



Studies on Biology of Mulberry Silkworm (*Bombyx Mori* L.) Feeding on Mulberry

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ABSTRACT

The studies on biology of mulberry silkworm on V1 variety of mulberry were carried out under laboratory conditions from March 2024 to April 2024. The durations of life stages were recorded from egg hatching till emergence of adults . Female laid eggs singly, that were round, ellipsoidal, with a flat ventral side and a tiny depression in the centre that consist of sticky substance with 164 ± 43.18 eggs per female. First instar larvae known as chawki worms have yellowish-brown body coloration and no markings on their bodies. The second to fifth abdominal segments were marked with two circular brown spots on both second and third instar larvae. The larvae in their fifth and fourth stages were entirely white. After four moults, the larva reached full maturity in 23.5 ± 2.08 days. After that, the pupal stage lasts for 9.75 ± 1.70 days. Before emerging as an adult, the pupa secretes an alkaline fluid that is brown in colour. This fluid softens the end of the cocoon and causes the silk strands to break down. Female moth lived longer as compared to male moth. The dimensions for length and breadth of the male and female moths were 1.412 ± 0.21 cm and 1.846 ± 0.21 cm and 0.532 ± 0.12 cm and 0.592 ± 0.06 cm, respectively. Thus, this study helps to understand the biology and economic benefits of rearing silkworm in the South-Western Punjab.

Key Words: *Bombyx mori*, Biology , Lifecycle, Sericulture, Silkworm.

INTRODUCTION

Sericulture is a rural agro-based industry that combines aspects of farming and village industry (Gurjar *et al*, 2018). It is a long-standing land-based practise in India that provides agrarian families with economic benefits and the opportunity for significant employment (Shewale, 2023; Kallamannavar *et al* , 2024). It is notable for its quick and minimal investment strong profits, which make it a perfect sector or business and fit in well with India's socioeconomic structure. It is appropriately referred to be the Kalpvriksha or Kamdhenu of the poor farmers (Sharnagat *et al*, 1994).

The four distinct types of silk *i.e.* Mulberry, Eri, Muga and Tasar silk are uniquely produced in India. According to Anitha (2011), India has the highest possibility of being the only nation in the world to grow all four economically viable

varieties of silk: mulberry, tasar, eri, and muga (Bhattacharjya *et al*, 2020). Mulberry silkworm (*Bombyx mori*) belongs to the order Lepidoptera and family Bombycidae. The monophagous silkworm, only eats mulberry leaves (Saha *et al*, 2022). It is raised carefully in regulated captivity for the manufacturing of commercial silk thread in rural agro industries in tropical and subtropical areas (Soumya *et al*, 2017; Zhang *et al*, 2019).

As per Kim *et al* (2010) the sericulture industry is essential for improving the rural poor community's social and economic conditions. Unfortunately, Punjab state does not prioritise India's sericulture business as a cottage industry. For India's silkworm rearing efforts to be improved and enhanced, there is a dearth of trained personnel and cutting-edge research. While sericulture has thrived in various parts of India, the same cannot be said for Punjab, a state known for its agricultural prowess. To address these challenges

and promote the growth of sericulture in Punjab, it is crucial to bridge the research gap and gather scientific insights into the biology and cultivation practices of mulberry silkworms. The current study was conducted at Guru Kashi University in Bathinda, Punjab, to examine the biology of mulberry silkworms on the V1 type of mulberry plant. By studying various aspects of the silkworm's life cycle, including egg characteristics, larval stages, pupal period, cocoon morphology and the characteristics of adult moths, the purpose of this study is to close the current research gap and provide insightful information to Punjab's sericulture sector. The creation of focused policies and interventions to assist the expansion and sustainability of sericulture, which will eventually benefit rural people and economy as a whole, will be made easier with an understanding of the biology and unique difficulties faced by mulberry silkworms in this area.

MATERIALS AND METHODS

A trail was carried out at Sericulture Laboratory, Department of Entomology, Guru Kashi University, Talwandi Sabo, Punjab during March 2024 to April 2024. The disease-free immature larvae of Mulberry silkworm (*B. mori*) were acquired from Regional Sericultural Research Station, Sujampur, Punjab and were maintained under the laboratory conditions at $25\pm 2.58^{\circ}\text{C}$ and $53.75\pm 11.08\%$ RH.

The mulberry leaves were collected from mulberry plants of V1 variety (Table 1) grown in Research Farm Area. The collected leaves were cleaned with the distilled water cut into small pieces (0.5 to 1.0 sq.cm) and given to the newly emerging larvae as food. These larvae were fed each day with mulberry leaves under hygienic conditions. Every day, four feedings of chopped mulberry leaves were provided at 8 a.m., 11 a.m., 3 p.m., and 6 p.m. The size of the chopped leaves was adjusted according on the larval instars. The larvae were not fed during their moulting period. The supply of food was increased in accordance with the silkworm's growth. The fully developed larvae were recognised as mature when they stopped feeding and become translucent with a creamy tint.

Hand-selected mature larvae were housed on mountages to make cocoons. After the adult emergence from cocoons, they were transferred onto the glossy paper sheets smeared with starch (it helps in easy separation of eggs from the sheet) for mating and egg laying. After the egg laying, the sheets containing eggs were kept in distilled water for removal of eggs in loose form and further stored under frozen conditions. The newly hatched larvae after each moult were moved into and kept separately in the 110 mm plastic petri plates while being fed on mulberry leaves. Ocular and stage micrometres were used to measure the size of each instar of the larva under a microscope. The entire period of the larval stages was calculated.

The time taken between pupal formation and the adult emergence was considered as pupal period. The cocoon's length as well as width was measured with a vernier calliper after the cocoon formation. When adults emerged from pupae, their colour and longevity were studied. Shape and the abdominal part were observed to distinguish between male and female adults. Female eggs were collected and counted every morning from 8:00am to 10:00am. Fecundity refers to the total number of eggs laid by an adult female in her lifespan. From the date of emergence to the time of adult mortality, the length of time for male and female moths was estimated individually.

RESULTS AND DISCUSSION

The female's newly deposited eggs were round, ellipsoidal, with a flat ventral side and a tiny depression in the centre. Eggs were pale white having a smooth chorion. Prior to hatching, it was entirely black during the time of oviposition. The reported results were consistent with Patel *et al* (2013).

Chawki worms have yellowish-brown body coloration and no markings on their bodies. The head was clearly apparent; it had a dark black colour with a glittering head capsule. The body was lengthy and covered in hairs in a dense pattern. The hairs were on the complete larvae body in a "C" shape. Two circular brown spots were present on both second and third instar larvae on the second to fifth abdominal segments. Eight abdominal segments were having a horn like

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Table 1. Description of mulberry variety used in the study.

Variety	Characteristics
Victory1 (V1) Selection from a hybrid of S-30 and Ber	Erect branched, Ovate and truncate base, thick, succulent, smooth, glossy, good rooting ability and higher yield.

Table 2. Data on Morphometries of adults and cocoon of *B. mori*. N= 40.

Sr. No	Characteristic	Male			Female		
		Min.	Max.	Av.+ S.D.	Min.	Max.	Av.+ S.D.
1.	Adults length	1.18	1.73	1.412±0.21	1.60	2.10	1.846±0.21
2.	Adults breadth	0.36	0.68	0.532±0.12	0.48	0.72	0.592±0.06
3.	Adults wing span	3.20	3.50	3.33±0.12	3.68	4.15	3.946±0.20
4.	Cocoon	3.00	3.23	3.106±0.10	3.15	3.40	3.254±0.10

Table 3: Data on Biology of mulberry silkworm, *B. mori* on its host *M. alba*

Sr. No.	Particular	Number of larvae observed	Larval Period (days)		
			Min.	Max.	Mean± S.D.
A	Larval Stages				
	1 st instar	80	3	4	3.5±0.57s
	2 nd instar	80	3	4	3.75±0.50
	3 rd instar	80	4	5	4.5±0.57
	4 th instar	80	5	6	5.5±0.57
	5 th instar	80	6	7	6.5±0.57
	Total larval period (days)	80	21	26	23.5±2.08
B.	Pupal period (days)	80	8	12	9.75±1.70
C.	Oviposition Period (hrs)	80	12	24	17.75±4.92
D.	Adult longevity (days)				
	Male	80	4	5	4.75±0.50
	Female	80	5	6	5.5±0.57
E.	Fecundity (Number of eggs)	80	110	213	164±43.18
F.	Temperature (°C)		22	28	25±2.58
G.	Relative humidity (%)		40	65	53.75±11.08

projections. A last segment of mature larvae were wider than the others and also consists of a hairy edge. The larvae in their fifth and fourth stages were entirely white and had the same markings as the second and third instar, but they were more obvious. Throughout their life cycle, the larvae had four moults and passed through five distinct instars.

The mean larval duration observed was 3.5±0.57, 3.75±0.50, 4.5±0.57, 5.5±0.57 and 6.5±0.57 d for first, second, third, fourth, and fifth instar larvae, accordingly. The total period of developmental stages of larvae was 23.5±2.08 d

(Table 3). When the larva in its last instar reached full maturity, it ceased feeding, displayed anxiousness, grew sluggish, gradually changed colour from white to light yellow, and raised its head to look for assistance in order to be able to begin spinning the cocoon, a sign that the larva was prepared for mounting on mountages. When a pupa first emerged, it was a bright yellow-brown coloration that subsequently turned dark brown. The average pupal period recorded was 9.75±1.70 days. A tough, one-threaded dirty white, oval in shape cocoon with one or two layers of hard, elastic protein was detected. The cocoon's length and width varied between 3.106± 0.10 and 3.254±

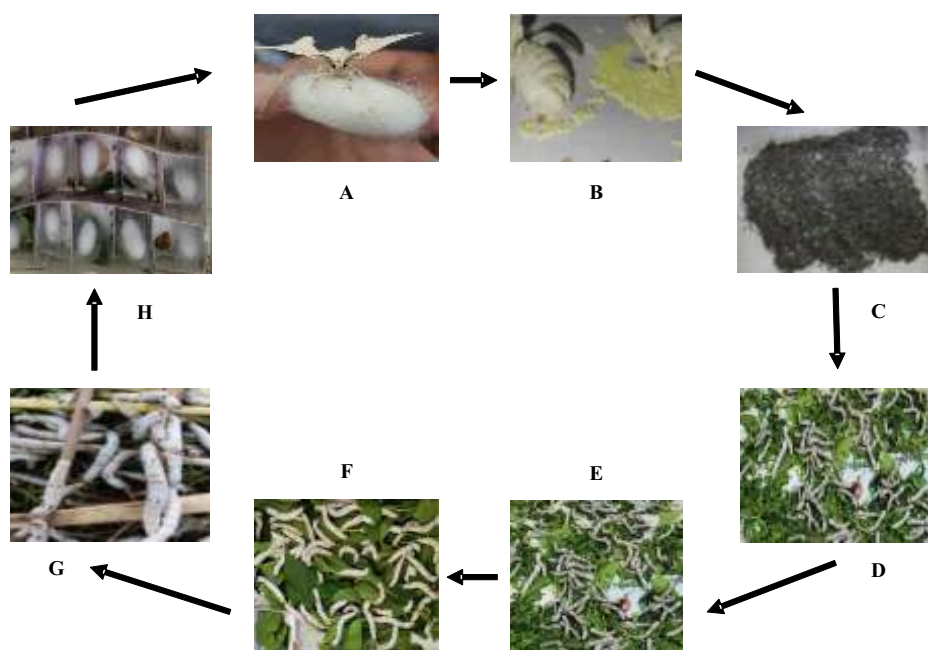


Fig. 1 A. Adult, B. Egg C. 1st instar larvae, D. 2nd instar larvae, E. 3rd instar larvae, F. 4th instar larvae, G. 5th instar larvae, H. Pupal stage of silkworm.

0.10 for male and female respectively. The reported results were consistent with Gurjar *et al* (2018).

Before emerging as an adult, the pupa secretes an alkaline fluid that is brown in colour. This fluid softens the end of the cocoon and causes the silk strands to break down, allowing the frail, crumpled adult to squeeze its way out. The male was a dirty white colour moth with bi-pectinate antennae, no ocelli, and present black compound eyes. Males were smaller than females and could be identified by their size of abdomen and black patterns on their fore and hind wings. The female moth had bi-pectinate antennae and had a dull white tint. The entire body and wings of adults were dirty, dull, white coloured, covered in a thin layer of scales, a tiny, hypognathous head, and a well-developed, coil-like proboscis. Male and female moths had wingspan measurements of 3.33 ± 0.12 cm and 3.946 ± 0.20 cm respectively. The dimensions for length and breadth of the male and female moths were 1.412 ± 0.21 cm and 1.846 ± 0.21 cm and 0.532 ± 0.12 cm and 0.592 ± 0.06 cm, respectively (Table 2). Similar type of results have been reported by Sangle *et al* (2022).

Fecundity data showed that the female laid 164 ± 43.18 eggs during the course of the full ovipositional phase (Table 3). The total oviposition period was 17.75 ± 4.92 hr. Male and female average ages at death were 4.75 ± 0.50 and 5.5 ± 0.57 d, respectively. These were in accordance with results obtained by Gurjar *et al*, (2018). The research highlighted India's potential to grow all four economically viable silk varieties, including mulberry silk, tasar silk, eri silk, and muga silk. The study revealed that *Bombyx mori*, which feeds on mulberry leaves, is a monophagous species that plays a vital role in commercial silk thread production. The findings call for increased investment and research in the sericulture industry to improve social and economic conditions in rural communities. It was found that the average larval period was 23.5 ± 2.08 d while the pupal period lasted for 9.75 ± 1.70 d. The study also reported on the dimensions of adult moths, such as length, breadth, and wingspan, as well as the measurements of male and female cocoons. It was observed that female moths laid an average of 164 ± 43.18 eggs during their oviposition phase, which lasted for 17.75 ± 4.92 hr.

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