

Biology and morphometrics of *Bradysia tritici* (Coq.) (Diptera, Sciaridae) on milky mushroom in Navasari, Gujarat, India

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ABSTRACT: Biology and morphometrics of *Bradysia tritici* (Coq.), a major pest of milky mushroom (*Calocybe indica* P&C), were studied. Adult longevity of male and female was 4.75 ± 1.64 and 6.10 ± 0.91 days, respectively. The female laid an average of 40.45 ± 5.21 eggs in her life period. The eggs were singly laid in clusters of 2 to 3 and hatched in 2.50 ± 0.51 days and the viability of eggs were 83.26 ± 5.88 per cent. The larval stage completed in 11.10 ± 1.07 days. The pre-pupal, pupal stages and total life cycle of male and female lasted for 1.60, 2.70, 47.0 and 20.15 and 21.50 days, respectively.

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KEY WORDS: Sciarid fly, pest, insect, milky mushroom, life stages, life cycle, fecundity

Bradysia tritici (Coq.) (Diptera, Sciaridae) on milky mushroom, is a major pest of milky mushroom (*Calocybe indica* P&C). Sciarid fly larvae causes damage to substrate, compost and casing materials. It causes damage 32 - 75 per cent (Sandhu and Brar, 1980; Khan and Javed, 2002). The biology and morphometrics of sciarid fly were studied at Post Graduate Research Laboratory of the Department of Entomology, N.M. College of Agriculture, Navsari Agriculture University, during May 2022. To raise the initial culture of sciarid fly, the adult flies were collected using aspirator from the mushroom bags procured from the Mushroom Unit. The sciarid fly was reared in the glass jars filled with spawned paddy straw layer of 2 to 3 inches. Some pieces of mushroom were placed over it. Ten adult pairs were transferred into glass jars using aspirator and honey solution (10%) was

provided to them as food. Glass jars were covered with black muslin cloth and held in position with help of rubber band. Adults laid eggs on the paddy straw with mushroom, at $26.7 \pm 1.66^{\circ}\text{C}$ temperature and 71.11 ± 2.45 per cent relative humidity. After 24 hours, eggs laid by each female were removed from stock culture using a soft camel brush. The eggs were counted and kept in separate Petri plates to find out the incubation period and hatching per cent. Young larvae were transferred to the Petri plates containing mycelial colonized paddy straw individually. The moisture was maintained by applying water over paddy straw. Measurement and period of each instar were recorded. Larvae were kept undisturbed for pupation. Pre-pupal and pupal period were recorded and pupae were allowed for adult emergence. The emerged adults were fed with honey solution as food and adult period, pre-

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oviposition, oviposition and post-oviposition period and measurement of male and female were recorded separately. A stereo-trinocular microscope Olympus-SZ (16) equipped with a brand Catcam-130 camera having software power Scope photo was used to measure the length and breadth of various stages of the sciarid fly.

The biology and morphometrics of sciarid fly, *B. tritici* was studied in detail (Table 1, 2, Fig. 1). The female laid eggs singly in clusters of 2 to 3 eggs on the spawned mycelial paddy straw. The freshly laid eggs were pulpy and white in colour. The fertile eggs were transparent and turned brown with the passage of time, while infertile eggs noted as slightly shriveled. Eggs were round to oval in shape and not visible to the naked eyes. At egg eclosion, the larval head become distinct and appeared with black dot in the egg. Length and breadth of eggs varied 0.21 to 0.25 and 0.11 to 0.15 respectively. The similar observation of egg laying pattern, shape and colour were reported by Sandhu and Brar (1980), Brar and Sandhu (1990) and Shivanna *et al.* (2003). The incubation period was 2 to 3 days with an average of 2.50 ± 0.51 days.

There were four larval instars. First instar body of freshly emerged maggot was dirty white in colour, transparent with a distinct shining black head which was quite visible to the naked eye. Apodous maggots were cylindrical in shape with visible alimentary canal. This is in accordance with the larval description given by Brar and Sandhu (1980). Length of the first instar ranged 1.32 to 1.80, while breadth varied 0.18 to 0.25mm. More or less similar measurement were reported by Lewendowski *et al.* (2004), who reported that length of first instar larvae of *B. tritici* was 0.36 to 1.40mm with average of 0.76 ± 0.22 mm. First instar larva completed on 2 to 3 days. Katumanyane (2020) noticed that larval period of first instar lasted for 2 days. Morphologically second instar larva resembled to the first instar but differ in size. Length varied from 2.60 to 4.45 and breadth 0.32 to 0.44mm. This is in agreement with Katumanyane (2020) on *B. impatiens* who reported it as 2.6 to 4.5mm in length and 0.3 to 0.45 mm in width. The second instar lasted for 2 to 3 days. Khanna *et al.* (2017), also

similar observation of 2 to 3 days. In third instar the raw food substances could be seen inside their abdomen. Length and breadth varied from 4.30 to 6.30 and 0.43 to 0.63mm. Katumanyane (2020) reported that the length varies from 4.6 to 6.5 mm in length, and 0.46 to 0.65 mm in breadth. The duration of third instar I was 2 to 3 days. Khanna *et al.* (2017) reported that third instar of *B. tritici* lasted for 2 to 3 days with an average of 2.40 ± 0.44 days when reared on *Agaricus bisporus*, while Katumanyane (2020) observed it as 2 days for *B. tritici*.

The fourth instar feeding was voracious and more active than other instars. Fully mature larvae stopped feeding and crawled down to casing material for the pupation. The length of fourth instar ranged between 6.61 to 7.72 and the breadth 0.64 to 0.75mm. Shivanna *et al.* (2003) reported that the average length and width of fourth instar of *B. tritici* as 7.22 ± 0.33 and 0.66 ± 0.06 mm, respectively. The duration of fourth instar larvae varied from 2 to 4 days. Khanna *et al.* (2017) and Katumanyane (2020) reported similar observation. The total larval developmental period of *B. tritici* varied from 9 to 13 days when reared on mycelia of milky mushroom. According to Khanna *et al.* (2017) larval stage of sciarid fly was lasted for 9 to 13 days with an average of 11.10 ± 1.07 days on button mushroom. Shivanna *et al.* (2003) noted that the total larval developmental period of *B. tritici* varied from 9 to 11 days with an average of 9.73 ± 0.05 days.

The full-grown larvae before pupation passed through a pre-pupal stage. In this stage fully mature larvae stopped feeding and reached to the casing material. At this stage larvae became motion less and spun little quantity of silk to form a very loose type of pseudo-cocoon. It is dirty white in color and its length got reduced. Sandhu and Brar (1980) observed that in the pre-pupal stage, the full-grown larvae became sluggish with suspended feeding and movement. Its length got reduced and forms pseudo-cocoon. The length of pre-pupae varied 2.08 to 2.53, while the breadth 0.21 to 0.25mm. The length and the breadth of pre-pupal stage was 2.51 and 0.23mm (Khanna *et al.*, 2017). The pre-pupal period

Table 1. Biology of sciarid fly, *B. tritici* on milky mushroom

Particulars	Min.	Max.	Mean \pm SE
Incubation period (days)	2.00	3.00	2.50 \pm 0.51
Hatching (%)	71.43	92.86	83.26 \pm 5.88
First instar (days)	2.00	3.00	2.60 \pm 0.50
Second instar (days)	2.00	3.00	2.75 \pm 0.44
Third instar (days)	2.00	3.00	2.55 \pm 0.51
Fourth instar (days)	2.00	4.00	3.20 \pm 0.70
Total larval period (days)	9.00	13.00	11.10 \pm 1.07
Pre- pupal period (days)	1.00	3.00	1.60 \pm 0.60
Pupal period (days)	2.00	3.00	2.70 \pm 0.47
Pre- oviposition period (hrs)	24	48	35.40 \pm 9.11
Oviposition period (hrs)	24	36	30 \pm 6.16
Post- oviposition period (hrs)	36	48	41.40 \pm 6.13
Sex ratio (Male: Female)	1:1.33	1:2.40	1:1.78 \pm 0.34
Male longevity (days)	4	6	4.75 \pm 1.64
Female longevity (days)	5	7	6.10 \pm 0.91
Male- Total life cycle (days)	17	23	20.15 \pm 1.79
Female - Total life cycle (days)	19	25	21.50 \pm 1.64
Fecundity (eggs/female)	35	52	40.45 \pm 5.21

ranged 1 to 3 days during the present study. This is in accordance with Khanna *et al.* (2017), who reported pupal period of *Bradysia* sp as 1.36 \pm 0.27 days.

The newly formed pupa was dirty white in color which changed to yellowish brown after 1 to 2 days of pupation. The mature pupa was dark grey to black in colour and at this stage compound eyes and appendages become distinct. The shape of the abdominal tips of male is quite different than female. The last abdominal segment of the male pupae was broader and relatively smaller than female. This is in accordance with the findings of Sandhu and Brar (1980). The pupae measured 2.38 to 2.56 in length,

while the breadth 0.51 to 0.56mm. According to Shivanna *et al.* (2003) the length and breadth of pupa ranged between 2.10 to 2.80 with an average of 2.39 \pm 0.19 mm and breadth ranged between 0.71 to 1.04 with an average of 0.80 \pm 0.07 mm, respectively. The duration of pupal stage varied 2 to 3 days. This is in contrast with the Shivanna *et al.* (2003) who reported the pupal duration was varied from 3 to 5 days with an average of 4.18 \pm 0.30 days.

Adults emerged during evening hours and resembled to mosquitoes. Greyish black adults possessed 14 annuli on the antennal flagellum in both the sexes. The flies had elongated abdomen



Fig. 1 Biology of sciariid fly, *Bradysia tritici* on milky mushroom

with long legs and wings. The male and female were similar in appearance except the shape of abdomen and size of the body. In case of male, the abdomen was slender and terminated in double claw like structure known as 'Claspers', while in case of female, the abdomen was swollen and terminated in a pointed ovipositor. The size of male sciariid fly, *B. tritici* was relatively smaller than female. The present findings are in agreement with the findings

of Brar and Sandhu (1980), Shivanna *et al.* (2003) and Khanna *et al.* (2017). The length of male fly varied 2.17 to 2.66mm with a wing span ranged from 0.84 to 1.02mm. In female, the length varied from 2.71 to 3.15 with a wing span from 1.27 to 1.75mm. These results are corroborated with the reports of Shivanna *et al.* (2003).

The fecundity of sciariid fly varied from 35 to 52

Table 2. Morphometrics of different stages of *B. tritici*

Stage	Length (mm)			Breadth (mm)		
	Min	Max	Mean \pm SE	Min	Max	Mean \pm SE
Egg	0.21	0.25	0.23 \pm 0.01	0.10	0.15	0.13 \pm 0.01
I instar	1.32	1.50	1.57 \pm 0.12	0.18	0.25	0.22 \pm 0.02
II instar	2.60	4.45	3.80 \pm 0.04	0.32	0.44	0.38 \pm 0.55
III instar	4.30	6.30	5.46 \pm 0.59	0.43	0.63	5.46 \pm 0.59
IV instar	6.61	7.72	7.11 \pm 0.34	0.64	0.75	0.68 \pm 0.03
Pupa	2.38	2.56	2.49 \pm 0.05	0.51	0.56	0.54 \pm 0.02
Male	2.17	2.66	2.51 \pm 0.17	0.84	1.02	0.40 \pm 0.05
Female	2.71	3.15	2.89 \pm 0.10	1.27	1.75	1.52 \pm 0.15

eggs. Shivanna *et al.* (2003) recorded fecundity of *B. tritici* from 50 to 70 eggs with an average 60.33 \pm 6.32 eggs; While, Khanna *et al.* (2017) noted it from 27 to 56 eggs with an average 42.3 \pm 6.32 eggs. The pre-oviposition period varied from 24 to 48 hours. Shivanna *et al.* (2003) recorded it as 36 to 48 hours with an average of 42.05 \pm 0.09 hours. Oviposition period varied from 24 to 36 hours. Shivanna *et al.* (2003) revealed the oviposition period as 12 to 36 hours with an average of 26.44 \pm 0.40 hours. The post-ovipositional period varied from 36 to 48 hours with an average of 39.43 \pm 10.83 hours. It varied from 36 to 48 hours with average of 40.45 \pm 0.82 hours when fed on white button mushroom (Shivanna *et al.*, 2003). The fecundity of sciarid fly reared on mushroom varied from 35 to 52 eggs with an average of 40.45 \pm 5.21 eggs. Shivanna *et al.* (2003) observed fecundity of *B. tritici* varied from 50 to 70 eggs with an average 60.331 \pm 6.32 eggs per female. However, slight variation in fecundity may be due to nutritional values of the host. The sex ratio of *B. tritici* was 1:1.78 \pm 0.34 (Male: Female). Shivanna *et al.* (2003) reported sex ratio of *B. tritici* as 1:1.32. The total life cycle varied from 17 to 23 days in males, while in females it varied from 19 to 25 days at 26.7 \pm 1.66 $^{\circ}$ C and 71.11 \pm 2.45 per cent RH. Sandhu

and Brar (1980) observed that the mean duration of life cycle was 28 days at 20 $^{\circ}$ C and 23.89 days at 22 $^{\circ}$ C, respectively. The present study will be useful in developing suitable IPM strategies against the pest.

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