.35	0.28 ± 0.03
1 st instar	1.23	1.90	1.52 ± 0.20	0.22	0.39	0.31 ± 0.05
2 nd instar	4.92	7.35	6.26 ± 0.78	1.09	1.33	1.23 ± 0.06
3 rd instar	8.34	10.53	9.56 ± 0.66	1.84	2.55	2.19 ± 0.22
Prepupa	6.20	6.58	6.37 ± 0.12	1.96	2.04	2.00 ± 0.02
Pupa	5.52	5.89	5.68 ± 0.11	2.49	2.67	2.57 ± 0.05
Adult (male)	8.21	8.72	8.18 ± 1.70	10.69	12.39	11.16 ± 5.70
Adult (female)	9.49	9.98	9.34 ± 1.90	14.90	16.60	15.43 ± 3.24

Table.2 Duration of different life stages of *B. cucurbitae*

Stage	Duration (Hours)			
	Minimum	Maximum	Av. ± S.D.	
Egg(incubation period)	13.0	29.0	19.6 ± 4.72	
1 st instar	0.6	1.0	0.81 ± 0.14	
2 nd instar	1.1	2.0	1.60 ± 0.40	
3 rd instar	2.1	3.0	2.61 ± 0.29	
Total larval period	3.8	6.0	5.02 ± 0.83	
Prepupal period	0.6	1.0	0.77 ± 0.42	
Pupal period	8.0	9.0	8.55 ± 0.31	
Total pupal period	8.6	10.0	9.12 ± 0.73	
Facundity	59.0	91.0	74.84 ± 11.69	
Preoviposition period	10.0	15.0	12.56 ± 1.62	
Oviposition period	13.0	28.0	21.44 ± 4.89	
Hatching percentage	82.0	88.0	85.24 ± 1.83	
Adult period	male	25.1	29.9	27.7 ± 1.42
	Female	31.1	36.7	34.12 ± 1.50
Total life span	male	13.0	30.0	21.92 ± 5.83
	female	16.0	35.0	25.28 ± 5.96
Sex ratio (male : female) total observed 200 adult	Male 94	Female 106	1.12	

*All measurements are mean of 25 observations

Measurements

The body length of pupa was recorded and summarized in Table 1. It is evident from the data (Table 6) that the length and width of prepupa ranged from 6.20 to 6.58 mm with an average of 6.37 ± 0.12 mm and 1.96 to 2.04 mm with an average of 2.00 ± 0.02 mm. The total maggot period varied from 3.8 to 6 days with an average of 5.02 ± 0.83 days. Almost similar

result was obtained by Mir *et al.*, (2014) on cucumber.

Duration of pupal stage of *B. cucurbitae*

The 25 pupa are observed for examining the pupal period. The observations are presented in Table 2. The observation presented that the prepupal and pupa period varied from 0.6 to 1.0 days and 8.0 to 9.0 day with an average of 0.77

± 0.42 and 8.55 ± 0.31 days, respectively. The total prepupal and pupal period varied from 8.6 to 10 days with an average of 9.32 ± 0.73 days. Lanjar *et al.*, (2013) observed the pupal period range between 7 - 13 days and the mean was 9.94 ± 1.03 days.

Adult

The adult flies emerged from pupa were pale yellow with wings stuck to their bodies and inactive. The fly takes a little time to take an appearance of fly. The adult having lemon yellow curved vertical markings on the thorax with reddish brown and shades on the outer border of the wings. Male flies were smaller than females. Male and female separated by presence of ovipositor in the posterior part of the abdomen. After 4-5 hrs the flies spread their wings. The length and width of the male with expanded wings was 8.18 ± 1.70 mm and 11.16 ± 5.70 mm, respectively, whereas, the female with expanded wings measured 9.34 ± 1.90 mm in length and 15.43 ± 3.24 mm in width. Table 1 findings are in close confirmation with the results reported by Mir *et al.*, (2014).

Measurements

Body length and width across the expanded wings of male and female of *B. cucurbitae* are presented in Table 1. The data from Table 1 revealed that length of the male fruit fly ranged from 8.21 to 8.72 mm (8.18 ± 1.70 mm) in length and 10.69 to 12.39 mm (11.16 ± 5.70 mm) in width, whereas the female fruit fly measured from 9.49 to 9.98 mm with an average of 9.34 ± 1.90 mm in length and 14.90 to 16.60 mm with an average of 15.43 ± 3.24 mm in width. Thus, the male is smaller than female. The findings are in close confirmation with the results reported by Mir *et al.*, (2014).

Longevity

The longevity of adults of *B. cucurbitae* is examined and results obtained are given in Table 2.

The data indicated that the male and female fruit fly lived for 25.1 to 29.9 day (Average 27.7 ± 1.42 day) and from 31.1 to 36.7 day (Average 34.12 ± 1.50 day), respectively.

Oviposition duration

Pre-oviposition and oviposition periods of this pest are observed and summarized in Table 2.

The data indicated that the pre-oviposition and oviposition periods varied from 10 to 15 and 13 to 28 days with an average of 12.56 ± 1.62 and 21.44 ± 4.89 days, respectively.

Ovipositional potential

To study the fecundity of the female, the newly emerged adult flies were collected and placed inside the rearing cages each ($75 \times 30 \times 30$ cm) (Plate 1). Each rearing cage had wire mesh on 5 sides and a wooden door at one side. The male and female flies were identified by visual examination under microscope. In male the abdomen was blunt and ovipositor absent.

They were also smaller in size than that of the females. On the bottom of each cage there was a 2 cm-thick layer of sieved sand with 5 per cent moisture. A honey solution (10 % W/V) was provided inside the cage for adult feeding. This honey solution was kept in a 10 ml beaker and a thumb sized water-soaked cotton swab was laid in such a way that half of it was immersed in honey solution and remaining half stayed above rim of the beaker to keep the solution in reach of adult fruit flies.

Slices of cucumber were kept inside each breeding cage for oviposition. These slices were replaced by fresh ones daily to avoid decay. The results are presented in Table 2.

From Table 2 it is observed that the number of eggs produced by a single female varied from 59 to 91 eggs with an average of 74.84 ± 11.69 eggs in laboratory condition. Lanjar *et al.*, (2013) observed that each female may lay 50 to over 91 eggs in the tissue of fruit.

Sex ratio of *B. cucurbitae*

In fruit fly adult sexes were determined on the basis of the presence of ovipositor in female and absent in the male (Plate 2). The observations are presented in Table 2 showed that out of 200 laboratories reared adults, 94 were males and 106 were females given a male to female ratio of 1:1.12.

Thus, the data clearly indicated that the females were predominant over males under laboratory conditions.

Entire life span

The duration of entire life span (from egg to the death of adult) of *B. cucurbitae* was observed and summarized in Table 2. It can be seen from the data that the life span of male varied from 13 to 30 days with an average of 21.92 ± 5.83 days and that of female, 16 to 35 days with an average of 25.28 ± 5.96 days. Thus, the life span of male was shorter than female.

Little changes observed in the measurements were due to variation in the abiotic factors and genetic factors.

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