Asian Jr. of Microbiol. Biotech. Env. Sc. Vol. 27, No. (3–4) : 2025 : 190-196

ISSN-0972-3005

DOI No.: http://doi.org/10.53550/AJMBES.2025.v27i03-04.009
Journal Home Page: www.envirobiotechjournals.com

A COMPARATIVE STUDY ON MORPHOMETRIC ANALYSIS OF ERI SILKWORM (*Philosamia ricini*) REARED ON CASTOR, EJAR AND PAPAYA LEAVES

SANGEETA GOGOI[1]*, BIKASH BORDEWA[2] AND GITALEE BHUYAN

Department of Zoology, Madhabdev University, Narayanpur 784 164, Assam, India

(Received 18 February, 2025; Accepted 9 April, 2025)

Keywords*: Silkworm, Sericulture, Cocoon, Castor leaves, Ejar, larvae.*

Abstract – Eri silkworm is the only completely domesticated non-mulberry silkworm native to India. It is traditionally reared in Assam by various ethnic groups from time immemorial. Eri silkworm is mainly reared on castor leaves, but being polyphagous insect it may be reared on other plant also. The present study is mainly to investigate the best suitable food plant of eri silkworm other than castor leaves. In our study eri silkworm was reared on castor (*Ricinus communis*) as control, ejar (*Lagerstroemia speciosa*) and papaya (*Carica papaya*) as experimental food plant. Regarding *L. speciosa* there is no any information present on it as the food plant of eri silkworm. According to local tribal people we took this plant as an experimental food plant of eri silkworm. The life cycle of the eri silkworm were studied and different larval instars were observed in three different trays in which the larva were fed by 3 different food plant (control and two experimental plants). A comparative morphometric study was revealed by using different morphological parameters. We already knew that castor is regarded as the primary food plant of eri silkworm, so the cocoon quality and silk production is very high but from the experiment it was found that ejar also can give a better cocoon quality and silk production. This article is based on a comparative study among the castor, ejar and papaya.

INTRODUCTION

Sericulture is an important cottage industry in India concerned with rearing of the silkworm (Mulberry, Eri, Muga and Tasar), reeling and spinning of cocoon for production of raw silk. India is the second largest producer of silk in the world next to China. In China, the natural silk was reported to be discovered first about 2460 BC. Sericulture or silk farming is regarded as a viable agrobased industry which was introduced 400 years back in India. It is a labour intensive, farm based industry which provides gainful employment, economic development and help in improvement the quality of life of rural people. The northeastern states of India has the unique distinction of being the only region producing four varieties of silk, i.e eri, muga, mulberry and tasar. Assam is called as the home land of muga and eri silkworm (Saikia, 2011). This region provides the favourable climatic condition and the food plants of this valuable silkworms is widely distributed in the entire region (Kumari *et al*., 2015). In Assam, specially the tribal folk (like Mising, Kachari, Bodos, Mikirs, Rabhas, Ahoms and Garos) traditionally pacticed rearing of eri silkworm from time immemorial. Around 1.30 lakhs families of Assam involved in rearing of eri silkworm. It has been reported that there is ample number of families involved in the rearing practiced and weaving activities of Eri silkworm which is helping them to increase their family income and large number of families were found to come out of poverty (De *et al*., 2007). In northeast India, eight eri silkworm eco-races are found i.e Borduar, Titabor, Khanapara, Nongpoh, Mendipathar, Dhanubhanga, Sille and Kokrajhar, among these ecoraces pure line strains of eri silkworm were isolated from Titabor and Borduar eco races.

Eri silkworm, *Philosamia ricini* is completely domesticated non-mulberry silkworm belongs to family *Saturnidae* and order *Lepidoptera*. There are 19 eri species recorded in tropical Asia, three of them namely *Samia ricini*, *Samia canningi* and *Samia fulva* are exclusively native to India (Peigler and

Naumann, 2003). Sarmah *et al*., (2015) discovered a new breed of eri silkworm through conventional breeding method. The life cycle of *Philosamia ricini* completed through eggs (koni), larva (polu), pupa (leta) in cocoon and adult moth (chakari). In summer, the life cycle is completed in 44-45 days and in winter it takes around 85-87 days.

Systematic position of eri silkworm

Phylum- Arthropoda
Class- Insecta
Order – Lepidoptera
Family – Saturnidae
Genus – *Philosamia*
Species- *ricini*

Eri silkworm are polyphagous as they feed on variety of plants species, over 30 species (Choudhury, 1982 and Reddy *et al.,* 1998) . It is exclusively native of Northeastern states of India which are later on introduced to the other parts of the India (Saratchandra, 2003). The farmers of several other states also start pactising eri culture to a great extent. Besides northeastern states, Andhra Pradesh, Karnataka, Madhya Pradesh, Jharkhand, Bihar, Orissa, tamil nadu and Sikkim has also taken up the eri culture. The optimum range of temperature required for the growth and development of eri silkworm is about 20-40ºC. Along with the environmental factors, the amount of nutrient content in the host plant have a great impact on the growth and development of the silkworm as well as in the cocoon production (Sarmah *et al.,* 2015 and Lalfelpuii *et al*., 2014) . For good quality of cocoon production, proper nutrition plays an important role. Therefore good quality of leaves with proper maintenance of hygience is very important in eri culture. Among the different food plants like Korha, Borpat, Borkesseru, Gulancha, Papaya and several others, castor (*Riccinus communis*) is regarded as the primary food plant of eri silkworm (Sannapa *et al.,* 2004). But the castor leaf is not available throughout the year and the crop has to be shown every year. During the winter season the leaves yield reduced to a considerable amount which creates problem to a very great extent in the field of eri culture. Therefore it is the peak time to scientifically investigate the perennial food plant for eri silkworm without compromising the quality and quantity of cocoon production. In this present study we have taken castor *Riccinus communis* (control plant), ejar *Lagerstroemia speciosa* and papaya *Carica papaya* (experimental plant) as food plant for eri silkworm and a comparative study is made among

MATERIALS AND METHODS

Study Area

The present study was done in our local area named Kholaguri, which is a small village of Bihpuria town in Lakhimpur district in the state of Assam (Fig. 1 and 2), India.

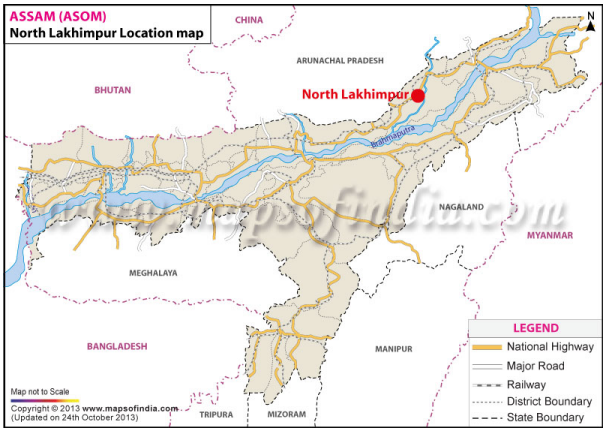

Fig. 1. Map of Assam (source-www.mapsofindia.com)

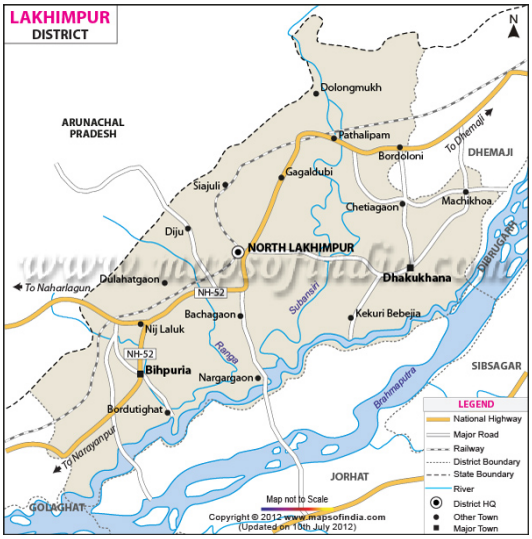

Fig. 2. Map of Lakhimpur (source-www.mapsofindia.com)

METHODOLOGY

- Disease free seed cocoons are obtained from our local tribal people and reared fully indoor. Healthy cocoons are spread on bamboo trays in a cool dark room and allowed them to hatched. After hatching the healthy males and females

moth are separated out and allowed them to mate in a quite dark room (dark basket or a box).

- Fertilized female moths are then oviposited within 25 hours on the wall of the rearing box. The eggs are small, oval, creamy white and are present in groups due to a gummy substance which makes them adhere to one another.
- The eggs laid are then collected and wrapped in a clean paper until the larva emerges out from it. The newly hatched larvae are yellowish in colour with black segments.
- After that we separated the larvae into three groups and placed them in different trays. These trays are made up of bamboo with their edges turned up. Each group has approximately same number of newly hatched larvae.
- These trays are now covered by clean nets. Net is used to prevent the larvae from flies, bees, insects and also from the dust and dirty pollutants. Young leaves of the three food plants (castor, ejar and papaya) are served to the larvae placed in three different trays for three times a day. Before serving the leaves, they were first washed properly and then dried to avoid any kind of infections or diseases. Moreover the cleaning of the trays was also carried out at regular intervals.
- The growing worms then undergo four moults and have five instar stages. Total larval period last for 30-35 days. The mature 5th instar larvae stops feeding and starts searching for a proper place to spin the cocoon.
- At this stage, the mature worms were picked up and transferred them to another box or basket of dry leaves and allowed them to undergo the cocoon spinning process.
- The length, breadth and weight of every instar was noted down and the time taken to complete different instar stages of life cycle were also observed and noted down. The mortality rate of every instar was also be noted. The live photos of different stages of eri silkworm were shoot and the length and weight of the silkworm of different stages feeding with different food plant were also measured using scale, weight machine.

RESULTS AND DISCUSSION

During the month of April, May and June 2022 the life cycle of the eri silkworm were studied and different larval stages served with three different food plant (placed in three different trays) was observed which is depicted in the chart below.

Life cycle

The life cycle of eri silkworm, *Philosamia ricini* can be scientifically classified into four stages-(a) egg (koni), (b) larva (polu), (c) pupa (leta) in cocoon and (d) adult moth (chakari).

Egg

The eggs are small, oval shaped which are creamy white in colour. The eggs adhere with each other by some colourless glue.

Larva

1st instar: After 9 days, eggs were hatched into small larva which is known as the 1st instar larva. The mature 1st instar larva served with young castor leaves was about 1cm in length and 0.3 cm in breadth, larva fed with ejar leaves are about 0.8 cm in length and 0.2cm in breadth and larva fed with papaya leaves were observed to be 0.6 cm in length and 0.2 cm in breadth. The newly hatched larva possesss a black colour head with yellow body colour. Their bodies are covered with tiny black hairs, black spots and black band is present near the dorsal side of the head.

2nd instar: After 5-8 days the 1st instar larvae undergoes 1st moult and become 2nd instar. The 2nd instar larva was larger than the 1st instar and measures about 1.9 cm in length and 0.5 cm in breadth fed with castor leaves, larva fed with ejar are 1.3 cm in length and 0.6 cm in breadth and larva is 1 cm in length and 0.3 cm in breadth fed on papaya leaves. The newly hatched 2nd instar larva has yellowish body with pale head and later the head becomes black. Their body is covered with whitish hair and pair of black spot found to be present longitudinally.

3rd instar: After 3-6 days the 2nd instar undergo 2nd moult and form 3rd instar which measured about 3.8 cm in length and 1 cm in breadth after fed on castor leaves, 3 cm in length and 0.8 cm in breadth larva observed after fed on ejar and 2.5 cm in length and 0.7 cm in breadth when fed on papaya leaves. The 3rd instar possesses black coloured head and the body becomes white in colour with white powdery substance. The body bears longitudinal black spot and white tubercles.

4th instar: After 2-5 days the 3rd instar undergoes 3rd moult and become 4th instar larva which is white in colour with powdery substance and with yellow head and clasper anal. In this stage the tubercles become larger and prominent than the 3rd instar. The 4th instar larvae measures 5.2 cm in length and 1.1

cm in breadth fed on castor leaves, the larvae fed with ejar are about 4.5 cm in length and 1 cm in breadth and larva measures about 4 cm in length and 0.9 cm in breadth when fed on papaya leaves.

5th instar- After 3-5 days the 4th instar undergoes 4th moult and becomes 5th instar larva. The body of the 5th instar becomes greenish white in colour and their head was yellow colour. 9 pairs of spiracles are distinctly visible in this stage. Body is divisible into head thorax and abdomen. The thorax consist of three segments i.e pro-thorax, meso-thorax and meta-thorax. Each thoracic segments carries ventrally a pair of legs called true legs. The abdomen is composed of 9 segments in which the third to sixth segments bears a pair of abdominal legs called pseudo legs which help in powerful gripping.

Spinning- After 4-7 days, the 5th instar become yellowish white in colour and at this stage they stop feeding and excrete some liquid along with their faecal matter. The mature worms become restless and raises their head in search of support so they can start spinning. During spinning the larva begins to secrete a sticky substance from its silk gland. This sticky substance later turns into a fine long thread when they come in contact with air.

Cocoon and pupa

After 3-5 days the larva completes spinning and form cocoon. The cocoon are off-white in colour. Inside the cocoon the worm moults for fifth and last time and turns into a pupa. The pupa are dark brown in colour and it has been observed that the skin of pupa is harder that previous instar larval skin. The body is divided into 11 segments and only 7 spiracles are visible at this stage.

Morphometric study

Morphometric study of different instar larva (1st -5th) fed on castor leaves.

1st instar

Parameter	Measurement in cm (average)
Length of the body	1
Breadth of the body	0.3
Weight of the body (gm)	0.35
Colour of the body	Yellow
Colour of the head	Black
Colour of the hair	Black

2nd instar

Parameter	Measurement in cm (average)
Length of the body	1.9
Breadth of the body	0.5
Weight of the body	0.79 gm
Colour of the body	Yellow
Colour of the head	Black
Colour of the hair	Black

3rd instar

Parameter	**Measurement in cm (average)**
Length of the body	3.8
Breadth of the body	1
Weight of the body	2.5
Colour of the body	White
Colour of the head	Black

4th instar

Parameter	Measurement in cm (average)
Length of the body	5.2
Breadth of the body	1.1
Weight of the body	4.5
Colour of the body	White
Colour of the head	Yellow

Adult male

Morphological parameteres	Measurement in cm (average)
Length of the body	3.11
Length of the head	0.31
Length of the thorax	0.98
Length of the abdomen	1.85
Width of the body	0.63
Length of the antennae	1.29
Width of the antennae	0.41
Length of the wing	9.77
Length of the leg: 1st pair	1.45
2nd pair	1.66
3rd pair	1.59

Adult female

Morphological parameteres	Measurement in cm (average)
Length of the body	4.14
Length of the head	0.31
Length of the thorax	0.99
Length of the abdomen	2.85
Width of the body	1.08
Length of the antennae	1.21
Width of the antennae	0.32
Length of the wing	10.32
Length of the leg: 1st pair	1.40
2nd pair	1.64
3rd pair	1.59

5th instar

Parameter	Measurement in cm (average)
Length of the body	8.9
Breadth of the body	1.5
Weight of the body	10.35
Colour of the body	White
Colour of the head	Yellow
Weight of the cocoon (gm)	3.30
Mortality rate (%)	6.7

Morphometric study of different instar larva (1st - 5th) fed on ejar leaves.

1st instar

Parameter	Measurement in cm (average)
Length of the body	0.8
Breadth of the body	0.2
Weight of the body	0.27
Colour of the body	Yellow
Colour of the head	Black
Colour of the hair	Black

2nd instar

Parameter	Measurement in cm (average)
Length of the body	1.3
Breadth of the body	0.6
Weight of the body	0.58
Colour of the body	Yellow
Colour of the head	Black
Colour of the hair	Black

3rd instar

Parameter	**Measurement in cm (average)**
Length of the body	3
Breadth of the body	0.8
Weight of the body	1.8
Colour of the body	white
Colour of the head	Black

4th instar

Parameter	Measurement in cm (average)
Length of body	4.5
Breadth of body	1
Weight of the body	3.6 g
Colour of the body	White
Colour of the head	Yellow

5th instar

Parameter	Measurement in cm (average)
Length of body	7.3
Breadth of body	1.2
Weight of the body	8.20
Colour of the body	White
Colour of the head	Yellow
Weight of cocoon (gm)	2.72
Mortaliy rate (%)	18.4

Morphometric study of different instar larva (1st - 5th) fed on papaya leaves.

1st instar

Parameter	Measurement in cm (average)
Length of the body	0.6
Breadth of the body	0.2
Weight of the body	0.19
Colour of the body	Yellow
Colour of the head	Black
Colour of the hair	Black

2nd instar

Parameter	Measurement in cm (average)
Length of the body	1
Breadth of the body	0.3
Weight of the body	0.43
Colour of the body	Yellow
Colour of the head	Black
Colour of the hair	Black

3rd instar

Parameter	Measurement in cm (average)
Length of the body	2.5
Breadth of the body	0.7
Weight of the body	1.2
Colour of the body	White
Colour of the head	Black

4th instar

Parameter	Measurement in cm (average)
Length of the body	4
Breadth of the body	0.9
Weight of the body	3
Colour of the body	White
Colour of the head	yellow

5th instar

Parameter	Measurement in cm (average)
Length of the body	4
Breadth of the body	0.9
Weight of the body	3
Colour of the body	White
Colour of the head	yellow
Weight of the cocoon (gm)	1.97
Mortality rate (%)	28.44

During the study period some photographs were taken of different stages of eri silkworm which are depicted below-

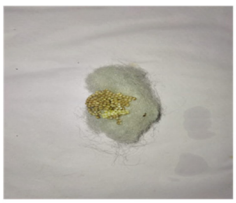

Fig 1: Eggs of eri silkworm

Fig 2: Egg hatches into larva

Fig 3: Silkworms fed with papaya leaves

Fig 4: Silkworms fed with castor leaves

Fig 7: cocoon formation

Fig 8: cocoons

Fig 9: pupa

Fig 10: Adult moth

Fig 11: Adult moth

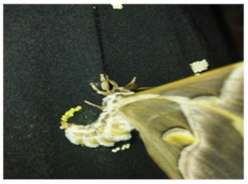

Fig 13: female moth laying eggs

CONCLUSION

We already knew that castor is regarded as the primary host plant of eri silkworm. It has been observed that the rearing performance on castor were better than ejar and papaya. In castor, growth of the larva was found to be higher and the feeding rate was also good. They have less mortality rate. The weight of the cocoon was found to be better than ejar and papaya. Therefore the silk production from these cocoons were very high.

The rearing performance on ejar were less than castor but better than papaya. Growth of the larva was less than castor. Their mortality rate was higher than castor. Their feeding rate was less than castor. The weight of cocoon was less than castor and better than papaya. On the other hand the rearing performance on papaya were less than castor and ejar. Growth of the larva were not good. It was less than castor and ejar. Mortality rate was found to be very high and the feeding rate was too much less than castor and ejar. Weight of the cocoon is very less.

It can be concluded that the castor is the primary food plant for eri silkworm so the cocoon quality and silk production is very high. The present study revealed that ejar also can give a better cocoon quality and silk production rate as compared to papaya leaves. From the study it was found that eri silkworm can be reared on ejar and papaya leaves during scarcity of castor leaves.

Author Contribution Statement

Conceptualization, Dr. Gitalee Bhuyan; Methodology, Sangeeta Gogoi and Bikash Bordewa: Investigation, Bikash Bordewa; the main text was written by Sangeeta Gogoi and Dr. Gitalee Bhuyan helped to edit the manuscript.

Conflict of Interest

We have no conflict of interest to disclose.

REFERENCES

Choudhury, S.N. 1982. Eri silk industry directorate of sericulture weaving, Government of Assam (India). 178.

Kumar, U. and Das, M. 2007. Ericulture as a remedy of rural poverty in Assam: A micro level study in Barpeta district.

Kumari, P. and Sharma, S. 2017. Eri silkworm (*Philosamia ricini*) rearing and comparative analysis of its economic parameters based on different food plants

in Deosal village, Mayok block, Morigaon district, Assam, India. *International Journal of Science and Research.* 6(5): 1737-1740.

Lalfelpuii, R., Choudhury, B.N, Gurusubramaniam, G, Kumar, N.S. 2014. Effect of different mulberry plant varieties on growth and economic parameters of the silkworm Bombyx mori in Mizoram. *Science vision.* 14(1): 34-38.

Map of india (from http://www.mapsofindia.com/maps/india-political-mapgif-color_fig (accessed 22 june 2022).

Peigler, R.A. and Naumann, S. 2003. Revision of the silk moth genus Samia. University of in carnate word, San Antonio. *Texas*.

Reddy, D.N.R., Baruah, A.M. and Reddy, R.N. 1998. Effective utilization of eri silkworm wastes. 278-280.

Saikia, J.N. 2011. Supply chain linkages and constraints in natural silk sector of Assam: A study of muga and eri silk. *International Journal of Multidisciplinary Management Studies.* 1(3).

Sannapa B.R., Naikia R.G. and Siddagangaiah, 2004. Ericulture adventure for rural betterment. *J Current Science.* 5: 137-140.

Saratchandra, B.A. 2003. A thought for development of ericulture in India. *Indian Silk*. 41(12): 25-28.

Sarmah, M.C., Sarkar, B.N., Ahmed, S.A. and Giridhar, K. 2015. Performance of C2 breed of eri silkworm, Samia ricini (Donovan) in different food plants. *Entomology and Applied Science.* 2(1): 47-49.