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A Study of *Philosamia Ricini* Life Cycle for ERI Culture in Northern Planes of India

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Abstract:
Eri silk has a grand share in Indian silk industry. After mulberry silk it is the second most produced types of silk in the terms of quantity. Eri silk is obtained from Philosamia ricini, a continuously breeding lepidopteran. It feeds on Ricinus communis leaves. In comparison to other silkworms Eri silkworm is less prone to diseases; as a result, it has emerged as a suitable option for silk production in plane regions. It can be cultured three times in a year i.e. in October, February & March. The worm completes its life cycle in four stages and the time required to complete one cycle varies according to climatic conditions. This study has been carried out to provide an insight into the various changes in mortality rate, weight, disease resistance, the rate of food consumption, time taken to complete life cycle and different stages shown by the worm. The observations revealed remarkable changes in above mentioned patterns under local climatic conditions.

Keywords: *Holometabolus, lepidopteran, ericulture*

1. Introduction

The eri silkworm, *Philosamia ricini* is raised in India and parts of the orient for its silk. India continues to the second largest producer of silk in the world after China. It has the unique distinction of producing all the four varieties of silk viz. mulberry, eri, tasar and muga [1]. Mulberry accounts for 92%, eri 5.5%, tasar 2% and muga 0.5% of the total raw silk production of the country. The silk produced by *Philosamia ricini* is not as fine or delicate as that of *Bombyx mori*, the mulberry silkworm, but it is more durable. Eri silkworms are continuously breeded, meaning they do not go into diapause, and their life is continuous without regard to seasons. *P. ricini* completes its life cycle in five instar stages, after completing fifth instar stage, spins a silk cocoon and changes into pupa. It spends three weeks in the cocoon and then emerges as imago to mate and lay eggs [2]. The eggs hatch into worms in a few weeks and then the cycle continues. *Philosamia ricini* is holometabolous lepidopteran and is of considerable economic importance in Indian silk industry. *Philosamia ricini* is an air breathing arththropod. It feeds on *Ricinus communis* leaves during its larval stage, the only feeding stage of its life cycle. In *Philosamia ricini*, the last instar larval development proceeds through five days with enormous increase in the size of the insect due to its voracious feeding. On the fifth day, however, the larvae stop feeding, evacuate and spin cocoons undergoing vigorous larval- pupal transformation thereafter. Silk is a delicate, translucent, horny fiber covered by sericin, a protein secreted from the silk gland for spinning the cocoon. The silk thread has an inner core of 75-80% fibroin and an outer envelope of 20-25% sericin. Silk is secreted as a liquid which becomes solid after being extruded.

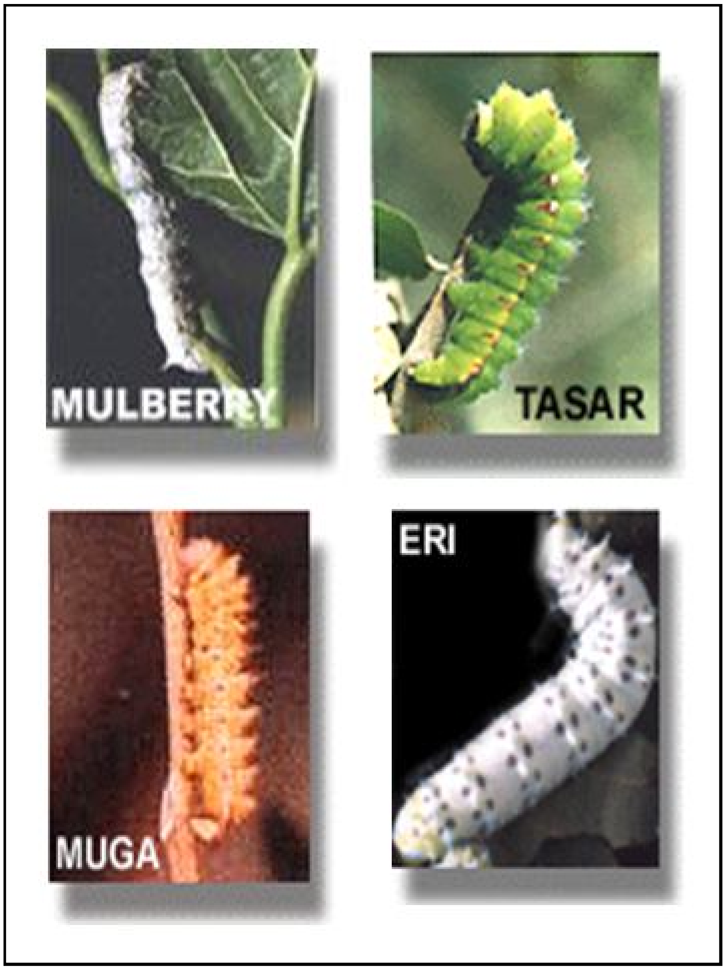

Figure 1: Different types of silkworms

2. Material and Methods

The complete study of lifecycle of Eri silkworm in different seasons were carried out with a view to provide insight into the fittest environment for the survival of the silkworm in northern planes of India. The experiments were carried out by considering two different seasons. The first case is for the observation of life cycle in the month of November to January and the second case is for observation in the month of February-April. The newly hatched larvae of *Philosamia ricini* were reared on tender fresh leaves of castor plant and maintained in the laboratory during the months of November to January at 10 to 25 $\pm 2\,^{0}$ C and humidity 80-85 % [3]. The insects were reared in wooden trays and their proper cleaning was done twice a day. In the second case, worms were maintained during the months of February-April in laboratory when the temperature varies between 15 to 35 $\pm 2\,^{0}$ C and humidity about 50 %. During both seasons the time taken to complete different instar stages of life cycle were observed and noted down. Insects from different instar stages were picked at regular intervals randomly and the change in their weight noted was observed in normal and healthy insects. Rate of the mortality was also observed in both seasons.

3. Results and Discussion

During life cycle, the worms during warmer seasons become flaccid, sluggish, show inactivity and ultimately stop feeding on reaching the last instar stage. Sometime these worms excrete yellowish, brown fluid in excretion and infected by the various infectious diseases. The body colour also changes depending upon the type of infection. The observation of time taken to complete different instar stages of life cycle in two different seasons, as shown in table (1), shows that during November to January the worm spends less time in different instar stages in comparison to that during February-April. As shown in the figure (3), the percent increase in the weight of healthy worms between from different instar stages, worms during November to January tend to gain more weight in comparison to that during February-April. Figure (3) gives a clear demonstration for increase in weight. As shown in the figure (2), the mortality rate also increases that fluctuated by 20-30 %. The change in temperature and humidity of our laboratory was also responsible for various infectious diseases. This also affects the mortality rate separately. As given in the table (2) that in case first 10 % worms of second instar were infected by Flacherie while in case second 30 % second instar worms were infected by Gracerie. During the third instar stage, some worms were infected by a new disease i. e. Muskerdine, which was not observed previously in our laboratory condition. The forth and fifth instar stages were infected by multiple diseases and the mortality of worms at high temperature reaches up to 90 %. The high mortality rate emphasizes low resistance of the worms towards diseases. So that at high temperature the worms were more susceptible towards the diseases. The loss in weight is also due to the decrease in rate of food consumption that fluctuated at different instar stages. At normal temperature the consumption rate fluctuates between 75-90 %, while at high temperature the rate of consumption between 10-50 %. The survivorship rates of species are generally expressed by survivorship curve. All holometabolus species show stair step type of curve. In our observation, the survivorship curve of *P. ricini* life cycle (Figure 2) during November - January showed such stair type of curve while there was some deviation observed in the life cycle of *P. ricini* during place between February-April. The graph showed steep declination as compared to stair type declination.

S.N.	Stage of Life Cycle	Nov. -Jan. No. of Days spent	Feb.-April No. of Days spent
1.	Ist Instar	3	6
2.	IInd Instar	4	6
3.	IIIrd Instar	5	7
4.	IVth Instar	5	8
5.	Vth Instar	5	8
6.	Cocoon	14	25

Table 1: Time taken to complete instar stages in two seasons

S.N.	Stage of Life Cycle	Nov. -Jan.	Feb.-April
1.	Mortality after hatching	30 %	50 %
2.	Ist Instar	25 %	60 %
3.	IInd Instar	10 % (Flacherie)	30% (Gracerie)
4.	IIIrd Instar	5.0 % (Flacherie) 15 % (Muskerdine)	5.0 % (Gracerie)
5.	IVth Instar & Vth Instar	10 % (Combination of diseases)	90 % (Combination of diseases)

Table 2: Rate of mortality of Philosamia ricini in two different seasons

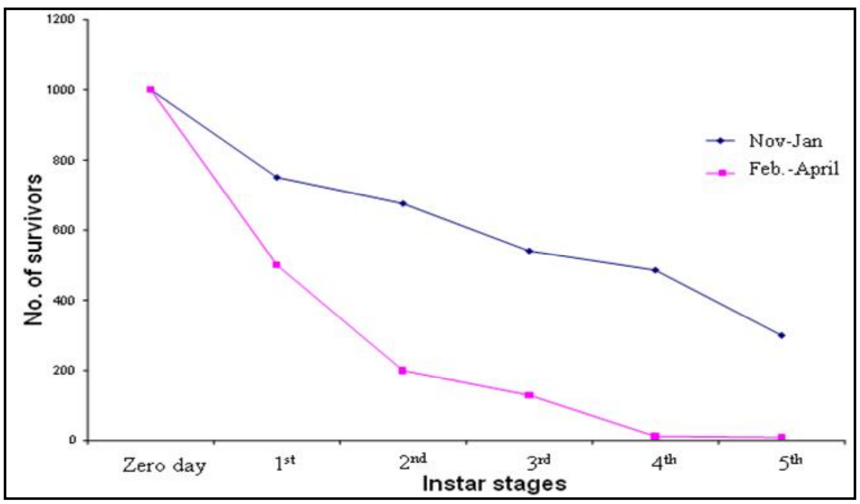

Figure 2: Survivorship curves of P. ricini in two seasons

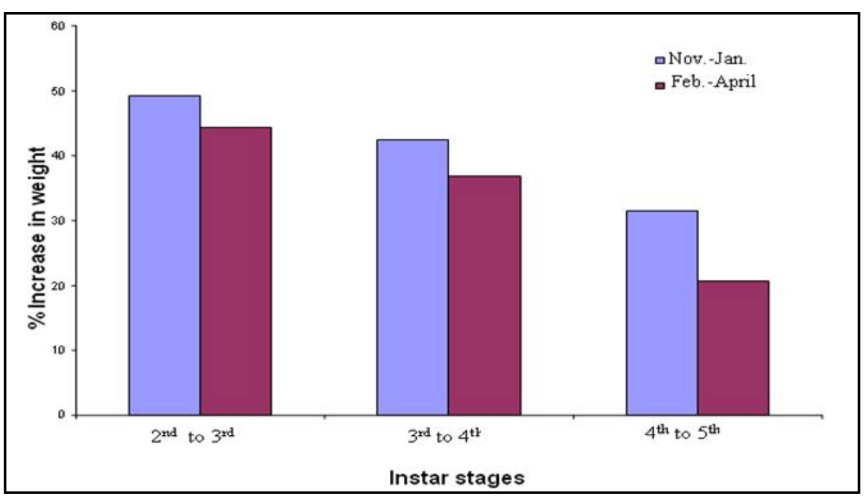

Figure 3: Weight increase between instar stages in two seasons

4. Conclusion

The result of this study reveals that the life cycle of *P. ricini* is season dependent. The life cycle of *P.ricini* in the season from Nov.-Jan. proceeds normally, whereas in the season of Feb. -April it shows many abnormalities like loss in weight, increased mortality, more susceptibility and less resistance towards the infectious diseases. Hence, the period from February to April is not suitable for ericulture in Northern planes of India. The worm is more prone to diseases like flacherie, gracerie & muskerdine during February to April and the time required to complete one life cycle increases. While during November to January worms exhibit greater tendency to gain weight between instar stages and show less mortality. Northern planes of India during November to January shows temperature variation from 10-25^{0}C and normal humidity which appears to provide a suitable condition for ericulture, the production of a more durable variety of silk.

5. References

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