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BIOLOGY OF FRUIT FLY, *BACTROCERA DORSALIS* (HENDEL) ON SAPOTA

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Studies on the biology of *Bactrocera dorsalis* on sapota (cv. Kalipatti) indicated that the female laid eggs in small clusters just underneath the rind of fruit, 2 to 4 mm. deep in the epidermis. The average length and breadth of freshly laid eggs were 0.85 ± 0.02 and 0.18 ± 0.01 mm, respectively. An incubation period of eggs ranged from 2 to 4 days with an average of 2.86 ± 0.83 days and hatchability was 81.06 ± 8.92 per cent. The larvae passed through three instars. The neonate larvae were translucent and white with slight yellowish in colour except its mouth part, which was black green in colour. The total larval period was completed within 6 to 13 days. The pupation took place in the soil. The pupal period was of 7.86 ± 1.33 days. The newly emerged, male and female adults of *B. dorsalis* were of faint brown to dark brown in colour. The wings of adults consisted of dark black spot on the apex part (apical angle). The average pre-oviposition, oviposition and post-oviposition period were 9.46 ± 1.75, 5.8 ± 1.49 and 3.7 ± 0.98 days, respectively. The average fecundity of the female was recorded as 148.13 ± 37.85 eggs. The average longevity of male was recorded as 11.46 ± 1.94 days while, that of female was 18.96 ± 2.29 days. Total life cycle completed in 24 to 33 days by male and 34 to 41 days by female.

Key words : Biology, Fruit fly, *Bactrocera dorsalis*, sapota.

INTRODUCTION

Sapota or sapodilla [*Manilkara achras* (Mill) Fosberg] synonym (*Achras sapota* Linn.) belongs to family Sapotaceae, commonly known as 'chiku' is evergreen fruit tree. India is considered to be the largest producer of sapota in the world. The major sapota producing states in India are Karnataka, Maharashtra, Gujarat, Andhra Pradesh and Tamil Nadu. The total area of sapota in Gujarat is about 27,367 hectares with an annual production of 2.73 lakh tonne. While, in South Gujarat, area under sapota cultivation is 11,786 hectares with an annual production of 10.81 lakh tonnes (Anonymous, 2010). Sapota is a hardy fruit crop but various factors affect the yield and economic value of fruit. Among them, damage done by various insect pests and mites is a major constraint. As many as 25 insect pests have been reported attacking sapota trees in India (Butani, 1979) whereas, in Gujarat 16 insect pests and mites found damaging to sapota (Patel, 2001). Fruit flies (Diptera : Tephritidae) have worldwide distribution, covering tropical, subtropical and temperate regions (Kapoor *et al.*, 1980). In India fruit flies have been recognized among ten most serious pests of agricultural crops causing an annual monitory loss to the tune of Rs 7000crore (Sardana *et al.*, 2005). In South Gujarat fruit fly *Bactrocera dorsalis* is very important pest of mango, sapota and banana. Information on its developmental biology is lacking on sapota crop. The present investigation, therefore, conceptualized biology of *B. dorsalis* to plan

management strategies against this pest.

MATERIALS AND METHODS

Studies on biology of *B. dorsalis* on sapota was undertaken at Fruit Research Station, Navsari Agricultural University, Gandevi, Gujarat, India during 2010. The initial culture of *B. dorsalis* was raised by collecting infested fruits of sapota. Infested fruits were kept in rearing jar (15 x 20 cm) having 5 cm thick layer of sieved moist sand to obtain the pupae. The top of each jar was covered with white muslin cloth to prevent the larvae from escaping. When all the full grown maggots enter into sand for pupation, rotted fruits were removed from the jars. Sand in the jar was sieved after 4 to 5 days to collect the pupae. Thereafter, pupae were transferred in clean plastic bottle (1.5 x 7.5 cm) individually. These bottles were covered with lid so as to prevent the escaping of adult flies. The flies emerged were utilized for further studies on life history. Freshly emerged adults were paired and confined in glass jars. The physiologically matured sapota fruits were placed inside the glass jar for oviposition by female. The sapota fruits were replaced after observing the oviposition puncture. The fruits punctured due to egg laying were cut open with a fine razor blade and eggs laid, if any were confirmed by using magnifying lens. About 2 x 1 x 1 cm size piece of fruit having eggs were smoothly cut and transferred in a separate petridish and observed twice a day for their hatching. Eggs were carefully transferred with a fine hair brush on a glass slide and observed under microscope to study their morphometric characters. When eggs hatched out, the neonate maggots were gently transferred on a fresh fruit slice (2 x 2 x 1 cm), later on they were kept in a individual petridish for further rearing. The food was changed every day to avoid microbial contamination. The maggots were reared following this method until they were full grown. The observations on various developmental periods and their morphometrics were recorded accordingly.

RESULTS AND DISCUSSION

The results on the biology of *B. dorsalis* were presented and discussed as under :

Egg **:** Under field condition, the female fly found to visit mostly on physiological matured fruits. The fly wonders on the surface of fruit and quickly flies off. After two to three such visits, finally it selects the fruit for oviposition. The fly walks over the fruit and surveys it by up and down movement of ovipositor. After selecting suitable place for oviposition, it bends its abdomen at right angle to the body and then gradually inserts its ovipositor in epidermis by forward and backward movement of abdomen. The female fly made several punctures in the fruits for oviposition. However, eggs were not laid in all punctures. In this way there were about 2 to 6 punctures on a single fruits wherein eggs are laid, which coined be terminated a 'True puncture'. While 7 to 12 punctures do not contain eggs, which termed as 'Pseudo-puncture'. In sapota pseudo-punctures were not clearly visible during the present investigation. A white coloured latex oozing out from site of puncture, which later on dries up near the puncture. It was further recorded that the fly prefer to laid eggs on lower half of the fruit and fallen fruits during the present study. Narayanan and Batra (1960) and Shah *et al.* (1948) observed that fruit fly laid eggs in clusters (2 to 15 eggs) below the skin of fruit, just underneath the rind of fruit at a depth of 2 to 4 mm in the epidermis, same results were obtained during present investigation.

The freshly laid eggs were shiny translucent and whitish in colour. The shape of egg was cylindrical, slightly curved on one side and narrow at both ends. Bansode *et al*, 2009 and Dale, 2002 also reported similar colour and shape of the eggs in case of *B. dorsalis* which confirm the present finding. observations on measurement of eggs revealed that the length of eggs varied from 0.80 to 0.86 mm (Av. 0.85 ± 0.02 mm), while the breadth varied from 0.15 to 0.20 mm (Av. 0.18 ± 0.015 mm) (Table-1). The present findings are in close occurrence with that of Bansode *et al.* (2009) who reported that the size eggs of *B. dorsalis* varied from 0.8 to 1.07 mm in length and 0.14 to 0.25 mm in breadth. The incubation period varied from 2 to 4 days with an average of 2.86 ± 0.83 days under laboratory condition on sapota. This period found more or less similar with that of Bansode *et al.* (2009) who reported, 1 to 4 days for *B. dorsalis* on sapota. Under the laboratory conditions the hatching percentage ranged between 64.70 to 94.44 per cent with an average of 81.06 ± 8.92 per cent. This results tally with the finding of Bansode *et al*, (2009), who reported average hatching per cent ranged from 86.07 ± 5.31 per cent on sapota.

Maggot **:** The results on maggot revealed that, it passed through three instars. During the present investigation the freshly emerged first instar maggots were translucent and white with slightly yellowish in colour except its mouth parts, which were dark black in colour. The head was pointed and slightly bend downward with a pair of mandibular hook. The maggot was apodous with three thoracic and nine abdominal segments. The cuticle of maggot was so translucent that the internal organs were clearly visible through it. The present findings are in close agreement with the report of Dale (2002) and Bansode *et al,* (2009) who reported that, the first instar larvae of *B. dorsalis* were apodous and white to slightly yellowish in colour. The length of first instar maggot varied from 1.33 to 1.45 mm, while breadth varied from 0.25 to 0.36 mm. Bansode *et al.* (2009) also reported, an average length and breadth of first instar maggot of *B. dorsalis* on sapota as 1.39 ± 0.03 and 0.28 ± 0.02 mm, respectively.

The results of above findings support the present finding. The full grown maggots were longer and broader with pointed cephalic end and blunt at posterior end. Moreover, the maggots were light yellowish in colour and have a jumping habit. The results are in accordance with report of Bansode *et al,* (2009) who observed that, the body of full grown maggot was long, conico-cylindrical and pointed at the head with twelve visible segments. The maggot after full feeding moves from the centre of fruit where they had been feeding another soft and fermented skin of fruit, they bore holes, come out and by their jumping movement fall on the ground (Pop up stage). The data on measurement indicated that, the length of full grown maggot ranged from 8.02 to 8.16 mm while that of breadth ranged from 1.46 to 1.54 mm. The results obtained during study period are more or less similar with Bansode *et al.* (2009). The total maggot period ranged from 6 to 13 days with an average of 8.5 ± 1.97 days. However, some of the earlier findings are closely tally with present observation. The larval period of *B. dorsalis* was 6 to 12 days on sapota (Bansode *et al.* 2009).

Pupa **:** The last instar larva stops feeding and found in searching for a suitable place, where it can remain sluggish. This formed the beginning of the pre-pupal stage.It can be seen from Table-1 that, the length of pre - pupa of *B. dorsalis* varied from 7.52 to 7.66 mm with an average of 7.57 ± 0.04 mm, while breadth ranged from 1.97 to 2.20 mm with an average of 2.12 ± 0.07 mm. The pre-pupal period was 16 to 24 hours with an average

of 19.73 ± 2.36 hours. Pupation took place at a depth of 0.5 to 5.0 cm in soil maintained in glass jar under laboratory condition. Narayanan & Batra (1960) and Bansode *et al.* (2009) also reported same result regarding site and depth of pupation in case of *B. dorsalis*. The colour of freshly formed pupa was creamy which later on turned to dull reddish yellow and finally pale brownish or light ochraceous at the time of emergance. The pupae were cylindrical in shape. The anterior end of pupa was narrow than the posterior end. The length of pupa varied from 3.96 to 4.19 mm with an average of 4.11 ± 0.08 mm, while breadth varied from 1.96 to 2.19 mm with an average of 2.11 ± 0.08 mm. Kalia (1992) also reported the pupal length as 4.4 mm and breadth as 2.3 mm in Bangalora variety of mango gives more confirmation to the present finding. The pupal period recorded during present investigation was varied between 6 to 10 days on sapota (Table I). The present findings confirmed by Bansode *et al.* (2009) who recorded the pupal period of *B. dorsalis* as 7.80 ± 0.82 days on sapota.

Table I : Details of life cycle of *B. dorsalis*

Sample No.	Particulars	Period (Days)		Mean ± S.D.
		Min	Max	
1.	Incubation period	2	4	2.86 ± 0.83
2.	Hatching per centage	64.70	94.44	81.06 ± 8.92
3.	Total larval period	6	13	8.5 ± 1.97
4.	Pre- pupal (Hours)	16	24	19.73 ± 2.36
5.	Pupal period	6	10	7.86 ± 1.33
6.	Pre-oviposition period	7	12	9.46 ± 1.75
7.	Oviposition period	4	9	5.8 ± 1.49
8.	Post-oviposition period	1	5	3.7 ± 0.98
9.	Adult longevity	-	-	-
9 a.	Male	8	15	11.46 ± 1.94
9 b.	Female	14	23	18.96 ± 2.29
10.	Total life cycle	-	-	-
10 a.	Male	24	33	29.63 ± 2.99
10 b.	Female	34	41	38.96 ± 2.29
11.	Fecundity (No. of eggs per female)	*84*	*192*	*148.1 ± 37.85*
	Room temperature °C	*26*	*33*	*29.33 ± 2.04*
	Relative humidity (%)	*58*	*64.5*	*60.94 ± 2.70*

Adult **:** The adult of *B. dorsalis* were faint brown to dark brown in colour. The third tergite consisted of yellow band which can be visible with incomplete costal and anal band. A yellow stripe marking on dorsum of thorax present. The hind wings were modified into a short tubular structure with round end, known as halters. The wings of adult consisted of dark black spot on the apex part (apical angle). The thoracic dorcum of segment of female consisted of typical "W" shaped marking on mesothorax. "T" shaped transverse band on middle part of dorsum of the abdomen and "T" was broken between fourth and fifth abdominal segments. The adult flies passed two prominent eyes on the dorso-lateral region of the head and bear aristate type of antenna. The male and female fruit flies can be distinguished by the shape of last abdominal segments. In male the

abdominal end was blunt while in case of female, the abdominal end was developed into a pointed ovipositor consisted black tip marking. Moreover, Males were smaller in size than female. Narayanan & Batra (1960) also reported that the male of *D. dorsalis* was smaller than the female. The results on morphological characters of *B. dorsalis* were similar with mark of identification given by Madhura & Verghese (2004). The length and breadth of adult male with expanding wings ranged from 4.95 to 5.12 mm and 11.16 to 11.29 mm, respectively. The length and breadth of adult female with expanded wing measurement from 5.95 to 6.18 mm and 11.96 to 12.08 mm, respectively. The present findings are more or less in agreement with that of Bansode *et al.* (2009) who mentioned the average length and breadth of adult female fruit fly as 5.00 ± 0.03 mm and 11.20 ± 0.03 mm, respectively, while in adult female fruit fly, length and breadth ranges from 6.10 ± 0.05 mm to 12.00 ± 0.03 mm, respectively in sapota.

Table II : Morphometrics of various life stages of *B. dorsalis* reared on sapota

S. No.	Stages	Range	Mean±S.D.
1.	Length of egg (mm)	0.80-0.86	0.85 ± 0.02
2.	Breadth of egg (mm)	0.15-0.20	0.18 ± 0.01
3.	Length of Newly emerged maggot	1.33-1.45	1.40 ± 0.04
4.	Breadth of Newly emerged maggot	0.25-0.36	0.29 ± 0.03
5.	Length of Full grown maggot	8.02-8.16	8.09 ± 0.03
6.	Breadth of Full grown maggot	1.46-1.54	1.49 ± 0.04
7.	Length of pre-pupae	7.52-7.66	7.57 ± 0.04
8.	Breadth of per-pupae	1.97-2.20	2.12 ± 0.07
9.	Length of pupae	3.96-4.19	4.11 ± 0.08
10.	Breadth of pupae	1.96-2.19	2.11 ± 0.08
11.	Length of male fly	4.95-5.12	5.02 ± 0.05
12.	Breadth of male fly	11.16-11.29	11.22 ± 0.04
13.	Length of female fly	5.95-6.18	6.10 ± 0.07
14.	Breadth of female fly	11.96-12.08	12.03 ± 0.03

The data presented in Table I showed that, the pre-oviposition period varied from 7 to 12 days with an average of 9.46 ± 1.75 days whereas the oviposition period ranged from 4 to 9 days with an average of 5.8 ± 1.49 days. The post - oviposition period varied from 1 to 5 days with an average of 3.7 ± 0.98 days during the present investigation. The present findings are more or less tally with Bansode *et al.* (2009) who mentioned pre-oviposition, oviposition and post-ovipositon periods were 7 to 12, 4 to 9 and 1 to 4 days, respectively on sapota. In laboratory, the egg laying capacity recorded during the study was varied from 84 to 192 eggs with an average of 148.1 ± 37.85 eggs per female. Narayanan & Batra (1960) also recorded 150 to 200 eggs per female when reared on mango which confirms to the present findings. It can be seen from the data (Table-1) that the male longevity varied from 8 to 15 days while, it was 14 to 23 days in case of female reared on sapota fruits. Doharey (1983) recorded longevity of *D. dorsalis* as high as 43.70 days on sapota fruit. Studies on longevity indicated that the female fruit fly lived longer than male fruit fly. The variation in adult longevity might be attributed due to different food materials utilized for feeding, climatic conditions at various localities.

On sapota, total life period from egg to death of adult male varied from 24 to 33 days with an average of 29.63 ± 2.99 day, while that of female varied from 34 to 41 days with an average of 38.96 ± 2.28 days. Earlier, Bansode *et al.* (2009) who reported that the total life cycle of *B. dorsalis* on sapota completed within 32.06 days for male and 39.90 days for female fruit fly. The present findings on total life period of fruit fly, *B. dorsalis* are in conformity with those of Doharey (1983) who reported 21.8 days when reared on sapota.

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