

Effects of temperature and relative humidity on rearing performances of Eri Silkworm (*Philosami aricini*)

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Abstract

Eri Silkworm (*Philosamia ricini*) is a delicate, domesticated insect which cannot tolerate diurnal and seasonal fluctuations in the environmental condition. The life cycle of silkworm is influenced by bio-ecological stress during larval period. Deviations in humidity and temperature levels below and above certain critical limits affect larval growth and development of Eri silkworm. In present study, several experiments were performed in four temperatures $20\pm3^{\circ}$ C, $24\pm3^{\circ}$ C, $28\pm3^{\circ}$ C and $32\pm3^{\circ}$ C each with three relative humidity 50%, 70% and 90% on rearing of Eri silkworm (*Philosamiaricini*) to study the effect of temperature and relative humidity on larval, cocoon and grainage parameter.Our findings clearly indicated that the $28\pm3^{\circ}$ C temperature and 70% relative humidity are the best for larval, cocoon and grainage parameter of Eri silkworm (*Philosamia ricini*).

Keywords: Cocoon parameters, Eri-silkworm (Philosamia ricini), grainage parameter, larval parameters, relative humidity, temperature

Introduction

Silk obtained from sources other than mulberry are termed as Non-Mulberry or Vanya silk (Eri, Muga, Tropical Tasar and Temperate Tasar). India produces 1950 Metric Tonnes of non mulberry silk. Among non mulberry silk, only Eri silk production is in increasing trend. Eri silk is known as Non violence silk and Ahinsa silk (there is no need to kill the pupae inside the cocoon as in the case of other silk because the Eri silk is spun into thread like cotton) and also said to be Poor person's silk because its cost of production is very less than other silk (Sarkar, 1980). The Eri silk is so popular because texture of the Eri fabric is coarse, fine and dense. It is very strong, durable and has elasticity, darker heavier than other silk. It blends well with wool and cotton hence it is widely used in home furnishing. Vegans and other Monks in India prefer this silk due to non Violence Silk. Thermal property (Warm in winter and cool in summers) of Eri silk makes it a suitable fabric for Shawls, Jackets, and Blankets. Baby dresses are also made from Eri silk because of its soft texture and moisture absorbent qualities. India is the largest

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producer of Eri silk in the world as 96% of Eri silk is produced in India of the total Eri silk produced in the world (Rajesh Kumar and S.K.Gangwar2010). Eri silk production in India in the year 2007-08 was 1,530 tones this made up 73% of the total Vanya silk production of 2,075 tonnes. Ericulture is believed to have originated in the Northeastern India especially Assam. Apart from the North-East region, Ericulture is also practiced in states of Andhra Pradesh, West Bengal, Uttar Pradesh, Uttaranchal, Bihar and Orissa (Krishna Rao, 2003, Ray et al., 2006). Recently Ericulture is being introduced in Madhya Pradesh, Delhi, Punjab, Karnataka and Maharashtra (Sahu et al., 2006. Kshama Giridhar et al., 2007). Eri silk is produced by Eri silkworm Philosamia ricini (Lepidoptera: Saturniidae) has a unique distinction among other three silkworms of having its potential host, the castor (Ricinus communis)an important agricultural oil bearing crop. (Sundarraj et al., 1972; Jolly et al., 1979; Dayashankar, 1982; Basaiah, 1988; Pandey, 1995;Reddyet al., 1998; andDebarajet al., 2002). The Eri silkworm (Philosamia ricini) is multivoltine, holometabolus, poly phagous, nonmulberry, completely domesticated silkworm. Eri silkworm itself is nutritious. It does not make annoying sound nor does have any odor. It does not need water to drink. Its mortality rate is less than

other silkworm. The main focus of my study is on socio-economic development of rearers of Ujjain District.

Material and Methods

The present study was conducted in the Zoology Department of Govt. P.G.M.V.M. Uijain M.P. The Eggs of Eri silkworm (Philosamia ricini) were collected from Govt. Sericulture Center Indore M.P, and standard rearing method was used suggested by (Choudhary S.N.1982). Experiments were performed at four different temperatures $(20\pm3^{\circ}C, 24\pm3^{\circ}C, 28\pm3^{\circ}C \text{ and } 32\pm3^{\circ}C)$, each temperature with three humidity 50%, 70% and 90% and study the effect of temperature and humidity on Larval parameters (larval length, larval weight, larval duration, ERR and pupation), Cocoon parameters (cocoon weight, shell weight, pupae weight and shell %) and Grainage parameters (Fecundity and hatching) of Eri silkworm (Philosamiaricini).

Larval parameters:

Larval duration were counted in days, larval weight and larval length were calculated and recorded of V^{th} instar mature larvae in gram and cm respectively. While ERR (effective rate of rearing) and pupation were calculated in percentage (%) by formulae.

Cocoon parameters:Cocoon weight, pupae weight, shell weight were calculated in gram while shell ratio was calculated in percentage (%) by formula.Grainage parameters:Fecundity was counted in number of eggs laid by a single female moth and hatching was calculated on the 3rd day after hatching by formula.The data were collected and subjected to the statistical analysis on computer. The mean values are presented in table.

Results and Discussion

Table No-1 shows the observations recorded at temperature $20\pm3^{\circ}$ C with different relative humidity and the maximum value of each parameter in reference to temperature and humidity are as follows:

A) **Larval parameter:** Larval length was observed maximum 5.3 cm with 70% RH. Larval weight was observed maximum 8.5 gm with 70% RH. Lowest larval duration was recorded 26 days with 70% RH. ERR was observed maximum 82% with 90%

RH. Pupation was recorded maximum 85% with 70% RH.

B) **Cocoon parameters:** Cocoon weight was observed maximum 2.90 gm with 70% RH. Pupae weight was observed maximum 2.55 gm with 70% RH. Shell weight was observed maximum 0.38 gm with 70% RH. Shell ratio was observed maximum 13.9% with 70% RH.

C) **Grainage parameter:**Fecundity was observed maximum 385 with 70% RH and Hatching was observed maximum 82% with 70% RH. Table 2 shows the observations recorded at temperature $24\pm3^{\circ}$ Cwith different relative humidity and the maximum value of each parameter in reference to temperature and humidity are as follows:

A) **Larval parameter:** Larval length was maximum 7.3 cm with 70% RH. Larval weight was observed maximum 9.5 gm with 70% RH. Lowest larval duration was recorded 22 days with 70% RH. ERR was observed maximum 96% with 70% RH. Pupation was recorded 92% with 70% RH.

B) **Cocoon parameters:** Cocoon weight was observed maximum 3.15 gm with 70% RH. Pupae weight was observed maximum 2.66 gm with 70% RH. Shell weight was observed maximum 0.50 gm with 70% RH. Shell ratio was observed maximum 15.6% with 70% RH.

C) **Grainage parameter:** Fecundity was observed maximum 378 with 70% RH and Hatching was observed maximum 95% with 70% RH (Table 3).

Table No-3 shows the observations recorded at temperature $28\pm3^{\circ}$ C with different relative humidityandthe maximum value of each parameter in reference to temperature and humidity are as follows:

A) **Larval parameters:** Larval length was maximum 6.5 cm with 70% RH. Larval weight was observed maximum 10.6 gm with 70% RH. Lowest larval duration was recorded 19 days with 70% RH. 4) ERR: - ERR was observed maximum 96% with 70% RH. Pupation was 93% recorded with 70% RH.

B)**Cocoon parameters:**Cocoon weight was observed maximum 3.39 gm with 70% RH. Pupae weight was observed maximum 2.84 gm with70% RH. Shell weight was observed maximum 0.55 gmwith 70% RH. Shell ratio was observed maximum 16.2% with 70% RH.

Table1-The rearing performance (larval, cocoon and grainage parameters) of Eri Silkworm (*Philosamia ricini*) in $(20 \pm 3^{\circ}C)$ at different relative humidity

Larval	Humidity		
Parameter	50%	70%	90%
Larval length	4.1 cm	5.3 cm	5.1 cm
Larval Weight	6.5 gm	8.5 gm	7.8 gm
Larval duration	30 days	26 days	32 days
ERR%	75%	80%	82%
Pupation	80%	85%	76%
Cocoon Parameter			
Cocoon weight	2.54 gm	2.90 gm	2.70 gm
Pupae Weight	2.22 gm	2.55 gm	2.54 gm
Shell weight	0.34 gm	0.38 gm	0.35 gm
Shell%	13.3%	13.9%	12.9%
Grainage Parameter			
Fecundity	371	385	350
Hatching	60%	82%	75%

Table 2- The rearing performance (larval,
cocoon and grainage Parameters) of Eri
silkworm (*Philosamia ricini*) in $(24 \pm 3^{\circ}C)$
at different relative humidity

Larval	Humidity		
Parameter	50%	70%	90%
Larval length	5.5 cm	7.3 cm	6.1cm
Larval Weight	8.3 gm	9.5 gm	8.4 gm
Larval duration	28 days	22 days	24 days
ERR%	78 %	96%	87%
Pupation	81 %	92%	82%
Cocoon Parameter			
Cocoon weight	2.92 gm	3.15 gm	3.08 gm
Pupae Weight	2.47 gm	2.66 gm	2.61 gm
Shell weight	0.45 gm	0.50 gm	0.46 gm
Shell%	15.4%	15.6%	14.9%
Grainage Parameter			
Fecundity	376	378	355
Hatching	83%	95%	75%

C) **Grainage parameter:** Fecundity was observed maximum 450 with 70% RH and Hatching was observed maximum 96% with 70% RH. Table 4 shows the observations recorded at temperature $32\pm3^{\circ}$ C with different relative humidityandthe maximum value of each parameter in reference to temperature and humidity are as follow:-

A) **Larval parameter**: Larval length was maximum 4.5 cm with 70% RH and 90% RH. Larval weight was observed maximum 6.4 gm with 70% RH. Lowest larval duration was recorded 24 days with 50% RH. 4) ERR: - ERR was observed maximum 82% with 70% RH. Pupation was recorded 71% with 70% RH.

B) **Cocoon parameters**: Cocoon weight was observed maximum 3.04 gm with 70% RH. Pupae weight was observed maximum 2.66 gm with70% RH.Shell weight was observed maximum 0.38 gm with 70% RH. Shell ratio was observed maximum 12.4% with 70% RH.

C) **Grainage parameter**: Fecundity was observed maximum 310 with 50% RH and Hatching was observed maximum 70% with 70% RH.

From above data, it is observed that the maximum value of each parameter in reference to temperature and humidity are as follow:-

A) **Larval parameter:**(Fig-1) the largest larval length 7.3 cm was observed in $24\pm3^{\circ}$ C temperature at 70% relative humidity. The maximum larval weight was recorded 10.6 gm in $28\pm3^{\circ}$ C temperature at 70% relative humidity. The best larval duration was 19 days in $28\pm3^{\circ}$ C temperature at 70% relative humidity. The best ERR% was 96% in both $24\pm3^{\circ}$ C and $28\pm3^{\circ}$ C temperatures at 70% relative humidity. The best pupation was 93% in $28\pm3^{\circ}$ C temperature at 70% relative humidity.

B) **Cocoon parameters:** (Fig-2) The Cocoon weight was recorded highest 3.39 gm in $28\pm3^{\circ}$ C temperature at 70% relative humidity. The best pupae weight 2.84 gm was found in $28\pm3^{\circ}$ C temperature at 70% relative humidity. The highest shell weight 0.55 gm was in $28\pm3^{\circ}$ C temperature at 70% relative humidity. The best shell ratio was 16.2% in $28\pm3^{\circ}$ C temperature at 70% relative humidity.

C) Grainage parameter: - (Fig-3) The fecundity was maximum 450 in $28\pm3^{\circ}$ C temperature at 70% relative humidity. Highest hatching% was observed 96% in $28\pm3^{\circ}$ C temperature at 70% relative humidity. The present result clearly indicates that larval weight, ERR%, pupation%, cocoon weight, pupae weight, shell weight, shell%, fecundity and hatching% were observed maximum in 70% relative humidity at $28\pm3^{\circ}$ C temperature. The lowest larval duration was recorded in 70% relative humidity at $28\pm3^{\circ}$ C temperature.

Table 3- The rearing performance	(larval,
cocoon and grainage parameters)	of Eri
Silkworm (Philosamia ricini) in (28 ±	3°C) at
different relative humidity	

Larval	Humidity		
Parameter	50%	70%	90%
Larval length	5.2 cm	6.5 cm	5.5 cm
Larval Weight	8.3 gm	10.6 gm	7.5 gm
Larval duration	21days	19days	22 days
ERR%	80%	96%	85%
Pupation	82%	93%	85%
Cocoon Parameter			
Cocoon weight	3.01 gm	3.39 gm	3.22 gm
Pupae Weight	2.55.gm	2.84 gm	2.74 gm
Shell weight	0.42 gm	0.55gm	0.48 gm
Shell%	13.01%	16.2%	14.9%
Grainage Parameter			
Fecundity	380	450	386
Hatching	82%	96%	84%

Table 4: The rearing performance (larval, cocoon and grainage parameters) of Eri Silkworm (*Philosamia ricini*) in $(32 \pm 3^{\circ}C)$ at different relative humidity

Larval	Humidity			
Parameter	50%	70%	90%	
Larval length	4.3 cm	4.5 cm	4.5 cm	
Larval Weight	6.2 gm	6.4 gm	6.0 gm	
Larval duration	24 days	25 days	25 days	
ERR%	73%	82%	79 %	
Pupation	60%	71%	52%	
Cocoon Paramete	Cocoon Parameter			
Cocoon weight	2.98 gm	3.04 gm	2.93 gm	
Pupae Weight	2.62 gm	2.66 gm	2.58 gm	
Shell weight	0.36 gm	0.38 gm	0.35 gm	
Shell%	12.07%	12.40%	11.09%	
Grainage Parameter				
Fecundity	310	280	277	
Hatching	62%	70%	55%	

Fig. 1: The Larval Parameters of Eri Silkworm (*Philosamia ricini*) in different temperature at different relative humidity





Fig 2: Cocoon Parameters of Eri silkworm (*Philosamia ricini*) in different temperature at different relative humidity

70 % RH

90 % RH

■ 50 % RH



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Fig No. 3- The Grainage Parameters of Eri Silkworm (*Philosamia ricini*) in different temperature at different relative humidity



The present result clearly indicates that larval weight, ERR%, pupation%, cocoon weight, pupae weight, shell weight, shell%, fecundity and hatching% were observed maximum in 70% relative humidity at 28±3°C temperature. The lowest larval duration was recorded in 70% relative humidity at 28±3°C temperature. Only larval length was highest in 70% relative humidity at 24±3°C temperature. From the above study it is concluded that the 28±3°C temperature and 70% relative humidity are the best for rearing of Eri silkworm (Philosamia ricini) for sustainable development of rears of Ujjain district. The life cycle of silkworm is influenced by bio-ecological Humidity stress during larval period. and Temperature influence the growth and development of Eri silkworm. Day to day change in weather during the larval rearing poses great threat to the cocoon crop. The impact of temperature and relative humidity (RH) on commercial traits of cocoons as well as biological aspects has been investigated extensively in various countries. Sugai E. et al., (1981) and Sahu, M et al., (2006) reported that the ideal range of temperature for the growth of silkworm BombyxmoriandEri silkworm Philosamia ricini is from 20°C to 40°C.

However, increase in temperature beyond 35°C cause less spinning, mortality of larval and pupae and poor moth emergence and sterility at adult stage.Gohain R. and Borua R. (1982) reported that shortest development period, highest larval weight, oviposition and silk material of Eri silkworm *Philosamia ricini* were found in $28\pm2^{\circ}$ C and 70% RH and survival was best in $28\pm2^{\circ}$ C and $26\pm2^{\circ}$ C at 70% RH. Pupal weight and weight of silk material were observed in $26\pm2^{\circ}C$ at 70% RH.Ullal and Narasimhanna (1987) reported that the high temperature followed by strong fluctuations results in poor quality cocoon of Bombyx mori. Anonymous (1987) reported that at low humidity larvae lose water from their body in considerable amount which result in inefficient metabolism and it also leads to less conservation of energy for pupae and adult stage and this may affect egg laying ability of the female moths. Pandey Priyanka et al., (2006) observed that the variation in temperature and relative humidity has significantly influenced to the larval duration of Bombyxmori. The Maximum larval duration of *Bombyxmori* was recorded at 26±2°C and 75%RH (relative humidity).Pandey and Tripathi (2008) indicated that decrease in the humidity from 80% to 75% caused increase in the larval weight and survival rate of larvae but further decrease in the humidity caused decline in the survival rate, hatching percentage and larval weight of silkworm Bombyxmori.MubasharHussainet al., (2011)studied that rearing of silkworm larvae (Bombyxmori.) at lower level of RH resulted in lower fecundity, hatching, pupation and higher larval mortality. It is concluded that the 28±3°C temperature and 70% relative humidity are the best for rearing of Eri silkworm (Philosamia ricini) for sustainable development of rears of Ujjain district.

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