J. Farm Sci., 33(2): (284-287) 2020

RESEARCH NOTE

Biology of Bihar hairy caterpillar, *Spilarctia obliqua* Walker (Erebidae: Lepidoptera) under laboratory condition on sunflower

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(Received: December, 2019 ; Accepted: April,2020)

Investigations on the biology of Bihar hairy caterpillar, *Spilarctia obliqua* Walker were undertaken at the University of Agricultural Sciences, Dharwad during *kharif,* 2018 under laboratory conditions. A single gravid female laid on an average 810 eggs. The incubation, larval and pupal period were recorded at 4-6.50, 22-25 and 10-12.50 days, respectively. The longevity of adult ranged from 8.00 to 9.00 days with an average of 8.47 days in female and 4.50 to 5.50 days with an average of 5.20 days in case of male.The total life cycle of male and female was 42-44 and 45-47.50 days, respectively.

Key words: Bihar hairy caterpillar, Biology, Sunflower

Sunflower stands third position, after soybean and groundnut in the total production, among oil seed crops throughout the world. It is known to be attacked by many insect pests,of which the defoliating species are more predominant (Rogers, 1992). The defoliator like Bihar hairy caterpillar (BHC) *Spilartia obliqua,* is a threat to the yield when the crop is cultivated during *kharif* or *rabi* seasons. It is sporadic in nature and occurs in large numbers when the conditions are suitable. The sunflower seed yield per hectare was reduced to 58.06 per cent because of attack of defoliator insect pests in a *kharif* crop (Suhas *et al*., 1996). The biology of the pest has been carried out by Debaraj and Singh (2010) and Ranjit (2015) on castor; Desai (2015) on cowpea; Nath and Singh (1996) on groundnut; Singh and Singh (1995) on sunflower, and Warad and Kalleshwaraswamy (2017) in field bean.

The average temperature and relative humidity that were prevailing during the investigations were 25.27 °C and 87.94 per cent, respectively. The grown-up larvae of Bihar hairy caterpillar were collected from the sunflower field and reared to get nucleus culture to study the biology. The caterpillars were reared upto adults. A pair of freshly emerged adult moths were released into a wooden cage (36×36×36 cm) for egg laying wherein provision for 10 per cent honey solution, as adult food and fresh sunflower leaves as oviposition substrate were made available. The cut end of the leaf stalk was covered with a wet cotton wad and inserted in the small bottle containing water for maintaining turgidity and freshness.

Five pairs of newly emerged male and female moths were released in the rearing cage at the rate of one pair per cage. The eggs laid every day were countedwith the help of lens till the death of female moth and fecundity was assessed. Longevity of the adults was also recorded. For incubation studies freshly laid eggs were kept in rearing boxes provided with wet blotting paper at the bottom which protected the eggs from desiccation. After two days when eggs turned to black purple colour, they were provided with fresh sunflower leaves as food for newly hatched larvae.

Twenty neonate larvae were released on leaves with the help of camel hair brush and kept in a rearing box (25 × 20 × 25 cm) whose top was covered with muslin cloth in order to facilitate aeration and observations were made on larval development. Fresh sunflower leaveswere provided as food on daily basis. For the last instar larvae, soil was provided inside the box at the bottom to facilitate pupation.

Observations were made on egg period, larval period (instarwise), total larval period, pre-pupal and pupal period and total life cycle. Reproductive characters of adults such as pre-oviposition and oviposition period, fecundity and adult longevity were also recorded.

Ten eggs, larvae, pupae and adults were used for morphometric observation under Lecia M165 C stereo microscope with high speed digital fire wire live camera and LAS measurement module and data transfer. The images were analyzed and the measurements were recorded into computer.

Egg: The results showed that under laboratory conditions moths laid eggs in masses on the lowersurface of the fresh leaves in single layer and these eggs were round on upper surface and flattened at base. The freshly laid eggs were initially greenish in colour which later turned to creamy white, slightly pale yellowish in colour. A day before hatching, the eggs turned dark brown in colour with dark heads of neonates being visible through eggs shell, neonates started moving their head to and fro and side ward. The egg hatchability percentage pf 94-97 with an average of 96 ± 1.53 was recorded. The incubation period ranged from 4.00 to 6.50 days with an average of 5.28 ± 1.51 days (Table 1). The diameter of the egg (length) was 0.64 ± 0.025 mm and width was 0.63 ± 0.020 mm (Table 2). These findings are in accordance with the reports of (Ranjit, 2015) and (Warad and Kalleshwaraswamy, 2017).

Larva: During its larval developmental period, the caterpillar moulted five times and passed through six larval instars.

First instar: The newly hatched larvae were small, creamy white with shining brown head and having brown spots over entire body from which white hair arises, which later turn black, and it was cylindrical in shape. The integument was transparent with five pairs of prologs on abdominal segments. The larvae turned pale yellow within few hours after hatching. The first instar larval duration ranged from 3.00 to 4.00 days with an average of 3.46 ± 0.17 days (Table 1). The larval head capsule length measured 0.19 to 0.21 mm with an average length of 0.20 ± 0.01 mm and head capsule width measured about 0.28 to 0.44 mm with

an average of 0.36 ± 0.08 mm. The body length of the larva measured about 2.2 ± 0.30 mm (Table 2).

Second instar: The second instar larvaes lightly increased in their body size, and they were light yellow in body colour with brown marking on thoracic segments and last abdominal segment, comparing to first instar larvae, they had more hairs on body. The thoracic legs were black with brown abdominal legs. The duration of second instar larva ranged from 2.50 to 3.50 days with an average of 3.10 ± 0.21 days (Table 1). The length and width of the head capsule measured about 0.38 - 0.46 mm with an average length 0.42 ± 0.04 mm and 0.53 - 0.59 mm with an average of width 0.56 ± 0.029 mm, respectively. The body size of the larva measured with an average of length 7.32 ± 0.38 mm, respectively (Table 2).

Third instar: The third instar larvae were similar to second instar but the colour of head and body segments was little darker compared to the second instar, and third instar larvae were very active than the first and second instar larvae and they feed entire leaves. The duration of third instar was varied from 5.00-6.00days with an average of 5.27 ± 0.26 days (Table 1). The larval head capsule length was measured about 1.08 to 1.32 mm with an average length of 1.20 ± 0.12 mm and head capsule width was measured about 1.37 to 1.41 mm with an average width of 1.39 ± 0.016 mm. The average body length of the third instar larvae measured about 14.72 ± 1.12 mm (Table 2).

Fourth instar: The colour of fourth instar larva was uniformly yellowish as segments were brown, and it had tuft of brownish white hairs which arose from reddish brown verrucae and in late fourth instar larval stage, the head turned dark brownish black, it was fed entire leaves except veins and midribs.The duration of fourth instar larvae ranged from 3.00-4.00 days with an average of 3.56 ± 0.22 days (Table 1). The average body length of the fourth instar larvae was measured about 20.94 ± 1.34 mm. further, the head capsule lengths and widths of fourth instar larvae of BHC ranged from 2.31-2.49 mm with an average of 2.40 ± 0.09 mm of length and 2.47-2.57 mm with an average of 2.52 ± 0.05 mm, respectively (Table 2).

Table 1. Studies on biology of Bihar hairy caterpillar, *Spilarctia obliqua*under laboratory condition

Sr. No.	Life stage (Biology parameters)	Range (Days)	Mean ± SD
1	Egg incubation period	4.00-6.50	5.28± 1.51
2	Larval Period		
	I instar	3.00-4.00	3.46 ± 0.17
	II instar	2.50-3.50	3.10 ± 0.21
	III instar	5.00-6.00	5.27 ± 0.26
	IV instar	3.00-4.00	3.56 ± 0.22
	V instar	3.00-4.00	3.69 ± 0.17
	VI instar	5.00-6.00	5.56 ± 0.27
3	Total larval period	22 -25	24.64 ± 1.30
4	Pre-pupal period	1.30-1.85	1.61 ± 0.20
5	Pupal Period	10-12.50	12.00 ± 0.48
6	Male longevity	4.50-5.50	5.20 ± 0.41
7	Female longevity	8.00-9.00	8.47 ± 0.39
8	Pre-oviposition period	1.50-2.50	1.81 ± 0.26
9	Oviposition period	3.50-4.50	3.93 ± 0.35
10	Post-oviposition period	1.50-2.50	2.02 ± 0.31
11	Total fecundity/female (number)	650-950	810.2 ± 100.57
12	Total life cycle Male (Egg to Adult) Female	42-44 45-47.50	43.25 ± 1.43 46.72 ± 1.21
13	Egg hatchability (%)	94-97	96 ± 1.53

SD: Standard Deviation. N = 20

Fifth instar: The fifth instar larvae of BHC were dark yellow in colour with reddish tinge and the colour of larval heads and thoracic shields were brown but the legs were found reddish brown. Spiracles were not clearly, visible only under magnification as circular patches, they feed entire leaves except midribs and veins. The duration of fifth instar BHC larvae varied from 3.00 to 4.00 days with an average of 3.69 ± 0.17 days (Table 1). The head capsule length ranged from 2.72-3.02 mm with an average length of 2.87 ± 0.15 mm and head capsule width varied from 2.73 to 3.13 mm with an average width of 2.93 ± 0.097 mm. Further, it was also recorded that the average body length of fifth instar larvae was about 25.86 ± 0.89 mm (Table 2).

Sixth instar: The fully grown up sixth instar larvae had dark black head with brownish legs and uniformly reddish-brown body with brownish black verrucae on which there were whitish hairs, they feed entire leaves and live individually. The duration of the sixth instar larvae ranged from 5.00 to 6.00 days with an average of 5.56 ± 0.27 days (Table 1). The average body length of sixth instar larvae were 29.74 ± 0.66 mm, and body width of 4.42 ± 0.41 mm. The head capsule length ranged from 3.06 to 3.34 mm with an average length of 3.20 ± 0.14mm and head capsule width varied from 3.71 to 3.91 mm with an average width of 3.81 ± 0.10 mm (Table 2).

Total larval period: The larval durationwas ranged from 22 to 25 days with the average of 24.64 ± 1.30 days, during the August-September, under laboratory conditions (Table 1). The above observations are comparable with the earlier reports wherein the larval period of *S. obliqua*which was 17.22 days (Singh and Singh, 1995), 24.72 days (Nath and Singh, 1996), 24 days (Debaraj and Singh, 2010), 25.48 days (Ranjit, 2015) and 20.55 days(Warad and Kalleshwaraswamy, 2017). Ranjit (2015) also reported that the average duration of first to sixth instar larvae of *S. obliqua* was 2.89 ± 0.63, 3.29 ± 0.46, 4.02 ± 0.84, 4.42 ± 0.49, 4.76 ± 0.59 and 6.08 + 0.71 days, respectively. The body lengths of first to sixth instar larvae were 5.02 ± 0.80, 7.93 ± 1.05, 11.40 ± 2.33, 17.50 ± 1.61, 23.45 ± 2.09 and 28.08 + 1.61 mm, respectively. The width of the head capsule from first to sixth instar was 0.39 ± 0.07, 0.61 ± 0.11, 1.43 ± 0.32, 2.08 ± 0.23, 2.97 ± 0.41 and 3.87 ± 0.26 mm, respectively. This variation may be attributed to variation in climatic conditions prevailing in the particular locality, type of food provided to the larval instars.

Pupa: During the pre-pupal period the full-grown larva stopped feeding, the body of larvae become sluggish and contracted, the average duration of the pre pupa was 1.61± 0.20 days. The pupae were found in thin silken cocoons in laboratory condition and also in soil. The newly formed pupae were soft and pale brown in colour later it turned a little darker a day prior to the emergence of adult, the anal

Table 2.Morphometry of Bihar hairy caterpillar, *Spilarctia obliqua*at different stages

Larval instars	Larval head capsule and body length measurements				
	Head capsule length (mm)		Head capsule width (mm)		Body length (mm)
	Range	Mean ± SD	Range	Mean ± SD	
I instar	0.19-0.21	0.20 ± 0.01	0.28-0.44	0.36 ± 0.083	2.2 ± 0.30
II instar	0.38-0.46	0.42 ± 0.04	0.53-0.59	0.56 ± 0.029	7.32 ± 0.38
III instar	1.08-1.32	1.2 ± 0.12	1.37-1.41	1.39 ± 0.016	14.72 ± 1.12
IV instar	2.31-2.49	2.40 ± 0.09	2.47-2.57	2.52 ± 0.053	20.94 ± 1.34
V instar	2.72-3.02	2.87 ± 0.15	2.73-3.13	2.93 ± 0.097	25.86 ± 0.89
VI instar	3.06-3.34	3.20 ± 0.14	3.71-3.91	3.81 ± 0.108	29.74 ± 0.66

Insect stages		Body length (mm)	Body width (mm)
Egg		0.64 ± 0.025	0.63 ± 0.020
Larva		29.74 ± 0.66	4.42 ± 0.41
Pupa	Male	17.20 ± 0.30	5.20 ± 0.20
	Female	17.65 ± 0.40	5.32 ± 0.19

SD: Standard Deviation, N = 10

aperture was located on the tenth abdominal segments. The pupa was coppery obtect, which had to develop into male moth had a slit representing the genital opening in the posterior part of ninth abdominal segment, in case of female the genital opening was situated on the 8th abdominal segment.

The duration of the pupae ranged from 10.00 to 12.50 days with an average of 12.00 ± 0.48 days (Table 1). The average length of male and female pupae measured about 17.20 ± 0.30 mm. and 17.65 ± 0.40 mm and it also recorded the average width of male and female pupae measured about 5.20 ± 0.20 mm and 5.32 ± 0.19 mm, (Table 2). The present work is in close agreement with the earlier reports of Singh and Singh (1995), and Nath and Singh (1996) who recorded pupal period of 10.25 and 11.46 days for male and female, respectively. Ranjit, (2015), Desai (2015), and Warad and Kalleshwaraswamy (2017) reported pupal period of 9.44 ± 0.55, 9.36 ± 0.49 and 8.60 days, respectively. This variation in duration of the pupal period may be attributed to the variation in temperature, relative humidity prevailing in that particular locality.

Adult: Emergence of the adult moths was usually noticed during night and rarely moths emerged during the day time. Soon after emergence, the moth was observed to be inactive and sluggish for some time. It was found that the moths were straw in colour with orange and brown streaks over the forewings and white streak along the anterior margin. The hind wings were found yellowish in colour with black markings. However, variations were observed in respect to number of black markings and their distribution on the wings. Black spots on each abdominal segment were also observed. The distinguish between female and male moth, the adult female moth is stouter body than male and female moth has bi-pectinate antennae while male possess setaceous antennae. Male survived for shorter period than female.

The longevity of the female adult moths during the present study was ranged from 8.00 to 9.00 days with an average of 8.47 ± 0.39 days compared to male 5.20 ± 0.41 days with a range of 4.50 to 5.50 days. The adult female moths occupied 1.50 to 2.50 days pre oviposition period with an average of 1.81 ± 0.26 days and the oviposition period and post oviposition periods of 3.93 ± 0.35 and 2.02 ± 0.31 days, repsectively. The present study was in accordance with the earlier work of Ranjit (2015) the female adult survived for 9.44 + 1.31 days with a range of 7 to 12days compared to male with an average of 7.00 + 1.54 with a range of 5 to 9 days, and oviposition period ranged from 3 to 5 days. Desai (2015) reported the Adult longevity of 7.08 + 0.81 days with a range of about 6 to 8 days in female moths, in case of male moth longevity was recorded from 4 to 6 days with an average of 5.00 ± 0.82 days, respectively. This variation may be due to the ecological factors like temperature, relative humidity and food.

Fecundity: The average fecundity of the female was 810.2 ± 100.57 ranging from 650 to 950 eggs (Table 1). Similar observations were made by earlier works like Ranjit (2015) and Desai (2015) who reported that the fecundity ranged from 111 to 1135 and 760 to 1420 eggs per female and Singh and Singh (1995) noticed that the *S. obliqua* laid 1849 eggs per female while Debaraj and Singh (2010) reported that the fecundity of *S. obliqua* female moth was 987 eggs per female.

Total life cycle: The total life cycle ranged from 45 to 47.50 days with an average of 46.72 ± 1.21 days in female compared to male with an average of 43.25 ± 1.43 days ranging from 42 to 44 days (Table 1). The present investigation is in close conformity with the Ranjit (2015) and Desai (2015)who reported that the total life cycle of male and female was observed with an average of 48.45 + 2.80 days and 52.44 + 2.43 days on castor, and with an average of 36.57 + 2.29 in case of male, whereas female43.30 + 3.94 days on cowpea, respectively. Similarly, Singh and Singh (1995), Nath and Singh(1996) and Debaraj and Singh (2010) reported that the total life span of *S. obliqua* was recorded to be 37.50, 53.06 and 39.60 days, respectively; and 37 to 42 days in male, whereas 39 to 44 days infemaleby Warad and Kalleshwaraswamy (2017). The present investigation on total life cycle however, slightly differed from the earlier workers who reported the life cycle variation may due to the ecological conditions of the particular locality and during summer, spring season in winter may be varies in temperature, humidity and food availability.

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