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BIONOMICS OF ORIENTAL FRUIT FLY *BACTROCERA DORSALIS* (HENDEL) ON GUAVA

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ABSTRACT

A study on bionomics and morphometrics of the Oriental fruit fly *Bactrocera dorsalis* (Hendel) was carried out during rainy and winter season guava crop over the period of 2018-2019 at the Department of Agricultural Entomology, BCKV, Mohanpur, West Bengal. Comparative bionomics data of *B. dorsalis* revealed that the egg, larval and pupal periods of *B. dorsalis* in the rainy season crop amounted to 1.56± 0.56, 10.14± 0.59 and 10.74± 0.42 days, respectively in the winter season these worked out to 2.11± 0.33, 11.0± 0.41 and 13.87± 0.82 days, respectively. The lifecycle got extended when reared with the winter season fruit crop compared to that of rainy season. This study revealed that short life cycle with more damage of oriental fruit fly, *B. dorsalis* was observed in the rainy season guava as compared to winter season.

Key words: *Bactrocera dorsalis*, guava fruit, fruit fly, lifecycle, egg, larval, pupal period, adult longevity, fecundity, rainy season, winter season

India is the world's largest producer of guavas (*Psidium guajava* L) and the third most grown fruit crop in West Bengal state, with guava trees blooming twice a year, in April-May and September-October, followed by ripening in the rainy and winter seasons, with a productivity of 15.2 tons per ha (Mitra et al., 2008; Anonymous, 2021). Due to its diverse adaptability, guava crop is threatened by a number of biotic stress including insect pests about 80 insect pest species were reported to infest the guava (Butani, 1979). Among them, Fruit flies are the one of the major pest that affect the yield and quality of guava fruits. Fruit flies belong to the family Tephritidae and order Diptera. It contains more than 4000 species in which about 700 species of sub family Dacinae has been presented all over the world (Fletcher, 1987). Among them, oriental fruit fly, *Bactrocera dorsalis* (Hendel) is a major pest and polyphagous in nature (Butani, 1979). In India, the yield loss due to *B. dorsalis* ranges from 1 to 31% with a mean of 16%. Being polyphagous, they breed profusely on guava as well as mango. A thorough knowledge of life history of an insect and its status during different seasons provide an important basis for developing efficient pest management strategies (Laskar, 2013). The present study assesses the comparative seasonal bionomics of *B. dorsalis* during different seasons in the guava growing tract in Indo-Gangetic alluvial plains of West Bengal.

MATERIALS AND METHODS

The study on the comparative seasonal bionomics of *B. dorsalis* was done during the rainy (July-September) and winter seasons (December-February) at BCKV, Mohanpur, Nadia district (23° 53´N, l88° 95´E, 9.75 masl) under laboratory conditions at Department of Agricultural Entomology, Bidhan Chandra Krishi Viswavidyalaya (BCKV), Mohanpur, West Bengal during 2018-2019. The guava variety L-49 was grown as per recommended practices without any insecticidal exposure. Laboratory conditions were not constant and maintained with surrounding weather conditions and checked using with digital temperature humidity meter. Mean temperature and relative humidity in rainy season as well as in winter season during 2018 and 2019 were 30.76°C, 24.93°C and 76.73%, 84.98%, respectively. Field collection of infested guava fruits were done from the Horticultural Research Station, Mondouri, BCKV, Mohanpur, West Bengal. Ten infested fruits were examined under laboratory conditions at Plant protection laboratory of Department of Agricultural Entomology. The fruits were kept singly in rearing glass jars (20 cm height with 14 cm diameter), provided 5-6 cm thick layer of sieved and sterilized sand as sites of pupation. The mouth of jars were covered with mosquitonet. This mosquito net is tightly wrapped with pair of rubber bands for avoiding the escape of last instar maggots as well as to extend the protection to maggots and pupae from predators and parasitoids. Moisture level inside the rearing glass jars were maintained by addition of distilled water in the sand at periodic intervals. This adds optimum moisture favouring the maggots to pupate inside sand kept in the rearing jars.

After eclosion of fruit fly adults, those were allowed to be there for a week and were provided with a diet of enzymatic yeast hydrolysate and sugar (1:3) together with water. After a week, among the sexually matured adult fruit flies, ten pairs of male and female flies were kept overnight separately in the vials for mating process and further used to study the life cycle studies of *B. dorsalis* on guava. Gravid females were kept in the cage provided with a piece of fresh fruits of guava having protein diet and 5% honey solution for egg laying. The eggs were detected by excavating the fruit just below the oviposition puncture through microscopic observations. The eggs were transferred in the Petri dishes containing pulp. The freshly laid eggs were collected daily and used for further studies.

Observations were taken on incubation period, larval duration, pupal period, oviposition period, pre and post oviposition period, adult longevity and total lifecycle. The adults which emerged on same day were paired in an insect proof net cage with 5 % honey and protein diet for egg laying and fecundity observed daily until the death of the female and male fruit flies. For observing the incubation period and egg hatchability %, 30 freshly laid eggs were observed in Petridishes having 10 eggs each as a replicate for the emergence of neonates. Emerging larvae were reared in glass jars having sand media and provided with half cut pieces of medium sized mature fruits of guava till pupation. Observations on moulting were made on three instars, which were easily visible. Similarly, pupal period was also observed. The newly emerged adults were separated as female and male on the basis of morphological features. The period from emergence of adults till death was also observed. Observations on biological parameters such as egg hatchability %, larval survival %, pupal recovery %, adult emergence %, sex ratio and fecundity/ female were made. For morphometrics, different life stages of *B. dorsalis* also were observed during two guava seasons under stereozoom microscope (n=10) and the measurements were made by using digital vernier caliper. The life history parameters were analysed with mean and standard deviation.

RESULTS AND DISCUSSION

The bionomics of *B. dorsalis* was studied in rainy and winter seasons of guava under laboratory conditions (Table 1). Fertilized females punctured the guava fruit with their long extendible ovipositor. A watery fluid oozed out from the puncture, later it transformed into a white or brown resinous deposit. Eggs were elliptical, smooth glistening white to creamy colour with elongate shape. During winter season guava, the egg period was maximum (2.11± 0.33 days) and minimum for rainy season crop (1.56± 0.56 days). The morphometric of life stages revealed that during rainy season, for egg, it measured 1.14± 0.08x 0.27± 0.01 mm, whereas during winter it was 1.12± 0.17x 0.2± 0.03 mm. This finding is in conformity with Sharma and Gupta (2018), Laskar (2013), Amur et al. (2017) and Vanitha (2015). Naik et al. (2017) found that egg incubation period was on an average of 1.85± 0.34 days. Ganesh (2009) reported that incubation period was 3.00± 0.71 days with a range of 2-4 days.

There were three larval instars, and these lasted for: first for 2.26± 0.20 days (measuring 4.74± 0.23x 0.57± 0.15 mm) during rainy season compared to winter one being 2.40± 0.24 days (4.32± 0.67x 0.54± 0.09 mm). These results were in conformity with Vanitha (2015) Second instar lasted for 3.42± 0.12 days during rainy season compared to winter season one being 4.2±0.37 days, with these being bigger when reared in rainy season and significantly differing from larvae reared on winter season. These findings are more or less concordant with Amur et al. (2017). Vanitha (2015) also found that duration of second instar as 2.20± 0.33 days. Third instar lasted for 3.45± 0.54 days (8.72± 0.33x 1.54± 0.74 mm) during rainy season, requiring less number of days compared to winter season. Vanitha (2015) found that length of third instar larvae was 8.60± 0.48 mm and breadth was 1.51± 0.17 mm. Amur et al. (2017) observed a duration of 2.75± 0.54 days, while Vanitha (2015) found it as 4.22± 0.32 days. Total larval period was minimum during rainy season- 10.14± 0.59 days and maximum being in winter season (11.56± 0.41 days). Prepupa creamy white to pale yellow lasting1.07± 0.44 days (6.68± 0.24x 2.08± 0.45 mm during rainy season, and as well as 1.18± 0.41 days (6.30± 0.13 x 2.03± 0.33 mm) in winter, respectively (Table 1).These results corroborate with those of Ganesh (2009), Singh and Sharma (2013), Vanitha (2015), Amur et al. (2017) and Sharma and Gupta (2018). Total pupal period observed in the rainy season was 10.74± 0.42 days (5.28± 0.16 x 2.12± 0.71 mm); and during winter it was 13.87± 0.82 days (4.79± 0.22 x 1.90± 0.16 mm), respectively. These observations conform with those given by Amur et al. (2017). Sharma and Gupta (2018) observed its size as 4.76± 0.02x 2.12± 0.03 mm. Singh and Sharma (2013) recorded the pupal duration to be 7.67± 0.27 days (Table 1).

Maximum number of adults emerged from the puparia between 7.00 am to 10.00 am, and during rainy

season, adult longevity of male was about 23.60± 3.49 days; and 27.10± 2.17 days in winter season. Male was comparatively large when reared in rainy season. Female was larger and lived longer, and during rainy season its longevity was about 34.98± 2.24 days, and 38.08± 3.06 days in the winter season. These results agree with those of Ganesh (2009), Singh and Sharma (2013), Vanitha (2015), Amur et al. (2017), Naik et al. (2017) and Sharma and Gupta (2018). Preoviposition period was observed to be 8.16± 0.81 days during rainy season which in winter was 9.01± 0.54 days. Ganesh (2009) recorded the preoviposition period as 8.32±

Table 1. Bionomics and morphometrics of *B. dorsalis* in different seasons on guava (n=10)

	Rainy season		Winter season	
Life stages	Range (days)	Mean± SD (days)	Range (days)	Mean± SD (days)
Egg (incubation period)	1.0-2.2	1.56± 0.56	1.6-2.2	2.11± 0.33
Larval period: 1st instar	2.0-2.5	2.26± 0.20	2.1-2.8	2.40± 0.24
Larval period: 2nd instar	3.0-4.4	3.42± 0.12	3.3-4.6	4.2± 0.37
Larval period: 3rd instar	3.1-4.3	3.45± 0.54	3.6-4.7	4.0± 0.30
Complete larval period	8.2-11.3	10.14± 0.59	9-12	11.0± 0.41
Prepupal period	0.5-1.5	1.07± 0.44	0.7-1.8	1.18± 0.42
Pupal period	9.0-12.0	10.74± 0.42	11-15	13.87± 0.82
Adult longevity (Male)	18.5-32.5	23.60± 3.49	19.4-36	27.10± 2.17
Adult longevity (Female)	26.1-45.8	34.98± 2.24	29.5-49.2	38.08± 3.06
Total life cycle (egg to adult emergence)	20.2-25.5	22.82± 1.65	21.3-30.5	26.37±1.24
Pre-oviposition period	7-13	8.16± 0.81	7-14	9.01± 0.54
Oviposition period	3-8.8	6.12± 0.76	3-6.5	5.46± 0.74
Post-oviposition period	1-4.5	2.82± 0.65	1-5	2.95± 0.13
Biological parameters	Range	Mean± SD	Range	Mean± SD
Fecundity (No.)	78-172	122.1± 17.15	56-131	82.3± 23.51
Egg hatchability %	90-95	91.66± 2.88	80-93.33	83.33± 1.65
Larval survival %	72-86	80.42± 6.73	70-85	71.62± 5.30
Pupal recovery %	70-85	78.50± 4.43	65-75	72.45± 2.31
Adult emergence %	76-92	83.2± 6.57	68-86	70.0± 2.15
Sex ratio (♂:♀)	1:1.10 -1:1.32	1:1.21± 0.57	1:1.03-1:1.15	1:1.08± 0.34
Morphometrics				

	Length (mm)		Breadth (mm)		Length (mm)		Breadth (mm)	
Life stages	Range	Mean± SD	Range	Mean± SD	Range	Mean± SD	Range	Mean± SD
Egg	0.97-1.34	1.14± 0.08	0.16-0.79	0.27± 0.01	0.88-1.30	1.12± 0.17	0.15-0.50	0.21± 0.03
1st instar larva	3.47-5.56	4.74± 0.23	0.39-0.69	0.57± 0.15	3.30-5.60	4.32± 0.67	0.40-0.60	0.54± 0.09
2nd instar larva	5.89-7.95	6.48± 0.41	0.87-1.04	0.90± 0.07	5.40-7.12	5.84± 0.09	0.80-0.92	0.84± 0.04
3rd instar larva	7.38-9.13	8.72± 0.33	1.06-1.79	1.54± 0.74	7.00-9.03	8.50± 0.83	1.10-1.80	1.49± 0.16
Prepupa	6.10-7.54	6.68± 0.24	1.83-2.62	2.08± 0.45	6.08-6.60	6.30± 0.13	1.5-2.51	2.03± 0.33
Pupa	5.10-5.40	5.28± 0.16	1.9-2.3	2.12± 0.71	4.31-5.19	4.79± 0.22	1.61-2.28	1.90± 0.16
Adult male (Expanded wing)	5.50-6.50	6.17 ± 0.41	7.4-9.87	9.32± 0.41	5.40-6.28	5.93± 0.22	7.10-9.43	8.94± 0.72
Adult female (Expanded wing)	5.84-6.63	6.57± 0.62	10.0-13.5	12.33± 0.14	5.90-6.80	6.28± 0.24	10.3-12.5	11.70± 1.30

SD = Standard deviation

1.11 days, and Amur et al. (2017) as 13.55 ± 1.33 days, while Naik et al. (2017) observed it as 12.10± 1.28 days. Oviposition period was 6.12± 0.76 days during rainy season whereas it was about 5.46± 0.74 during winter season. Vanitha (2015) observed this as 5.96± 1.65 day. Post-oviposition period during rainy season was 2.82± 0.65 days whereas during winter season, it was about 2.95± 0.13 days; Ganesh (2009) recorded it as 3.00± 0.76 days. Patel and Patel (2018) reported it as 1.60± 0.69 days. The total life cycle took 22.82± 1.65 days during rainy season, and comparatively longer i.e. 26.37± 1.24 days in winter. These results agree with those of Singh et al. (2010), Singh and Sharma (2013) and Mir et al. (2014) (Table 1).

Fecundity differed significantly between rainy and winter season, it was 122± 17.15 in rainy season, and less during winter of 82.3± 23.51. Ganesh (2009) observed the fecundity as 155± 34.32. Egg hatching % during rainy season was of 91.66± 2.88% whereas during winter season it was about 83.33± 1.65%. These results agree with those of Amur et al. (2017) and Ganesh (2009). Larval survival % was more and 80.42± 6.73% during rainy season compared to winter season (71.62± 5.43%); and pupal recovery was 78.50± 4.43% during rainy season, as against 72.45± 2.31% during winter season. Adult emergence was more when reared in rainy season crop (83.2± 6.57 %) than winter (70± 2.15%).These results corroborate with those of Sohail et al. (2015). Sex ratio (♂:♀) of male and female was 1:1.21± 0.57during rainy season, which was 1: 1.08± 0.34 during winter season, as observed by Singh and Sharma (2013), and Amur et al. (2017) observed it to be 1:1.17. Amur et al. (2017) and Sohail et al. (2015) brought out the variations in the bionomics of fruit fly, *B. dorsalis* during different seasons (Table 1).

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