

# BIOLOGY OF *PHILOSAMIA RICINI* ON HOST PLANT *RICINUS COMMUNIS*

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## Abstract

*Philosamia ricini*, Hutt. is a non- mulberry, multivoltine, domestic moth, reared indoor. It is a polyphagous insect and feeds on the leaves of several food plants viz, Castor, Tapioca, Wild castor, Barkesseru, Kesseru, etc. The main objective of the study is to study the life cycle and morphology of *Philosamia ricini*. The eggs were collected from Directorate of Sericulture, BTC, Kokrajhar, Assam, India. The newly hatched larvae of *Philosamia ricini* were reared on tender fresh leaves of castor plant and maintained in the laboratory during the month of March, 2017 to May, 2017 at 25.89° C and humidity 84%. The insects were reared in plastic boxes and a shoe box. The study revealed that, the life cycle completed successfully from the 22 March, 2017 to 12 May, 2017. The total number of days for the study of the experiment was 51. During the study of this life cycle it was observed that in successive moulting, the larva changes its colour and becomes bigger in size and the larva moults four times and so there are five stages of larval development and they completed their larval stage in 20 days. Since it is an economically important insect, the study of its life cycle was important to know the insect as well as larval stages and its host plant.

**Key word:** Cocoon, Larva, pupa, Instar, Castor plant, Eggs.

## INTRODUCTION

Sericulture is an agro based industry. It involves rearing of silkworm for the production of raw silk, which is obtained from certain specific species of insect which are Eri, Muga, Tasar and Mulberry silkworm. Among the 4 types of silkworm, Eri silkworm, *Philosamia ricini*, Hutt. is a multivoltine and their cocoons are open mouthed.

The Eri silkworm *Philosamia ricini*, Hutt. is also known as Endi or Errandi and it belongs to family Saturniidae. It is one of the commercially exploited silkworm species and can be reared indoors throughout the year to produce silk. The silk produced by *Philosamia ricini* Hutt. is called Eri silk. The production of

eri silk is traditional in north-eastern states of Assam and particularly carried by the tribal people of Assam, Bihar, Orissa, U.P., West Bengal and some other states of India where ericulture is practised on commercial basis. The systematic position of Eri moth is:

Phylum-Arthropoda

Class-Insecta

Order-Lepidoptera

Genus-*Phylosamia*

Species-*ricini*.

The eri silk moth or Ricini moth has a brown wing colour in different shades of brown and has a beautiful black stripe along the wings. They also have yellow spot and lines on the wings. At the tip of the wings is a small eye spot meant to distract predators. The body of the moth is white with brown stripes. The male moth smaller than the female moth and bear bushy antennae and smaller abdomen. The moths are nocturnal in habit. This is multivoltine. Six broods can be reared in a year with adequate supply of food. Though *ricini* species are mostly cultured, there are about 16 other varieties of eri silk worm. One of the other important eri species is *Philosamia cynthia* which are mostly found in wild form. They may be uni, bi or trivoltine.

Eri silkworm is a polyphagous insect and feeds on the leaves of several food plants viz, Castor (*Ricinus communis* L.), Tapioca (*Manihot esculenta*, Crantz.), Wild castor (*Jatropha curcas* L.), Papaya (*Carica papaya* L.), Barkesseru (*Ailanthus exceisa* Roxb.), Kesseru (*Heteropanan fragrans* Seem.), etc. Although, Eri silkworm is known to feed on the leaves of more than 30 host plant species but among them Castor is considered as the principal host plant (Govindan et al., 1978; Arora and Gupta, 1979; Dayashankar, 1982; Devaiah et al., 1985; Gogoi, 1998; Chowduary, 2006 and Sannappa et al., 2007).

The life cycle of *Philosamia ricini*, Hutt. is completed through (a) eggs (koni), (b) larva (polu), (c) pupa (leta) in cocoon and (d) adult moth (chakari). In summer, the life cycle is completed in 44-48 days and in winter it takes about 85-87 days (Bhattacharyya and Bhattacharyya 2012)

- (a) **Eggs.** The eggs are oval shaped with medium size. It is covered by a hard chitinous white coloured shell. The shell colour may be creamy as in wild forms. The eggs are attached to the surface with one another by colourless glue. A female moth after copulation lays about 300-500 eggs in cluster. The laying may continue for 3 to 4 days but the eggs of first two days are only kept for rearing. The hatching of eggs takes place after about 10 days but it depends on the temperature of the environment. The hatching may be delayed upto 14-15 days in winter. Temperature and humidity play important role in hatching of the eggs.
- (b) **Larva.** After hatching, the larvae tend to remain together. It is about one centimeter in length. It grows to a size of 8 centimeters, when mature. The newly hatched larvae possess a black coloured head and the body becomes yellow in colour but gradually changed to green yellow. The male and female larvae can be distinguished in later stage by the genital markings. The first moult occurs after three days. The larva or the polu matures in 17 to 45 days depends on the environmental temperature and humidity. During this period, the larva moults four times. During the onset of moulting, the larva becomes motionless and it does not feed. On moulting, the integument of the head breaks on the sides and the larva comes out with a new integument. The larva possesses a long tubular silk gland. This gland is responsible for production of silk. The silk gland secretes the silky substance to form the cocoon. In the cocoon, the larva transforms into a chrysalid.
- (c) **Pupa.** The larva of last instar before moulting ceases feeding and transforms into a chrysalid. The larva excretes silk substance after settling in a crevice and spins the cocoon. In 3-4 days, the cocoon formation is completed. Inside the cocoon the larva transforms itself into a brown coloured chrysalid. It is an intermediate form in between the larva and the moth. The essential organs of the

moth are formed. The body is covered by hard integument. It can survive for long time inside the cocoon. The colour of the chrysalid turns black before the emergence of the moth.

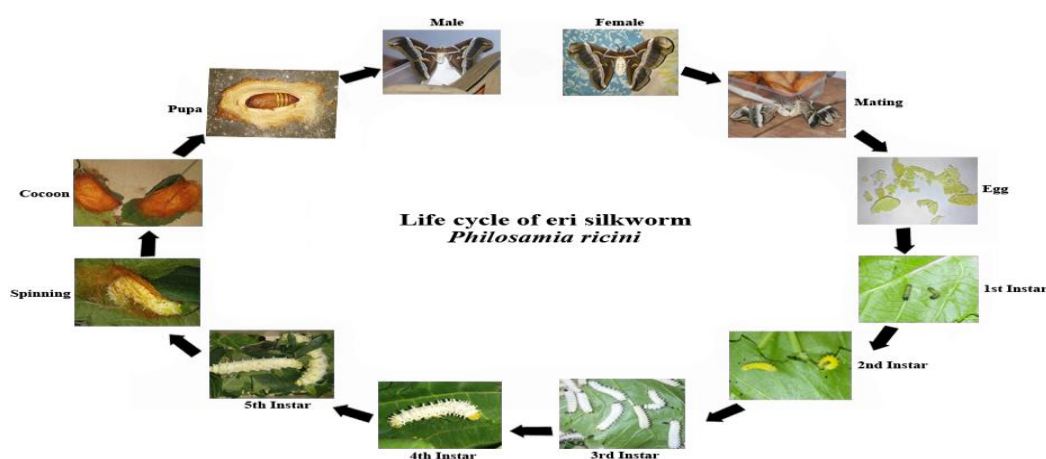
- (d) **Moth.** The moth emerges from the chrysalid forms after about 2 weeks. The moth comes out through the open end of the cocoon. It emerges normally in morning hours. After sometime they fully stretch their wings. The colour of the wing varies from green to orange brown and the wing expanse varying from 10 cm to 15 cm. After stretching the wings, the male finds out the female for mating which lasts about 24 hours. During mating the moths remain motionless. The male unpairs in next evening. After unpairing, the female lays the eggs normally during the night. A female moth lays about 300-500 eggs in cluster in 3-4 days.

## Materials and method:

The eggs were collected from Adabari Sericulture Farm, Kokrajhar, BTAD, Assam. The newly hatched larvae of *Philosamia ricini* were reared on tender fresh leaves of castor plant and maintained in the laboratory during the month of March to May at 25.89°C and humidity 84%. Sum of 10 worms were reared in plastic boxes and a shoe box and their proper cleaning was done twice a day. Fresh tender leaves were provided every day after washing properly. During spinning period leaves of *Clerodendrum infortunatum* were kept in the box for spinning of larva. The length and breadth of every instar is noted down and the time taken to complete different instar stages of life cycle were also observed and noted down. The live photos of different stages of *Philosamia ricini* were shot with the help of camera. The morphometric measurement of different stages of life cycle were also taken with the help of a scale, vernier caliper and visual observation.

## Results and discussions:

**Lifecycle:** The life cycle of *Philosamia ricini*, Hutt. Is completed through (a) eggs, (b) larva, (c) pupa in cocoon and (d) adult moth.



### Egg:

March-22, 2017, the eggs of eri silkworm, *Philosamia ricini*, Hutt. were collected from Adabari sericulture farm, kokrajhar, BTAD, Assam. The eggs are oval shaped with  $0.24 \pm 0.01$  cm in length and  $0.15 \pm 0.00$  cm breadth. It is covered by a hard chitinous creamy coloured shell. The eggs are attached to the surface with one another by colourless glue.

### Larva:

#### 1<sup>st</sup> instar:

April-1,2017,after10days eggs hatches into small larvae which is known as 1<sup>st</sup> instar. After hatching the larvae tends to remain together. The mature 1<sup>st</sup> instar is about  $0.75\pm 0.02$  cm in length and  $0.12\pm 0.01$  cm in breadth. The newly hatched larvae possesses a black coloured head and the body becomes yellow in colour but later some larvae became slightly green because they fed on green castor leaves. Their bodies are covered with tiny black hairs, black spots and a black band is present near the dorsal side of the head.

### **2nd instar:**

April- 6,2017, after 5 days the 1<sup>st</sup> instar undergo 1<sup>st</sup> moult and become 2<sup>nd</sup> instar. The 2<sup>nd</sup> instar is larger than the 1<sup>st</sup> instar and measures about  $1.55\pm 0.05$  cm in length and  $0.39\pm 0.01$  cm in breadth. The newly hatched 2<sup>nd</sup> instar have yellowish body with pale head and clasper anal later the head and clasper anal becomes black. Their body is covered with whitish hair and pair of black spot longitudinally.

### **3<sup>rd</sup> instar:**

April- 9,2017,after 3 days the 2<sup>nd</sup> instar undergo 2<sup>nd</sup> moult and form 3<sup>rd</sup> instar which measured about  $2.36\pm 0.09$  cm in length and  $0.55 \pm 0.02$  cm in breadth. The 3<sup>rd</sup> instar possesses black coloured head and the body becomes white in colour with powdery. The body bears longitudinal black spot and white tubercles.

### **4<sup>th</sup> instar:**

April-11,2017,After 2 days the 3<sup>rd</sup> instar undergoes 3<sup>rd</sup> moult and become 4<sup>th</sup> instar which is white in colour with powdery and with yellow head and clasper anal. In this stage the tubercles becomes larger and more prominent than the 3<sup>rd</sup> instar. The 4<sup>th</sup> instar measures  $3.83\pm 0.07$  cm in length and  $0.78 \pm 0.03$  cm in breadth.

### **5<sup>th</sup> instar:**

April 14, 2017,after 3 days 4<sup>th</sup> instar undergoes 4<sup>th</sup> moult and becomes 5<sup>th</sup> instar. The body of the 5<sup>th</sup> instar becomes green white in colour with powdery and their head is yellow. The newly hatched 5<sup>th</sup> instar have green anal plate and clasper anal. They measured about  $6.8\pm 0.21$  cm in length and  $1.53\pm 0.02$  cm in breadth. In this stage their tubercles became larger and harder than the 4<sup>th</sup> instar. They contain 9 pairs of spiracles which become fully visible in this stage. Their body is divided into head thorax and abdomen. The thorax consists of three segments namely pro thorax, meso – thorax and meta-thorax. Each of the three thoracic segment carries ventrally a pair of legs which is called true leg. Each leg carry sharp distal claws which are used for holding castor leaves while feeding. The abdomen composes of nine segments. The third to sixth and the last abdominal segment bears a pair of abdominal legs which are called pseudoleg which have powerful gripping. In this stage they become fully solitary.

### **Spinning:**

April-20,2017,after 6 days the 5<sup>th</sup> instar becomes yellowish white in colour and they stop their feeding and excrete some liquid with their faecal matter. In this stage the mature worm becomes very restless and raises their head in search of support so as to be able to start spinning. During spinning the larva begins to secrete sticky substance from its silk gland and these sticky substance turns into a fine long and solid thread of silk into the air and they cast silk thread around attaching them to the leaves.

### **Cocoon and Pupa:**

April-23,2017, after 3 days the larvae completes spinning and form cocoon. The cocoon is brick red in colour and inside the cocoon after few days the worm moults for fifth and the last time and turns into pupa. Soon after pupation the pupa is pale yellow in colour and soft but later it becomes copper brown in colour and the pupal skin becomes harder. Their body is divided into 11 segments and only 7 pairs of spiracles are visible. In ventral side from posterior side female pupa has a fine longitudinal line on the 2<sup>nd</sup> and 3<sup>rd</sup> abdominal segment whereas such marking is absent in case of male. The male pupa measures about  $3.07\pm 0.07$  cm in length and  $1.28\pm 0.03$  cm in breadth. The female pupa is about  $3.11\pm 0.05$  cm in length and  $1.29\pm 0.02$  cm in breadth. The colour of the pupa becomes black before the emergence of moths.

### **Adult moth:**

May-10,2017,male and female moth emerges from the chrysalid form after 17 days. The moth comes out through the open end of the cocoon. As soon as the moth emerges, they secrete some brown liquid which is

known as meconium. The newly hatched male and female moth abdomen has almost same size and their wings remain very soft but after sometime the male abdomen gradually become smaller and they fully stretch their wings which becomes harder.

Body is divided into head, thorax and abdomen. Whole body is covered with fine scale. They are  $3.11 \pm 0.07$  cm long and  $0.63 \pm 0.02$  cm width in case of male and  $4.14 \pm 0.09$  long and  $1.08 \pm 0.08$  cm width in case of female. Head bears paired compound eyes, antennae and reduced mouth parts which lack proboscis. The antennae is about  $1.29 \pm 0.02$  cm long and  $0.41 \pm 0.01$  broad in case of male whereas  $1.21 \pm 0.01$  cm long and  $0.32 \pm 0.01$  broad in case of female. Thorax shows pro, meso and meta-thorax. Each segment bears paired legs. Meso and meta-thorax bear paired wings which is  $12.77 \pm 0.25$  cm long in case of male and  $12.9 \pm 0.16$  cm long in case of female. Dorsally abdomen shows eight narrow segment in case of male and seven swollen segment in case of female and ventrally abdomen shows 7 narrow segment in case of male and 6 in case of female. The last segment is modified to form reproductive organ. In case of male on each side of the penis there is a hook called herpes which is used for holding female during breeding. In case of female at the ventral side on 6<sup>th</sup> segment there is a genital aperture to which ovipositor is attached.

### Mating:

May-11, 2017, mating occur at 9.25 am and at 11.25 pm the male separates from the female. During breeding when the male finds their mates, then the moth presses the end of their abdomen together.

### Egg laying:

May-12, 2017, after separation within 24 hrs the females start laying eggs which are green white in colour but later it becomes white in colour. The average no. of eggs laid by females within 2-3 days is 270.



fig.1 egg



fig.2 immature 1<sup>st</sup> instar



fig.3 mature 1<sup>st</sup> instar



fig.4 newly hatched 2<sup>nd</sup> instar



fig.5 mature 2<sup>nd</sup> instar



fig.6 3<sup>rd</sup> instar



fig.7 4<sup>th</sup> instar



fig.8 immature 5<sup>th</sup> instar



fig.9 mature 5<sup>th</sup> instar



fig.10 before spinning



fig.11 during spinning



fig.12 cocoon



fig.13 immature pupa



fig.14 mature pupa



fig.15 pupa turns to black

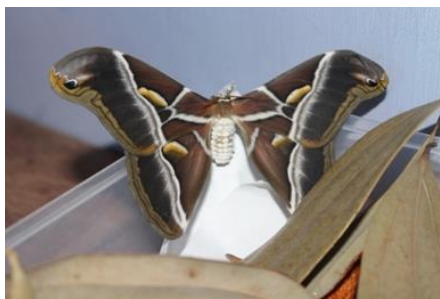


fig.16 adult male



fig.17 male reproductive structure



fig. 18 adult female



fig.19 female reproductive structure



fig.19 mating



fig.20 egg laying by female

## Morphometric study:

### *Adult Male:*

Morphological parameters	Measurement in (cm)
Length of the body	3.11±0.07
Length of the Head	0.31±0.01
Length of the thorax	0.98±0.01
Length of the abdomen	1.85±0.06
Width of the body	0.63±0.02
Length of the antennae	1.29±0.02
Width of the antennae	0.41±0.01
Length of the wing	12.77±0.25
Length of the Leg	
1 <sup>st</sup> pair	1.45±0.20
2 <sup>nd</sup> pair	1.66±0.01
3 <sup>rd</sup> pair	1.59±0.20

### *Adult Female:*

Morphological parameters	Measurement in (cm)
Length of the body	4.14±0.09
Length of the Head	0.31±0.01
Length of the thorax	0.99±0.01
Length of the abdomen	2.85±0.09
Breadth of the body	1.08±0.02
Length of the antennae	1.21±0.01
Width of the antennae	0.32±0.01
Length of the wing	12.9±0.16
Length of the Leg	
1 <sup>st</sup> pair	1.40±0.01
2 <sup>nd</sup> pair	1.64±0.02
3 <sup>rd</sup> pair	1.59±0.02

### *Larva:*

#### 1<sup>st</sup> instar:

Parameters	Measurement in cm
Length of the body	0.75±0.02
Breadth of the body	0.12±0.01

Colour of the body	Yellow
Colour of the head	Black
Colour of the hair	Black

#### 3<sup>rd</sup> instar

Parameters	Measurement in cm
Length of the body	2.36±0.09
Breadth of the body	0.55±0.02

Colour of the body	White
Colour of the head	Black

#### 2<sup>nd</sup> instar:

parameters	Measurement in cm
Length of the body	1.55±0.05
Breadth of the body	0.39±0.01

Colour of the body	yellow
Colour of the head	black
Colour of the hair	whitish

#### 4<sup>th</sup> instar

parameters	Measurement in cm
Length of the body	3.83±0.07
Breadth of the body	0.78±0.03

Colour of the body	White
Colour of the head	Yellow

#### 5<sup>th</sup> instar:

Parameter	Measurement in cm
Length of the body	6.8±0.21
Breadth of the body	1.53±0.02

Colour of the body	White
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Colour of the head	Yellow
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### Male Pupa:

parameters	Measurement in cm
Length of the pupa	3.07±0.07
Breadth of the pupa	1.28±0.03
Colour of the pupa	Copper brown

- All the parameters are average of 10 individual.
- ± = Standard error of mean

### Female pupa:

parameters	Measurement in cm
Length of the pupa	3.11±0.05
Breadth of the pupa	1.29±0.02
Colour of the pupa	Copper brown

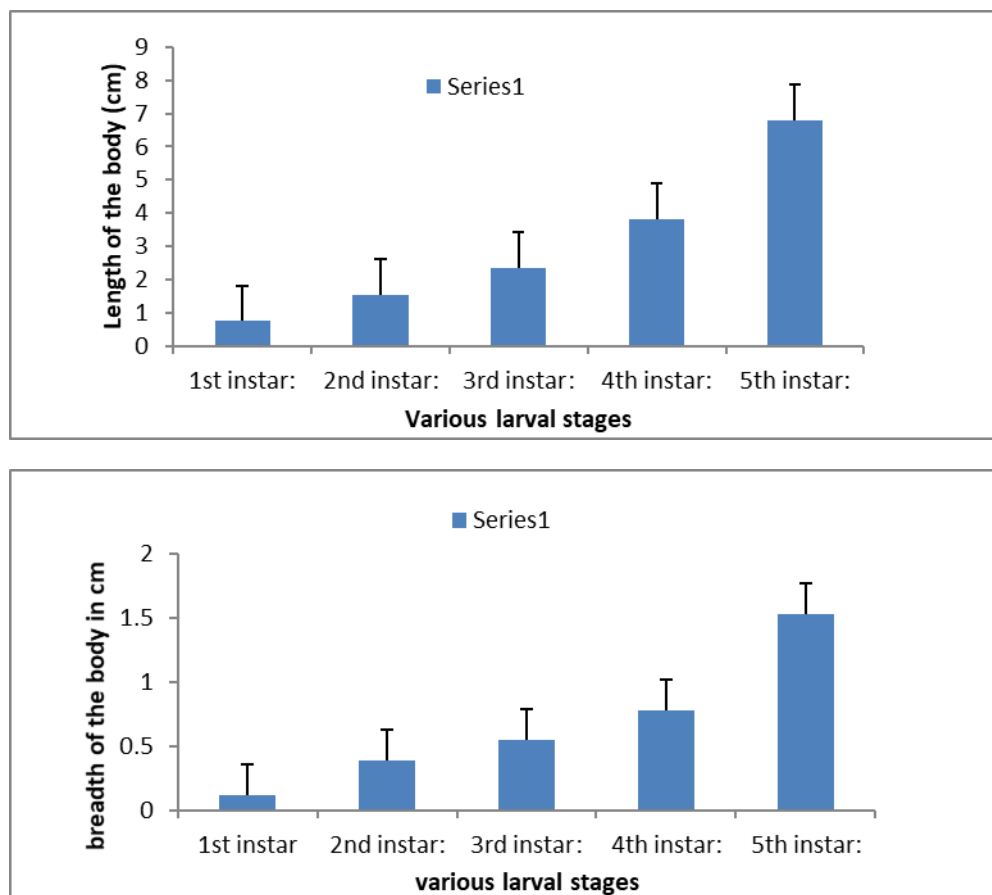


fig.22 graphical representation of breadth of various larval stages

## Conclusion:

The life cycle of *Philosamia ricini* was studied in the laboratory of Zoology dept. Science College, Kokrajhar. The Study revealed that, the life cycle completed successfully from the 22 March,2017 to 12 May,2017. The total no of days for the study of the experiment was 51 .During the study of this life cycle it was observed that in successive moulting ,the larva changes its colour and becomes bigger in size and the larva moults four times and so there are five stages of larval development and they completed their larval stage in 20 days.Since it is an economically important insect,the study of its life cycle was important to know the insect as well as larval stages and its host plant.

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