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Biology of mulberry silkworm (*Bombyx mori*. L.) in laboratory at Bilaspur (Chhattisgarh)

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Abstract

The field experiments were conducted at Entomology Laboratory of Barrister Thakur Chhedilal College of Agriculture and Research Station, Bilaspur (Chhattisgarh) during 2021-22, to know the biology of mulberry silkworm, *Bombyx mori* L. in laboratory. The freshly laid eggs by female silkworm were oval, ellipsoidal, about 1 mm in diameter and slightly dig in center of egg at dorsal side and ventral side flat in shape and lays about 300 to 500 eggs at a time on the egg sheet. The eggs were covered with gelatinous secretion by which they stick to the egg sheet. The average incubation period from 8 to 10 days whereas, the hatching percentage was 95.5 ± 6.36 per cent.

The body colour of newly hatched larva was yellowish brown in colour with no any marking was observed on larval body. The head was distinctly visible, dark black in colour with shining head capsule, body elongated with numerous hairs arrangement on full larval body. The total larval period completed in an average of 27.5 days.

The freshly formed pupa appeared shining yellow brown in colour which later on became dark brown in colour. The pre pupal days completed in an average of 2.5 days. The pupal period lasting in 10 days. The adult emergence varied from 60 to 75 per cent. The sex ratio of male and female (Male: Female) varied from 4:06 to 6:04. The total life cycle of male completed in an average of 53.5 days. The total life cycle of female completed in an average of 55.5 days.

Keywords: Agriculture, biology, laboratory, mulberry, silkworm

1. Introduction

Sericulture is the science of rearing of silkworms and production of silk. Silk is the most elegant textile in the world with natural sheen, unparalleled grandeur, high absorbance, light weight, soft touch, inherent affinity for dyes, glamour, resilience and highly durable (CSB, 2016). These exquisite qualities of silk have made the silk an inevitable companion of the eve all over the world and have become popular as "Queen of Textiles".

Natural silk is made of two proteins viz., sericin and fibroin, fibroin being the structural center of the silk and sericin being the sticky material surrounding it (Mane *et al.*, 2017). Silk is secreted in the fluid state from the two salivary (labial) glands of silkworm, *Bombyx mori* L. The silkworm, *Bombyx mori* L. is a domesticated insect belong to the family Bombycidae of the order Lepidoptera. Silkworm, *Bombyx mori* L. is monophagous and feeds only on mulberry leaves.

India is the only country in the world producing all four varieties of silk viz., Mulberry silk, Tasar silk, Eri silk and Muga silk. India stands the best chance of being the only country in the world that produces all four commercially recognized varieties of silk, notably mulberry, tasar, eri, and muga (Anitha, 2011).

All these four varieties of silk are produced through commercial rearing of *Bombyx mori*, *Antheraea mylitta*, *Philosamia ricinii* and *Antheraea assama*, respectively. However, the best quality silk is obtained from the cocoons of the larvae of mulberry silkworm and is produced mostly in many states of India accounting for 70.21 per cent (25,348 MT) 2 followed by Eri 19.84 per cent (7,175 MT), Tasar 9.32 per cent (3,370 MT) and Muga 0.66 per cent (240 MT) of the provisional total raw silk production of 36,152 MT (CSB, 2020).

India is the second largest producer and also the largest consumer of the silk. The world raw silk production was about 1,59,648.00 MT (ISC, 2018). China stands first in the world in silk production with 1, 20,000 MT or 75.16 per cent of the produce (ISC, 2018). India's raw silk production is 36,152 MT and area under mulberry is 2.40 lakh ha in 2019-20 (CSB, 2020).

In India sericulture is being practiced in 5 traditional states viz., Karnataka, Andhra Pradesh,

Assam, West Bengal and Tamil Nadu. Karnataka stands in first place with the production.

2. Materials and Methods

The experiments were conducted at Entomology Laboratory of Barrister Thakur Chhedilal College of Agriculture and Research Station, Bilaspur 2021-22.

The rearing of silkworms were conducted according to the methods suggested by Krishnaswami (1978) [1]. Eggs were kept for hatching in the laboratory at room temperature. After hatching of eggs, top two full blown leaves of mulberry tree below the growing bud were picked up and chopped into small pieces (0.5 to 1.0 sq.cm) and sprinkled over the newly hatched young larvae. Subsequently after 30 minutes the newly hatched larvae together with mulberry food were transferred into the rearing trays with the help of feather and spread on bed. Moulting was confirmed by the presence of casted off skin of larva of subsequent instars. During the investigation larval period, larval weight, total larval duration of different instars, pupal period, and longevity of male and female, egg hatching percentage were recorded. Description of different stages of the larvae were prepared by examining details of specimens and measurement of different stages.

3. Results and Discussion

3.1 The following biological parameters were observed

3.1.1 Eggs: The freshly laid eggs by female silkworm were oval, ellipsoidal, about 1 mm in diameter and slightly dig in center of egg at dorsal side and ventral side flat in shape and lay about 300 to 500 eggs at a time on the egg sheet. The eggs were covered with gelatinous secretion by which they stick to the egg sheet. The colour of eggs was lemon-yellow initially and later they were turning white. After some days it turned completely black in colour before hatching.

The data on morphometries of length from 1 to 1.5 mm with an average 1.25 ± 0.35 . Whereas, width of the eggs from 0.9 to 1.2 mm with an average 1.05 ± 0.21 mm. (Table 1). The average incubation period from 8 to 10 days with an average 9.0 ± 1.41 days whereas, the hatching percentage was 95.5 ± 6.36 per cent.

The present findings are close in agreement with the findings of Patel *et al.*, 2013, who reported incubation period from 7 to 11 days with an average 8.32 ± 1.18 days of PMxCSR2 hybrid. However, 98.03 percent hatching observed in NB4D2xKA (Meshram, 2002) [3].

3.1.2 Larva: The body colour of newly hatched larvae was yellowish brown in colour with no any marking was observed on larval body. The head was distinctly visible, dark black in colour with shining head capsule, body elongated with numerous hairs arrangement on full larval body. However, second and third instar larva had brown black head with greybrown body colour, hairs were arranged on full larval body with "C" shape and two round brownspots marking on second and fifth abdominal segments, respectively. A horn like projection on eight abdominal segment and last segment wider than other segments with hairy margin. The fourth and fifth larvae were pure white in colour and same marking characteristics as describe for second and third instar, but it clearly visible. They were found to moult four times and passed through five larval instars.

The first instar larva measures about 4 to 6 mm with an average of 5 ± 1.41 mm in length and 0.8 to 1.5 mm with an average of 1.15 ± 0.49 mm in width. The second instar larva

measures about 10 to 13 mm with an average of 11.5 ± 2.12 mm in length and 1.5 to 2 mm with an average of 1.75 ± 0.35 mm in width. The third instar larva measures about 13 to 18 mm with an average of 15.5 ± 3.53 mm in length and 2 to 2.5 mm with an average of 2.25 ± 0.35 mm in width. The fourth instar larva measures about 28 to 36 mm with an average of 32 ± 5.65 mm in length and 4 to 6 mm with an average of 5 ± 1.41 mm in width. The fifth instar larva measures about 53 to 65 mm with an average of 59 ± 8.48 mm in length and 6 to 8 mm with an average of 7 ± 1.41 mm in width.

The larval duration of first, second, third, fourth and fifth instars larvae were 4.5 ± 0.70 , 3.5 ± 0.70 , 5.5 ± 0.70 , 6.5 ± 0.70 and 7.5 ± 0.70 days, respectively. The total larval period completed in 25-30 days with an average of 27.5 ± 3.53 days.

When final instar larva became full grown it stopped feeding showed restlessness, become sluggish and gradually changes in colour from white to light yellow and raise their head in search of support so as to be enabling to start spinning of the cocoon which indicate that larva ready for mounting on moutage.

3.1.3 Pupa: The freshly formed pupa appeared shining yellow brown in colour which later on became dark brown in colour. The pre pupal days completed in 2 to 3 with an average of 2.5 ± 0.70 days. The pupal period lasting in 8 to 12 with an average of 10 ± 2.82 days.

3.1.4 Adult: Before emergence into adult, the pupa secretes a brown colour alkaline fluid that softens one end of the cocoon and break down of its silk strands take place, feeble crumpled adult squeezes its way out. The male was dirty white coloured moth, antennae were bi-pectinate, ocelli were absent and black compound eyes were present. Males were smaller in size than females and could easily be distinguished with the help of presence of black colour marking on fore and hind wings, also size of abdomen. The female moth was dull white in colour with bi-pectinate antennae. The forewings and hind wings of both the sexes were dirty and dull white coloured, respectively. Adults were sluggish and weak fliers, the entire body and wings were covered with scales, head was small and hypognathous and proboscis was well developed and coiled. The wing span of male moth was 21.5 ± 0.70 mm in length and 33.5 ± 3.53 in width. The wing span of female moth was 28.5 ± 2.82 mm in length and 47.5 ± 3.82 in width. The adult emergence varied from 60 to 75 with an average of 67.5 ± 10.60 per cent. The pre ovipositional period completed in 4.45 to 9 with an average of 6.72 ± 3.21 hrs. The ovipositional and post ovipositional period completed in 1.15 to 3 and 3 to 4 with an average of 2.25 ± 1.06 and 3.5 ± 0.70 days, respectively.

The sex ratio of male and female (Male:Female) varied from 4:06 to 6:04 with an average of $5:05 \pm 0.05$. The male adult longevity varied from 4 to 5 days with an average of 4.5 ± 0.70 days. Whereas, female adult longevity varied from 4 to 7 days with an average of 5.5 ± 2.12 days. The total life cycle of male completed in 46 to 61 with an average of 53.5 ± 10.60 days. The total life cycle of female completed in 48 to 63 with an average of 55.5 ± 10.60 days.

The present findings are agreement with the findings of Jatuporn and Nijura (2017) who studied the biology of the mulberry silkworm (Mcon-1) on mulberry variety S-30 under laboratory conditions during November 2017 to December 2017. The results revealed that eggs were laid singly with gummy substance which consists of an average of

331.30±29.79 eggs per female. The eggs hatched in 8.67±1.03 days with 95.89±2.83 per cent egg hatching. The larva moulted four times to become fully mature in 23.77±0.77 days. The pre-pupal and pupal periods were 2.29±0.46 and 10.20±0.92 days, respectively. The average pre-oviposition, oviposition and post-oviposition period were recorded

6.87±0.83, 19.73±2.08 and 114.99±6.79 hrs, respectively. The average longevity of the female and male recorded 141.72±6.73 and 111.64±4.46 hrs, respectively. The sex ratio was 1: 1.3 (Male: Female). The life span of female found to be relatively more than male moth.

Table 1: Morphometrics of various stages of mulberry silkworm, *Bombyx mori* L

Sr. No.	Stages	Length			Width		
		Min.	Max.	Mean±S.D.	Min.	Max.	Mean±S.D.
1	Egg (mm)	1	1.5	1.25±0.35	0.9	1.2	1.05±0.21
2	Larva						
	I instar (mm)	4	6	5±1.41	0.8	1.5	1.15±0.49
	II instar (mm)	10	13	11.5±2.12	1.5	2	1.75±0.35
	III instar (mm)	13	18	15.5±3.53	2	2.5	2.25±0.35
	IV instar (mm)	28	36	32±5.65	4	6	5±1.41
	V instar (mm)	53	65	59±8.48	6	8	7±1.41
3	Pupa (mm)	18	21	19.5±2.12	5	8	6.5±2.12
4	Cocoon (mm)	27	31	29±2.82	12	14	13±1.41
Morphometrics of adults of mulberry silkworm, <i>Bombyx mori</i> L							
5	Female with wingspan(mm)	26	30	28±2.82	45	49	47±3.82
6	Male with wingspan(mm)	21	22	21.5±0.70	31	36	33.5±3.53

Table 2: Biology of mulberry silkworm, *Bombyx mori* L.

Sr. No.	Stages	Period		
		Min.	Max.	Mean±SD
1	Incubation period (Days)	8	10	9±1.41
2	Hatching percentage (%)	91	100	95.5±6.36
3	Larval period (Days)			
	I instar	4	5	4.5±0.70
	II instar	3	4	3.5±0.70
	III instar	5	6	5.5±0.70
	IV instar	6	7	6.5±0.70
	V instar	7	8	7.5±0.70
	Total Larval Period	25	30	27.5±3.53
4	Pre pupal (Days)	2	3	2.5±0.70
5	Pupal period (Days)	8	12	10±2.82
6	Pre ovipositional period (hr.)	4.45	9	6.725±3.21
7	Ovipositional period (Days)	1.5	3	2.25±1.06
8	Post ovipositional (Days)	3	4	3.5±0.70
9	Adult emergence (%)	60	75	67.5±10.60
10	Sex Ratio (Male: Female)	4:06	6:04	5:05±0.05
11	Adult longevity (Days)			
	Male	4	5	4.5±0.70
	Female	4	7	5.5±2.12
12	Total life cycle (Days)			
	Male	46	61	53.5 ±0.60
	Female	48	63	55.5±10.60



Egg D'FLS & Hatched Larvae



Mature Larvae



Cocoon



Male & Female Pupa



Male & Female Adult

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