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BIOLOGY AND LIFE CYCLE OF *BACTROCERA CUCURBITAE* COQUILLET, A SERIOUS PEST OF CUCURBITS IN JAMMU REGION (JAMMU AND KASHMIR) INDIA

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ABSTRACT

Bactrocera cucurbitae Coquillett, commonly called as melon fly, is a polyphagous pest of a variety of economically important agricultural crops. This dipteran fly is a serious pest of cucurbits. The study on its biology and life history reveals that a gravid female lays eggs in small clusters about 2-3mm deep in fruit pulp. The average time period for completion of the life cycle by passing through various life stages viz. egg, larva, pupa and adult, is 23.5±5.94. The longevity of the adult male and female flies is about 13±2.41 and 15.5±3.49 respectively. Adults are strong fliers and have characteristic markings on the thorax and abdomen.

Key Words:

Bactrocera cucurbitae; Cucurbits;
Biology; Life Cycle.

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INTRODUCTION

Cucurbits, belonging to family Cucurbitaceae, are the vegetable crops which are primarily consumed as food worldwide. They constitute the largest group of the summer vegetables. Cucurbits are rich in iron, vitamins (A,B,C), proteins, minerals. They are known for numerous medicinal properties as bitter gourd juice being used to cure diabetes; bottle gourd fruit juice has high blood pressure and heart valve blockage ameliorating properties. Cucurbit seeds are valued for their high oil and protein contents comparable to that of legumes and are richer in methionine, a crystalline amino acid containing sulphur and essential for nutrition. Cucurbits are infested with a variety of insect pests from early stages of the crop to the harvest stage. Major insect pests of cucurbits are Red pumpkin beetle, Hadda beetle and Melon fruit flies.

Fruit fly (*Bactrocera cucurbitae*) is one of the most destructive pests of cucurbits causing direct yield loss. In India, because of the polyphagous nature of their larvae, fruit flies are considered as one of the ten most serious insect pests of the entire agriculture. Of 207 species of fruit flies found in India, nine are identified to be the major and economically important (Sardana *et al.*, 2005).

Bactrocera cucurbitae (Coquillett) and *Bactrocera tau* (Walker), commonly called as melon fruit flies are the two major species of the fruit flies infesting cucurbits. They have

also been found feeding on some solanaceous crops like tomato and brinjal (Kapoor and Agarwal 1983). Generally, the female fruit flies puncture the soft and tender fruits and lay the eggs. After hatching, the maggots feed on the pulp of the fruits and simultaneously the secondary infection also attacks, resulting in rotting of fruits. In India, about 50 per cent of cucurbits are partially or completely damaged by fruit flies (Gupta and Verma, 1992).

MATERIALS AND METHODS

For studying the life cycle of melon fruit fly, *Bactrocera cucurbitae* Coquillett, the adults were collected from the fields of cucurbits, by using entomological nets and were kept in the rearing cage, under laboratory conditions. They were continuously fed on cotton swabs dipped in cucumber juice. The adults were released in pairs for mating and to record the fecundity rate of the female as well as longevity of both male and female. Observations were made with regard to life cycle, biology, feeding behavior and the extent of damage caused by these insect pests in laboratory and supplemented by field studies. Data gathered during the experiment was analyzed statistically for calculating mean, standard deviation and standard error.

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RESULTS AND DISCUSSION

Distribution

The melon fruit fly is cosmopolitan in distribution being found all over the world. In the world, it has been reported from Afghanistan, Bangladesh, Cambodia, China, Egypt, Hawaii, Iran, Laos, Malaysia, Nepal, Oman, Pakistan, Philippines, Singapore, Solomon Islands, Somalia, South Africa, Sri Lanka, Tanzania, Thailand, United Arab Emirates, Vietnam, and India (Weems *et al.*, 2001). India is considered its native home (Dhillon *et al.* 2005). Bezzi (1913) published the first report on melon fruit flies, in which he listed 39 species from India. In the state of Jammu and Kashmir it has been reported by Ganie *et al.* (2012).

Host

Melon fruit flies are known to infest over 70 host plants, amongst which, fruits of Bitter gourd (*Momordica charantia*), Musk melon (*Cucumis melo*), Snap melon (*Cucumis melo* var. *momordica*) and Snake gourd (*Trichosanthes anguina* and *T. cucumeria*) are the most preferred host as reported by Doharey (1983). Occasional hosts include eggplants, fig, mango, orange, papaya and peach (Weems *et al.*, 2001). It has also been recorded as pest of cucumber (*Cucumis sativus*) and Bottle gourd (*Lagenaria siceraria*).

Life Cycle and Associated Biological Observations of *Bactrocera cucurbitae* Coquillett

Adult Emergence

Pupae of the melon fruit fly, *Bactrocera cucurbitae* are oriented in the soil in such a way so that maximum and easy emergence of the adults become possible. At the time of emergence of the adult, a latero-ventral cleft is formed at the anterior end of the pupa which gives enough space to the adult fly to wriggle out of the pupa. The lightly coloured newly emerged fly, remains sluggish for some time, sitting at one place. Gradually with the passage of time adult attains darker reddish yellow colour, stretches its wings and legs and moves through the soil to escape. Maximum emergence of the adult was recorded in the early morning hours by the author in the study area. 100% emergence in case of *Bactrocera dorsalis* was observed by Lall and Sinha (1959) when pupation took place one inch below the soil surface.

Adult's Feed

In the field, immediately after emergence the adult flies start feeding on the ripe fruits. However, in laboratory they were fed with the cotton swabs dipped in fresh juice of cucumber. A significant role of diet in enhancing the longevity and fecundity of the adult flies was recorded by Drew *et al.* (1983) who also observed that diet containing bacteria, sugar and water enhance the longevity and egg laying capacity of the melon fruit flies.

Mating

In the field, observations on the copulatory behavior of *Bactrocera cucurbitae* reveal that the mating mostly takes place at dusk. During copulation, male initially flies on the top of female and then climbs on the back of the female. Male uses pro and meso-thoracic legs for making grip on the female during the process of copulation.

Tsubaki and Sokie (1988) studied the copulatory behavior of *Bactrocera cucurbitae* and reported that mating between male and female flies occurs for 10 or more hours and sperm transfer increase with increase in copulation time, however, mating duration does not influence the egg hatchability. Lall and Sinha (1959) in Bihar also observed that in case of *Bactrocera cucurbitae* copulation occurs at dusk and found males to be more active than females.

Oviposition (Fig. 1)

The female flies prefer young green and tender fruits to lay eggs. Before oviposition, the female fly wanders from one fruit to another possibly to select a suitable site for puncturing or for sensing the presence of conspecific larvae, since the fruits already infested with maggots are not preferred by new gravid flies for oviposition. Similar observations were reported by Green *et al.* (1983) that *Bactrocera dorsalis* declined to oviposit in the fruit containing conspecific larvae. After selecting the host fruit, female fly thrusts its ovipositor inside the fruit and lay eggs in small clusters, usually 2 to 4 mm deep in the fruit pulp. As reported by Renjhen (1949) in *Bactrocera cucurbitae* Coq. sometimes pseudo-punctures are also seen on fruits, the tactile bristles of the ovipositor help in locating a hole and differentiating hard and soft surfaces of fruits.

Usually oviposition lasts for 5-7 minutes as recorded in the field observations. Weems and Heppner (2001) reported that sometimes eggs are also laid into unopened flowers and maggots successfully develop in the taproots, stems and leaf stalks.

Pre-oviposition and oviposition periods of *Bactrocera cucurbitae* were recorded to be 10 to 16.3 days and 5 to 15 days, respectively, by Koul and Bhagat (1994). However, Back and Pemberton (1917) observed that the pre-oviposition period of the flies fed on cucumber ranged between 11 to 12 days.

Eggs and Incubation

Freshly laid eggs are shiny white, elliptical, slightly curved and measure 1.8-2 mm in length. Hatching of the eggs occur within 1.1 to 1.8 days at 25°C (i.e. at room temperature). Renjhen (1949) reported the incubation period for *Dacus cucurbitae* to range from 24 hours 20 minutes to 9 days 4 hours and 15 minutes. However, Doharey (1983) reported the egg incubation period being 4.0 to 4.2 days at 27±1°C, on pumpkin, bitter gourd and squash gourd.

Maggot (Fig. 2)

Larvae are dirty white, apodous, cylindrical and elongate maggots. Anterior end is narrower and broadens towards posterior end. Head is not clearly distinguishable from rest of the body. A total of about 11 distinct body segments are visible. The first segment is dark and bears pharyngeal hooks. Larvae have three instars. The last instar ranges from 7.5-11.8 mm in length. Amphipneustic spiracles are present in the maggots. Anterior pair lobed whereas posterior pair with contiguous spiracular plates each with three long subparallel slits. The distinctive characteristic of the melon fruit fly larva which makes it different from other fruit fly larvae is the presence of a dark sclerotized horizontal line below the

spiracular region on the caudal end, with a curved ridge on each side.

A detailed technical description of the maggots of fruit fly, *Bactrocera cucurbitae*, was given by Weem *et al.* (2001). He described the maggots bearing anterior buccal carinae usually 18 to 20 in number, anterior spiracles slightly convex in lateral view and large, sharply pointed mouth hook present on each side of cephalo-pharyngeal skeleton. Each hook is about 3 times the length of hypostome.

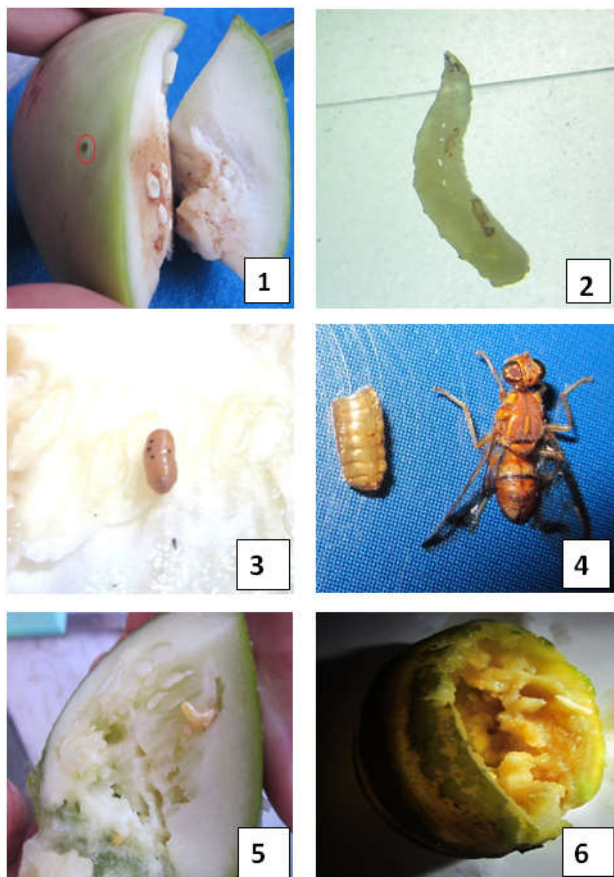


Fig 1 Ovipositing site of female fruit fly; 2. Maggot of *Bactrocera cucurbitae*; 3. Pupa; 4. Adult fly emerged from pupa; 5. Maggots feeding on soft pulp of cucumber; 6. Damage pattern of maggot feeding in musk melon.

Post hatching and feeding behavior of maggots

Maggots live inside the fruit and feed on soft pulp of fruit and ultimately make them unfit for human consumption. Larval stage lasts for 5-15 days. Wriggling movements of the maggots can be seen when the fruits containing maggots are cut open. Full grown maggots are highly active and can hop from a looped state to a distance of 6 to 10 inches in length.

Prepupa

Fully grown maggots stop feeding and become sluggish and finally they come out of the fruit by making one or two exit holes for pupation in the soil. This non feeding prepupal stage lasts for 1 to 2 days with an average 1.5±0.25 days.

Sharma (2005) recorded that prepupal stage lasted for about a day in case of *Bactrocera dorsalis*. Patel and Patel (1998) observed that average duration of prepupal stage in *Dacus*

ciliates bred on little gourd in Gujarat was 0.75±0.27 and 0.63±0.25 days during August to September and April to May.

Pupa(Fig. 3)

Barrel-shaped pupae vary in colour from dull red to chocolate brown. Average length of pupa varies from 5 to 6 mm. In field, pupation occurs in soil at 0.5 to 15 cm below the soil surface. The depth upto which the larvae move in the soil and pupate depends on the texture and moisture of the soil (Jackson *et al.*, 1998; Pandey and Mishra, 1999).

Under laboratory conditions the pupal stage lasts for 9 to 11 days. Doharey (1983) observed the pupal stage for 7 days on bitter melon and 7.2 each on pumpkin and squash gourd at 27±1°C. However, Narayanan and Batra (1960) reported that in general the pupal period during the rainy season and winter varies from 6 to 9 days and 15 days respectively.

Adult(Fig. 4)

The adult fly is stout and slightly longer but slender than housefly, and about 6-8 mm in body length. Female flies are larger in size than males and can be easily distinguished from the males due to the presence of a three segmented ovipositor at the posterior end of the abdomen. The head and eyes are dark brown. Aristate antennae are present. The dorsum of the thorax is reddish yellow with light yellow markings. One pair of transparent forewings is present and the hindwings are reduced to halteres for balancing the body. Wings are distinctively patterned. A thick brown band extends along the costal margin, the leading edge of wing, ending in a larger brown spot at the tip. Another thin band extends from the anal area or wing base just inside the trailing edge of each wing. A brown band also present along the jugal fold of the wing. Abdomen is reddish yellow with darker bands on the second and third abdominal segments.

Adult longevity

The melon fruit fly remains active throughout the year on cucurbits. Adults may survive for 10 months to a year. Under laboratory conditions adult longevity of male and female feeding on cucumber juice has been recorded to vary between 10-16 days, with an average of 13±2.37 days and 11-20 days with an average of 15.5±3.49 days respectively. However, as per the observations carried out by Vargas *et al.* (1997) the female fruit fly survived for 123 days on papaya in the laboratory (24°C, 50% RH and LD 12;12) while at 29C they survived for 23.1 to 116.8 days.

Table 1 Duration of different stages in the life cycle of *Bactrocera cucurbitae* Coquillitte

Stage	Duration in days		mean±SD
	Min.	Max.	
Incubation period	1	3	2±0.79
Larval period	5	15	10±3.96
Prepupal period	1	2	1.5±0.40
Pupal period	9	11	10±0.79
Total period	16	31	23.5±5.94
	Adult Longevity		
Male	10	16	13±2.41
Female	11	20	15.5±3.49

Nature of Damage (Fig. 5, and Fig. 6)

The eggs are laid by the females in soft tender fruits by piercing them with their ovipositors. A watery fluid oozes from these punctures which reduces the market value of the crop. Many a time pseudo-punctures have also been observed on the fruit skin. After being hatched the maggots feed inside the fruit. They bore into the fruit pulp and make feeding galleries. As a result, the fruit rots and become distorted. Feeding by maggots often open ways for secondary pathogens and fastens fruit decomposition. The extent of losses caused by *Bactrocera cucurbitae* varies from 30 to 100% depending on the cucurbit species and season (Dhillon *et al.*, 2005). These pests thus reduce the quality as well quantity of cucurbit fruits and adversely affect the growth of plants.

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