

Study on the difference in production of indoor mulberry silkworm (*Bombyx Mori L.*) and outdoor mulberry silkworm in Bilaspur (C.G)

Dr. Alka Dubey

Asst. Professor Zoology, Govt. J P Verma Arts and Commerce,
College Bilaspur (C.G)

Abstract

This paper presents a comparative analysis of the production outcomes between indoor and outdoor rearing of the mulberry silkworm. The study area is central silk board Koni Bilaspur (Chhattisgarh) in India. Factors such as environmental conditions, resource utilization, and economic viability are examined to determine the optimal approach to maximize silk yield and farmer income. (Elumalai et al., 2020) (Porto, 2014) how the differing rearing environments impact the growth, development, and productivity of the mulberry silkworm is explored

Keywords: Silkworm, Sericulture, Mulberry, Cocoon, Silk cultivation

1. Introduction:

The process of cultivating silkworms for the production of silk is called sericulture. Sericulture industry combines attributes of both agriculture and industry. It is most significant industry that provides livelihood to millions of people worldwide. Silk is highly valuable agriculture product that form part from about 0.2 percent of total fiber that is produced globally. China and India are fore runner in production of silk fiber. It is a significant industry in India, providing livelihoods to millions of rural people. The mulberry silkworm, “*Bombyx mori L*” is dominant species reared for silk production in the country, this silkworm has been domesticated for majority of India’s silk output. Mulberry is perennial plant that is adaptable to vast climatic conditions from temperate to tropic, different soil is suitable for it to flourish. India is the only country globally producing four types of natural silk as mulberry, tasar, muga and ERI, among these four variety of mulberry silk contributes 74% which is maximum. Rearing of these silkworm has been an outdoor activity historically but it is also reared indoor with controlled environment as temperature, humidity and air regulation to optimize its production. However, in recent year, there has been growing interest in the practice of outdoor mulberry silkworm rearing, where the insects are allowed to feed and develop in natural environmental conditions. (Jiragal et al., 2019) This study aims to investigate the differences in production outcomes between indoor and outdoor mulberry silkworm rearing in India. Recent research has shed light on the important role of the gut microbiome in the health and development of the mulberry silkworm. Silk producing states in India are Andhra Pradesh, Karnataka, Tamil Nadu,

Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Maharashtra, Odisha, Jammu & Kashmir, Uttar Pradesh & West Bengal. Among these states Karnataka is the major producer of Mulberry silk in India. Chhattisgarh is recognized for its Kosa silk which is derived from Tussar cocoons found on tree like Saja, Sal Mulberry. The Bilaspur is the key area for both Kosa and Mulberry Silk Production in Chhattisgarh. The state government has implemented schemes for Mulberry silk development and extension scheme to promote Mulberry silk production. Chhattisgarh reported 8000 metric ton production of Mulberry Silk in 2017. This records a decrease from previous number of 9000 metric tons from 2016. Ambikapur, Bastar, Bilaspur Champa, Kawardha, Korba, Raigarh & Sarguja are main silk producing district in Chhattisgarh.

Material and methods

The Present study were conducted in the indoor area at Central Silk Board Koni Bilaspur (Chhattisgarh) and outdoor study at field of the same institute which is 500 meters just behind it. We divided present study in four months to August, September, October and November. Life of silk worm consists of 5 stages as egg, larvae, cocoon, pupa and the moth. Our work was focused on eggs and larvae Stage. Larvae were provided with freshly cut mulberry twigs of approximately 0.5 to 1.0 cm in length. Mulberry leaves were provided to larvae contained in cleaned rearing tray, so that it can start feeding on leaves easily. Interval of providing of food, cleaning of space and quantity of mulberry leaves were well regulated as per requirement. Larvae were feed three times a day at 10.00 a.m., 2.30 p.m., and 6.00 p.m. respectively. The life cycle of mulberry silkworm completes in 45-55 days. stages of silkworm are egg, larva, pupa, and moth. Egg stage is lasting for 9–10 days, larva stage which is 24-28 days, pupal stage is 8-10 days and moth stages 3-4 days. Rearing was ensured to be clean and disinfected to procure quality silkworm eggs (Disease free laying or DFLs), optimal temperature and humidity levels were maintained. Here is a more detailed breakdown of preparation steps

Rearing house preparation: Cleanliness and Hygiene: The rearing house and all the equipment were cleaned and disinfected with 2-4% formaldehyde solution. Adequate ventilation was ensured to prevent the buildup of moisture and to maintain quality of air. Temperature around 25°C and Humidity between 70-80%. Adequate but diffused lighting was provided. Hygiene practices were adopted. It was ensured that hands were always washed with disinfectants before entering the rearing house and unnecessary entry of people was restricted. Disinfection procedures were followed. 5% high grade bleaching powder was sprinkled around rearing house at an interval of 5-6 days.

Procurement of Quality silkworm eggs (Disease Free Laying or DFLs): Eggs used at the Silk board are obtained from reputable grainages that produce disease free seeds. It is ensured at the center that eggs are free from diseases and are of a pure or hybrid race

Rearing bed Preparation: Special tray or racks were used for rearing the silkworms. Regular Supply of fresh, high quality mulberry leaves are ensured as silkworm's primary food. Chopped Mulberry leaves are sprinkled on rearing tray to prepare a feeding bed. Humidity control is important in rearing bed preparation. Foam Strip soaked in water is placed on the tray to maintain humidity.

Incubation and Brushing: Eggs are incubated in a dark room with a temperature of 25°C and humidity of 80%. Once the eggs hatch, silkworm larvae are transferred to the rearing tray using a method called Brushing. By this method Larvae are gently brushed onto the leaves.

Early and late age rearing:

Early Age rearing:

Temperature: Maintain a temperature of 26°C for III instar larvae, 25°C for IV instar and 24°C for V instar larvae.

Humidity: Maintain 80% humidity for III instar larvae and 70% for IV and V instar larvae.

Late Age Rearing:

Mounting: Mount the silkworm on suitable mountages like rotary or bamboo mountages.

Cocoon production: After the silkworms reach maturity, they will start spinning cocoons.

Disease prevention and control: Strict hygiene practices are maintaining at the site to prevent diseases. Rearing house and equipment are regularly disinfected. Regular inspection of silkworm for signs of disease are done to take appropriate remedy.

Harvesting and cocoons collection: Cocoons are harvested on the 5th Day of Mounting. Irregular-sized, flimsy and stained cocoons are removed in quality control method.

Environmental Conditions	Indoor Mulberry Silkworm	Outdoor Mulberry Silkworm
Weather	Controlled	Depends on environment
Temperature	Consistent temperature	Variable temperature
Humidity	Consistent Humidity	Depends on environment
Predators	Barrier for predators	Affected by predator
Sunlight	Low Sunlight	Natural Sunlight

Key point about indoor silk production

- 1) Controlled Environment
- 2) Higher Quality Potential
- 3) Higher Labor Input
- 4) Better disease control

Arthropoda → Mendibulata → Insecta → Pterygota → Bombax Mori





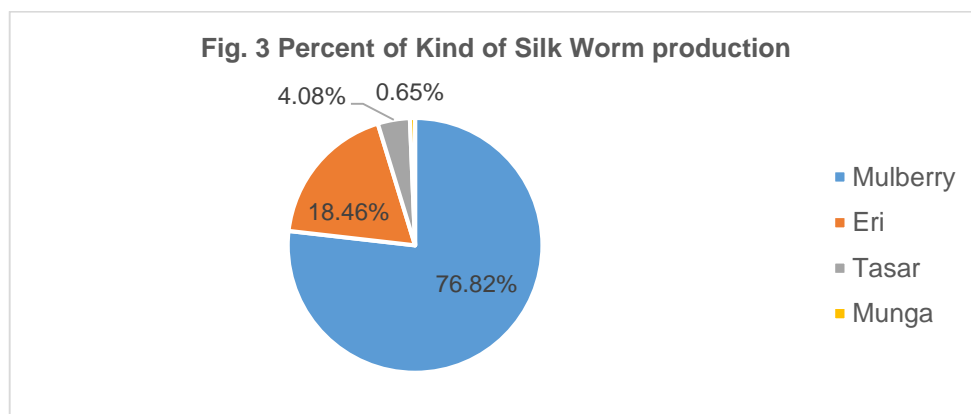
Fig. 1 Indoor photograph of Mulberry silkworm (*Bombyx Mori L*) cocoon at Central silk Board Koni Bilaspur (C.G)



Fig. 2 Outdoor photograph of Mulberry silkworm (*Bombyx Mori L*) Larvae at Farm beside Central silk Board Koni Bilaspur (C.G)

Reason to select Mulberry Plant for Study

Mulberry silk production in India is highest to 76.82 percent of total silk production, Source Central Silk board of India Ministry of textile.



REARING PERFORMANCE AND LARVAL MORTALITY IN OUTDOOR CONDITION

Date of hatching - 06.09.2023 To 21.10.2023
 Larval period - 24 - 28 Days
 Total No. of DFL - 1st crop 20 DFL egg, 1200 Larva ignition
 Hatching Percentage - 57.5 outdoor rearing
 Production Percentage - 42.5 %
 Mortality No. - 690

Table.1 The number of Mortality, percentage of Mortality and reason of Mortality on all 5 stages of Instar Larva of Silkworm (*Bombyx mori* L.) in Outdoor Condition

Stagee	No. of Larva	No. of Mortality	% of Mortality	Reason
1 st Instar Larva (3-5 Day) 27° C 1 st Molting	1200	300	25	Viral, Bacterial, Fungal Disease weather & predators
2 nd Instar Larva (2-4 Day) 25° C 2 nd Molting	900	160	17.77	Viral, Bacterial, Fungal Disease weather & predators
3 rd Instar Larva (3-6 Day) 23° C 3 rd Molting	740	110	14.86	Viral, Bacterial, Fungal Disease weather & predators
4 th Instar Larva (4-5 Day) 26° C 4 th Molting	630	70	11.11	Viral, Bacterial, Fungal Disease weather & predators
5 th Instar Larva (6-8 Day) 27° C 5 th Molting	560	50	8.9	Viral, Bacterial, Fungal Disease weather & predators
	510	690	57.5	Production of 42.5

REARING PERFORMANCE AND LARVAL MORTALITY IN INDOOR CONDITION

Date of hatching - 06.09.2023 To 21.10.2023
 Larval period: - 24 – 27 Days
 Total No. of DFL - 1st crop 20 DFL egg 1500 Larva ignition
 Hatching percentage - 48.66 Indoor rearing
 Production Percentage - 51.33 %
 Mortality No. - 730

Table.2 The number of Mortality, percentage of Mortality and reason of Mortality on all 5 stages of Instar Larva of Silkworm (*Bombyx mori* L.) in Indoor Condition

Stage	No. of Larva	No. of Mortality	% of Mortality	Reason
1 st Instar Larva (3-5 Day) 27° C 1 st Molting	1500	320	21.33	Viral, Bacterial & Fungal Disease
2 nd Instar Larva (2-4 Day) 25° C 2 nd Molting	1180	160	13.55	Viral, Bacterial & Fungal Disease
3 rd Instar Larva (3-6 Day) 23° C 3 rd Molting	1020	110	10.78	Viral, Bacterial & Fungal Disease
4 th Instar Larva (4-5 Day) 26° C 4 th Molting	910	80	8.79	Viral, Bacterial & Fungal Disease
5 th Instar Larva (6-8 Day) 27° C 5 th Molting	830	60	7.22	Viral, Bacterial & Fungal Disease
	770	730	48.66	Production – 51.33%

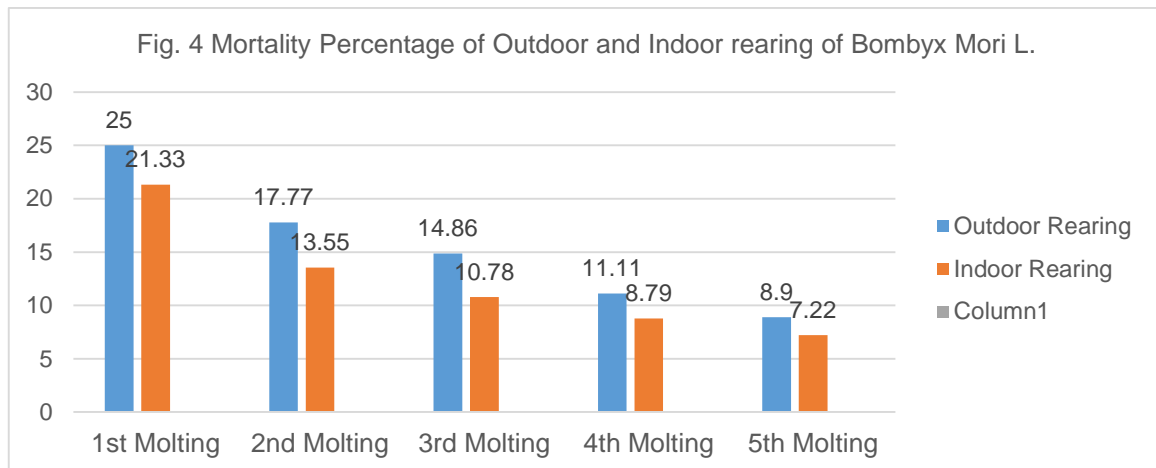
Result & Discussion

The data collected during all the four months in the whole experimental period was statistically analyzed and presented below

Mortality of larvae in different instar: Mortality number and percentage of *Bombyx mori* L. during whole experiment period under Outdoor Condition and Indoor Condition are presented in Table no. 1 and Table no. 2 respectively. In Table 1, it has been observed that, the highest mortality was 300 out of 1200 that is 25%, obtain during the 1st molting. In 2nd molt 160 worms perished out of remaining 900 worms that comes to 17.77% mortality. Mortality of worms in 3rd molt was 110 out of 740 that is 14.86% a little less from previous molting. In 4th Instar 70 worms died out of 630 that makes 11.11%. In final Molting mortality number was 50 out of 560 that was lowest. In Table No. 1 that present data of outdoor condition shows total 57.5% mortality and production of 42.5% (Table 1). It seems beside diseases of all kind, weather and predator leads to greater mortality.

The Table 2 present Rearing performance, Mortality number and percentage of Mulberry Silkworm at indoor condition. Experiment was initiated with 1500 larvae in 1st Instar, mortality was 320 worms that is 21.33%. In 2nd Instar 160 worms out of 1180 perished which is 13.55%. In 3rd molting out of 1020 worms 110 were dead constituting to 10.78%. In 4th molting

percentage of mortality fell to 8.79%, which further fell to 7.22% in final molting. Total Mortality percentage of worms after all the molting stage was 48.66%, so production percentage becomes 51.33 (Table 2), which is slight higher than that produced in outdoor rearing. Thus, from the present study it has been observed that, indoor Mulberry silkworm rearing is more fruitful than outdoor rearing. Mortality is more in outdoor rearing as compared to indoor rearing.



Study of indoor and outdoor rearing shows that in outdoor rearing fresh mulberry leaves are available in plenty for feeding of larvae, which contain sugar, minerals, vitamins, lipids, proteins which help silkworm to grow and hence there is a possibility of best silk (silk fiber protein) production, whereas outdoor silkworm larvae which dwell in natural conditions have access to more natural sunlight and air and have plenty of space are more bigger in size and appear healthy but still as they are over exposed to nature's irregularities such as strong wind, rainfall, fluctuating temperature, seasonal climate change, pathogens, predators like birds, snakes, insects (lady bird beetle, lacewing, ground beetle, aphid, midges, yellow jacket, wasp, syrphid flies) causes heavy loss in early stages of instars. Preventive measures adopted for pest and disease in outdoor rearing became futile due to consistent infestation by both pests and pathogens are common in open conditions. In indoor rearing, predators like ants, lizards, rats, squirrels are not allowed to come near larvae. Barriers are made for these predators and environmental effect on them were kept as minimum as possible. These indoor larvae were given artificial feeding. Hygiene was maintained in them, which increases the possibility of production. I have summarized result in form of graph which is easy to understand. By studying the graph, we come to know that indoor rearing is better than outdoor rearing and silk production can be increased by indoor rearing.

Reference

1. Ajit Kumar Sinha and B.C Prasad, 2011, Variability in the Ecoraces of Tropical Tasar Silkworm *Antheraea Mylitta* Drury, Nature proceedings, doi:10.1038/npre.2011.6161.1.
2. Bhargava *et al.*, (2001), Genotype- environment interection for silk yield contributing characters in silkworm, *Bombax mori* L. *Genetika*, 33 pp 39-52
3. Chatterjee *et al.*, (2004), ISSR profiling of genetic variability in the ecotypes of *Antheraea mylitta* Drury, the tropical tasar silkworm, *Rus. J. Genet.* 40, pp 152-159.

4. Kar *et al.*, (2005), Genetic variability and genetic structure of wild and semi-domestic population of tasar silkworm (*Antheraea mylitta*) ecorace Daba as revealed through ISSR markers, *Genetica* 125, pp 173-183.
5. Mahendran el al., (2006), Genetic variation in ecoraces of tropical tasar silkworm, *Antheraea mylitta* D. using RFLP technique, *Current science*, 90, pp 1.
6. Manohar Reddy *et al.*, (2011), Pattern of Silk Yield and Silk Filament Quality in Ecoraces and F₁ Hybrids of indian Tropical Tasar Silkworm, *Antheraea mylitta* Drury (Lepidoptera: Saturniidae) in relation to Crop Seasons, *Academic journal of entomology*, 4(3), pp 88-93.
7. Renuka G Shamitha. G *International Journal of Environmental Sciences* Volume 4 No.2 2013, 140.
8. Shamitha G and Purushotham Rao A., (2005), Studies on Genetic aspects of Tasar silkworm, Andhra local ecorace (*Antheraea mylitta* D), Proceedings of National workshop Organised by CTR&TI, Ranchi and RTRS, Warangal. On “Recent advances in Tasar culture” June 21-22nd, pp 154-156.
9. Sinha *el al.*, (1994), *A review on the breeding and genetic aspect of Tropical tasar silkworm, Antheraea mylitta* D. In Proc. Of the conference on cytology and genetics, 4, pp7-16.