BIONOMICS OF *BACTROCERA DORSALIS* (DIPTERA: TEPHRITIDAE) – AN IMPORTANT PEST OF MANGO (*MANGIFERA INDICA*) IN JAMMU (J & K)

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[Tara, J. S. & Gupta, M. 2016. Bionomics of *Bactrocera dorsalis* (Diptera: Tephritidae) – an important pest of Mango (*Mangifera indica*) in Jammu (J & K). Munis Entomology & Zoology, 11 (1): 176-180**]**

ABSTRACT: Mango (*Mangifera indica* L.) is known as "king of fruits". Several insects are known to cause significant damage to mango and affect its productivity. One of them is *Bactrocera dorsalis* which is an important pest of mango in India. Keeping in view the medical, economical and dietary importance of mango and damage done to it by different insect pests, work was done to study the biology of this pest which causes huge damage during (May to September). Adults are strong fliers, eggs are laid in the soft skin of ripening fruits. On hatching, the maggots bore into the fruit further and feed on soft pulp. The infested fruits bear depressions with dark green punctures and when cut open wriggling maggots were seen inside. Later, the affected fruits get malformed and in conjugation with bacterial activity, fruits rot and ultimately fall down. Maggots emerge from these fruits and pupate in the soil.

KEY WORDS: Bionomics, *Bactrocera dorsalis*, Mango.

Tephritid fruit flies (Diptera: Tephritidae) are the most devastating insect pests having a foremost influence on global agricultural products, effecting yield losses, and dropping the value and marketability of horticultural crops. The genus *Bactrocera* is considered a serious threat of horticultural crops because of the wide host range of its species and the invasive power of some species within the genus (Clarke et al., 2005). They deposit their eggs into fruits and vegetables, the flesh of which is subsequently consumed by the developing larvae (White & Elson-Harris 1992). There are about 325 species of fruit flies occurring in the Indian subcontinent, of which 205 are from India alone (Kapoor, 2005). Out of which Oriental fruit fly *Bactrocera dorsalis* Hendel, is also considered as a serious pest of horticultural crops. In India, the loss in fruit yield ranges from 1 to 31% with a mean of 16% (Verghese et al., 2002). According to Butani (1979) it breeds profusely on guava (*Psidium guajava*) during March, shifts to Loquat (*Eriobotrya japonica)*, Apricot (*Prunus armeniaca*) and Plum (*Prunus domestica*) during April- May, then migrates to peach (*Prunus persica*) and fig (*Ficus carica)* in June and finely to Mango (*Mangifera indica*) during June-August. Peak activities of adults coincide with the availability of developed fruits of Mango and Guava which form the principal hosts of the fruit fly (Prasad and Bagle, 1978). Feeds on mango, guava, Peach, Apricot, Cherry, Pear, Chiku, Ber, Citrus and other Plants totaling 250 hosts (Atwal, 1976).

Keeping in view the role played by these crops in raising the economy of a country, the present studies were undertaken to study the mode, extent and nature of damage caused by *Bactrocera dorsalis* in J&K.

MATERIALS AND METHODS

Studies were carried out from May 2013 to April 2014 at four different Locations viz. Marh, Udheywala, Udhampur and Samba. The infested fruits were collected from different collection sites and were kept in the laboratory in rearing cages with wire guage on the sides and the top and filled basally with a thick bed

of soil for recording the mode of pupation, pupal period and pattern of adult emergence. Copulatory behavior of the flies was studied under field conditions as they donot copulate in the lab.

The cages were filled basally with a thick bed of soil for recording the mode of pupation, pupal period and pattern of adult emergence. For studying the nature and mode of damage, observations were made both in the field and the lab at different times. Under natural conditions, fruit selected after oviposition by female flies were wrapped with a muslin cloth. Egg hatching and pupal period was observed under lab conditions.

RESULTS

Biological studies:

Copulation

Field observation reveals that mating takes place during early morning hours. During copulation, male fly climbs on the back of the female making a grip on its body with pro and meso thoracic legs, while meta thoracic pair is used for balancing itself on the substratum. It has been seen that if mating pair when disturbed, they fly together in this posture to a distant place and continue the process. Copulation in *Bactrocera cucurbitae* takes place at dusk and found males to be more active than females (Lal & Sinha, 1960).

Selection of fruit stage for oviposition

Adult females prefer to oviposit on both unripened and ripened fruits. Tender and over ripe frits are not selected for oviposition. However, Sharma (2005) while studying the oviposition behavior on guava in jammu recorded that only those fruits were selected whose colour changes from yellow to green i.e which are at the ripening stage. Similar observations were made on citrus plants by Chhetry (2009).

Ripen bananas are most conducive to stinging by *Dacus dorsalis* than less ripe ones (Armstrong, 1983). The present investigator observed that fruit flies do not prefer to lay eggs on the over ripe fruits. The fruits which were previously infested with maggots were not selected by gravid females for oviposition. It is due to the reason that the odour emanated by the overripe fruit and the maggot infested fruits repel female flies to oviposit on these fruits. Similar observtions were made by Green et al. (1983) that *Bactrocera dorsalis* declined to oviposit in the fruit containing conspecific larvae.

Oviposition

Before ovipositing, female fly scan one fruit after another possibly for sensing the presence of conspecific larvae or select a suitable site for puncturing. After sometime, female thrusts its ovipositor inside the fruit and lay eggs in small clusters just under the skin of fruit (Fig. 3). Wings are placed laterally and remain fully stretched during the act of oviposition and slightly bend its abdomen while inserting its ovipositor into the fruit surface. Female remain nearly motionless. The female flies after ovipositing were seen cleaning their ovipositor with the help of hind pair of legs. The author also observed that a single fruit can be attacked by a number of flies and more than one female may lay eggs in a single fruit. Oviposition behavior of *Dacus dorsalis* was also studied by Sharma (2005) who also recorded the similar observations on guava in jammu region of J&K state.

The present investigator has noticed that besides actual ovipositional sites the, female punctures number of sites. This is because after initial puncture if the site does not found fit, fly leaves the spot and flies to some other suitable place or spot.

Field observations revealed that oviposition lasted for 4-6 minutes. Similar observations was made by Chhetry (2009) who found that on citrus plants oviposition lasted for 3-5 minutes whereas Sharma (2005) while studying oviposition period on guava recorded that oviposition is completed in 8-10 minutes. As the female oviposits at different fruis at a time, therefore the fecundity of the female could not be determined. However, at a spot the female fly laid 2-36 eggs. Sharma (2005) recorded the presence of 2-5 eggs at one place inside the guava fruit.

Egg: The freshly laid eggs are laid below the skin of host fruit in groups by puncturing it by means of ovipositor. They are shiny, translucent, white, cylindrical and slightly curved (Fig. 4). It measures about 0.8- 1 mm in length. Average width of egg is 0.18-0.22mm (Table 2). Sharma (2005), however reported egg length of 0.9-1.00 mm.

Incubation period

Incubation period varies from 2-5 days. However, Doharey (1983) reported 3.2 days as incubation period of the eggs of *D.dorsalis* when fed on guava at IARI, New Delhi and also recorded 98.4 percent survival of eggs. Sharma (2005) recorded incubation period of 2-5 days during summer and 4-8 days in winter. Chhetry (2009) recorded incubation period of 7-10 days.

Larvae: Freshly hatched larvae (Fig. 5) are transparent and elongated while full grown are creamy white. The Maggots are Pointed anteriorly and broader towards posterior end. It is 11 segmented and the first segment is somewhat darker in colour with phyrangeal hooks. The segments from 1-5 gradually increases in size while there is a gradual increase in size from 6-10. Paired spiracles are present.

Maggot length varies from 1.45-7.00mm in length and 0.48-3.70 mm in width. Sharma (2005) observed full grown maggot length of 8-9 mm and width of 5mm. Since the size of the larvae is small so number of larval instars could not determined. The total larval period recorded was 5-6 days with an average of 5.5 ± 0.5 days (Table 2). Sharma (2005) has observed larval period to range between 5-6 days during summer and 9-32 days during winter on guava. Chhetry (2009) has reported larval period to range between 14-35 days on citrus plants.

Post hatching and feeding behavior of maggot

Maggots feed on the soft fruit pulp and make the fruit unfit for human consumption in association with bacterial degradation. When the fruits are cut open wriggling maggots were seen inside it. Full grown maggots are active and can hop from a looped state to a distance of 3 to 6 inches in length and 1 to 1.5 inches in height.

Prepupa

Before undergoing pupation, The mature larva emerges from the fruit, drops to the ground enters in the soil and transforms into a non feeding prepupal stage which lasts for 1-2 days Sharma (2005) has also reported the same for 1 day on guava and Chhetry (2009) recorded that prepupal stage lasted for 1to 3 days on citrus.

Pupa: Pupae (Fig. 6) are Barrel shaped with round posterior and flattened anterior ends. Pupae are light brown in color with distinct segments. It measures 4-5mm to 2-3 mm in width. Pupation of the full grown maggot takes place in the soil. Duration of pupal period was observed to be 4-10 days. Sharma (2005) has also reported that pupal period lasted for 4-10 days during summer and 14- 42 days during winter months.

Adult migration: While pupation, paupae tends to orient themselves in soil in such a way so that maximum emergence of the adult takes place. At the emergence of the fly, the author has observed a latero ventral cleft is formed at the anterior end of pupa upto the middle of the 4th abdominal segment. The pupa remains intact from the dorsal side. Newly hatched fly is light in colour which gradually acquires adult colour after sometime.

Adult: Adult flies (Figs. 1 & 2) are stout, slightly larger than a housefly. It measures 14mm across the wings and 7 mm in body length. Forewings are transparent and hind wings are reduced to slender organs called Haulters. Antennae are of aristate type. Color of fly is brown with dark brown lines and the thorax has bright yellow markings. Female flies are larger than males and are distinguished by having ovipositor. The ovipositor is very slender and sharply pointed.

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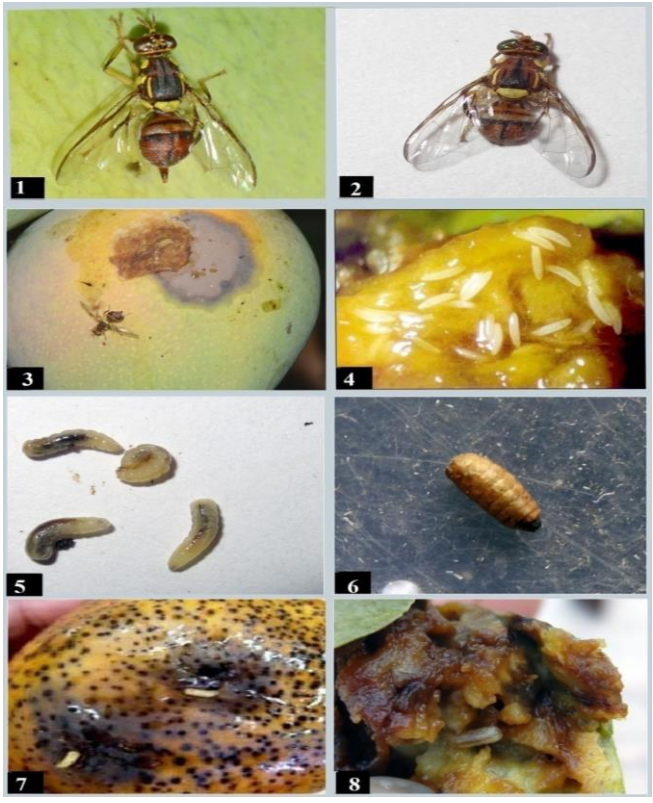
Table 1. Morphometric measurements of different stages of *Bactrocera dorsalis* Hendel.

Stage	Length (mm)		Width (mm)	
	Min-Max	Mean ± S.E	Min-Max	Mean± S.E
Egg	0.8- 1	0.9±0.1	0.18-0.22	0.21-0.01
Larvae	1.45-7.00	3.49±2.19	0.48-3.70	2.50- 2.70
Pupa	4.25-5.00	4.47 ±0.54	2.00 -2.25	2.21 ±0.2
Adult	7.00-7.25	7.1±0.12	13.25-14.2	14±.45

Table 2. Duration of different stages of the life cycle of *Bactrocera dorsalis* Hendel on Mango.

Developmental stages	**Duration (days)**	
	Range	Mean ± S.E
Egg	2-5	3.3 ± 1.20
Larvae	5-6	5.5 ± 0.5
Pre pupal period	1-1.5	1.1 ± 0.28
Pupa	4-10	6.6 ± 2.4
Adult longevity	4-5	4.5 ±0.35
Total life cycle	16-27	19.6 ±4.3



Figures 1-8. 1. Adult female of *Bactrocera dorsalis*, 2. Adult male, 3. Ovipositing female, 4. Eggs, 5. Larvae, 6. Pupa, 7. Damage, 8. Damage made to pulp.