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BIOLOGY OF *ZEUGODACUS TAU* (WALKER) ON BOTTLE GOURD

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ABSTRACT

Biology of *Zeugodacus tau* (Walker) (Diptera: Tephritidae) was studied on bottle gourd under laboratory conditions. It was observed that 4-10 eggs/ female were laid singly or in clusters, embedded vertically or slightly slanting inside the fruits. Preoviposition, oviposition, post-oviposition and incubation periods were observed to be from 10 to 16, 11 to 28, 1 to 4 and 1 to 3 days, respectively. Mean larval period was 1.4, 1.8 and 2.8 days, for 1st, 2nd and 3rd instars, respectively, with total larval duration of 6.0 days. Prepupal and pupal period were 0.9 and 8.2 days, respectively. The mean longevity of male and female was 28.4 and 31.6 days, respectively.

Key words: *Zeugodacus tau*, *Lagenaria siceraria*, biology, morphometrics, developmental stages, instars, larval period, pupal period, oviposition, longevity

The global invasion of Tephritidae (fruit flies) attracts a great deal of attention in the field of quarantine and invasives. The devastating effects that fruit flies inflict to the horticultural crops, and the transboundary nature, have made them as key pests (Enkerlin, 2003). *Zeugodacus tau* (Walker) (Diptera: Tephritidae) is an economically important pest known from almost all parts of the Indian subcontinent. It is a pest on a wide variety of food plants and in certain seasons it causes havoc (Shen et al., 2014). In Asia, approximately 30-40% of losses are caused by *Z. tau* infestation (Jaleel et al. 2018). The female fly punctures the soft and tender fruits with the ovipositor and lays eggs below the exocarp of the fruit. The maggots that hatch from the eggs bore into the fruit and feed on the placenta with secondary infection, resulting in rotting and premature fall of fruits. The knowledge of pest biology has not only academic or scientific importance, but it also points the weak linkage used for development of effective management strategy. Detailed understanding of the biology of the pest like *Z. tau* will be very helpful in devising effective IPM. The present study is on the biology of *Z. tau* on bottle gourd under laboratory conditions.

MATERIALS AND METHODS

The culture of *Z. tau* was initiated with the maggots collected from bottle gourd field and study was done during kharif 2019 in the Division of Entomology (21.4± 7.32°C; 23-94% RH). The infested fruits were kept in 20x 20x 8 cm plastic trays on a 5 cm-thick layer of sieved moist sand to facilitate pupation. The newly emerged adult flies were collected and placed inside the rearing cages (35x 30x 35 cm), provided with glucose solution (10% W/V) and slices of bottle gourd as a source of food and site for oviposition. A compound microscope with slide mounted specimen was used to record the number of eggs present in each bottle gourd slice. The eggs collected were placed in 5 cm dia petridishes with moist filter paper at the bottom to prevent desiccation. Morphometrics of life stages were carried out using calibrated ocular micrometer and vernier caliper. Ten replicates of each stage viz. egg, freshly hatched maggots, full grown maggot, pupae and adult were maintained for linear measurements. In addition to the above parameters colour, shape and period for each lifestage were observed. Observations on preoviposition, oviposition and postoviposition periods, fecundity, incubation period, egg hatchability, larval, prepupal, and pupal periods, adult longevity and sex ratio were also observed.

RESULTS AND DISCUSSION

Eggs of *Z. tau* were shiny white, elliptical, smooth, slightly curved, elongate, tapering anteriorly with slightly protruding micropylar opening while rounded posteriorly and turning darker as hatching approached. Morphometric observations revealed that the egg measured 1.26± 0.15 (length) and 0.24± 0 .04 mm (breadth) (Table 1). Incubation period lasted for

Table 1. Biology and morphometrics of *Z. tau*

Stage	Length (mm)		Breadth (mm)	
	Range	Mean± SD	Range	Mean± SD
Egg	0.96-1.37	1.26± 0.15	0.2-0.34	0.24± 0.04
		Maggot		
1st Instar	1.21-3.72	2.68± 0.98	0.22-0.55	0.42± 0.12
2nd Instar	4.08-7.59	5.65± 1.23	1.04-1.46	1.29± 0.12
3rd Instar	7.98-10.79	9.16± 1.05	1.38-2.82	1.84± 0.49
Prepupa	6.22-7.33	6.74± 0.43	1.94-2.44	2.13± 0.19
Pupa	4.92-5.91	5.48± 0.35	1.86-2.69	2.31± 0.24
		Adult (with expanded wings)		
Male	6.75-8.81	7.76± 0.75	10.31-15.10	13.85± 1.40
Female	8.19-10.9	9.24± 0.78	14.88-17.35	16.55± 0.69

Life stages	*Range	Mean± SD
Incubation period (days)	1-3	2.3±1.35
Maggot Period (days)		
1st instar	0.5-2	1.4± 0.81
2nd instar	1-3	1.8± 0.63
3rd instar	2-3	2.8± 0.67
Total maggot period (days)	3.5-8	6.0± 2.11
Prepupal period (days)	0.5-2	0.9± 0.55
Pupal period (days)	6-10	8.2± 1.31
Mating period (hours)	2-4.5	3.1± 0.97
Preoviposition period (days)	10-16	12.1± 1.2
Oviposition period (days)	11-28	16.3± 6.8
Post-oviposition (days)	1-4	2.4± 0.7
Fecundity	57-92	73.6± 15.0
Hatching %	81-86	83.0± 3.4
Adult longevity (days)		
Male	17-38	28.4± 2.6
Female	23-39	31.6± 1.1
Temperature (°C)	13.4-29.3	21.4± 7.32
Relative humidity (%)	23-94	46.6± 11.52

2.3± 1.35 days. The present results corroborate with the earlier findings of Kabir et al. (1997) who found incubation period in *Z. tau* as 1-3 days; Patel and Patel (1998) and Naik et al. (2017) who observed this as 1-2 days; and Singh et al. (2010) and Vasudha et al. (2019) as 1.30 days, when reared on pumpkin and bitter gourd, respectively. Larvae passed through three instars, are apodous and frugivorous with an elongated body, pointed anteriorly or cephalic and blunt posteriorly. Freshly emerged first instar was translucent, pale white, gut content visible through translucent skin and cephalopharyngeal skeleton weakly sclerotized except for anterior portion of pharyngeal sclerite. Second instar maggot was creamy white in colour, elongate, ellipsoidal in shape, body weakly sclerotized except for anterior portion of pharyngeal sclerite, anterior spiracles well developed and similar to third instar.

The first and second instar maggot measured 2.68± 0.98 and 5.65± 1.23 mm in length and 0.42± 0.12 and 1.29± 0.12 mm in breadth, respectively. The full grown third instar maggot was creamy white with an elongated body, tapering anteriorly except the eighth segment which is truncated, blunt posteriorly and has a tapered head with black oral hooks. It exhibited a peculiar habit of leaping into the air, this hopping behaviour assisted dispersal of the maggots and to find a suitable place for pupation. Length and breadth of full-grown maggot was 9.16± 1.05 and 1.84± 0.49 mm, respectively (Table 1); and duration was 1.4± 0.81, 1.8± 0.63 and 2.8± 0.67 days, respectively. The total maggot period was 6.0± 2.11 days agreeing with those of Patel and Patel (1998), Liu and Lin (2000), Mir et al. (2014), Naik et al. (2017) and Vasudha et al. (2019). Full grown maggots were slightly bent, and stopped feeding, became stationary and measured 6.74± 0.43x 2.13± 0.19 mm, with duration of 0.9± 0.55 days. Pupation occurs in the moist soil or sand, freshly formed pupae were brownish yellow, segmented, barrel shaped and rounded anteriorly; and later the colour changed into

pale brown to brownish grey with eleven segments; it measured 5.48± 0.35 x 2.31± 0.24 mm with duration of 8.2± 1.31 days, these results agree with earlier ones (Singh et al., 2010; Waseem et al., 2012; Laskar, 2013 and Vasudha et al., 2019).

The freshly emerged adult flies were less active, pale yellow with wings attached to the body. After emergence, adults crawled to a sheltered spot nearby until their wings unfold and dry. The flies became brown or ferruginous brown after 2-3 hr. Two round spots on the face, conspicuous black or dark brown markings on lateral and median part of thorax and typical T shaped marking on abdomen. Wings are large with fuscous shadings on the outer margin and costal band largely expanded into a distinct spot at the apex. Adults are moderate in size; female flies are bigger, are easily distinguishable by the presence of a tapering abdomen ending in a pointed ovipositor. These findings confirm with those of Kitthawee and Rungsri (2011), Mir et al. (2014), Sharma et al. (2017), Naik et al. (2017), Leblanc et al. (2019) and Vasudha et al. (2019). Mating was observed in late afternoon hours. A prolonged mating period, which include courtship and copulation ranged from 2-4.5 hr observed now is in conformity with the findings of Singh et al. (2010), Waseem et al. (2012) and Mir et al. (2014) who found prolonged mating period upto 4 hrs. The preoviposition, oviposition and post-oviposition periods varied from 10-16, 11-28 and 1-4 days, respectively. These findings agree with those of Mir et al. (2014), Sharma et al. (2017), Naik et al. (2017) and Thakur et al. (2017). Fecundity was 73.6± 15.0, with eggs laid at intervals of 1-4 days. The hatching of eggs was 83.0± 3.4. These results corroborate with those of Mir et al. (2014) and Thakur et al. (2017). Male and female longevity was 28.4± 2.6 and 31.6± 1.1 days, respectively agreeing with earlier results of Singh et al. (2010), Mir et al. (2014) and Vasudha et al. (2019).

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