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Effect of castor and cassava foliage on growth and cocoon characters of Eri silkworm (*Samia Cynthia ricini*)

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Abstract
Eri silkworm *S. ricini* is a semi domesticated and polyphagous in nature. The aim of the present study to evaluate the effect of castor (*Ricinus communis*) and cassava (*Manihot utilissima*) leaves on growth and cocoon characters of *S. ricini.* The observed results on the economic parameters are larval duration (20 days), larval weight (4.083±0.06), cocoon weight (2.2±0.03), pupal weight (1.85±0.01), shell ratio (22.27±1.02) and effective rate of rearing (77.19±1.97), survival rate (84.21%) and mortality rate (15%) were noted in eri silkworm. However, the analyzed economic parameters are found to be higher in eri silkworm fed with castor leaves when compared to cassava leaves. *S. ricini* highly prefers the castor leaves for their growth and development.

Keywords: Eri silkworm, castor, cassava leaves, economic parameters

Introduction
Sericulture is an agro-based industry. It involves rearing of silkworms for the production of raw silk, which is the yarn obtained out of cocoons spun by certain species of insects. The major activities of sericulture comprises of food-plant cultivation to feed the silkworms which spin silk cocoons and reeling the cocoons for unwinding the silk filament for value added benefits such as processing and weaving.
Sericulture plays a distinguished role in the rural economy of India. It is a viable agro-based industry, which was first introduced into India about 400 years. Since then the industry is flourishing as an agro-based industry. India, has the distinction of being the only country in the world, producing all the five commercially exploited silk varieties *viz*. Mulberry, Tropical Tasar, temperate/Oak Tasar and Muga silk. The non-mulberry silks (Tasar, Muga & Eri) are now being popularized as *Vanya* silk.

Eri culture
Eri culture plays significant role in rural livelihood security especially among marginalized and weaker section of the society covering more than 0.18 million families of the country with an annual production of 4236MT (CSB, 2015). Eri culture is prevalent mainly amongst the tribal women in hill districts of North Eastern Region. It is believed to have originated in the Brahmaputra valley of India (Jolly *et al*., 1979) [9]. In recent years, the farmers of several other states *viz*. Andhra Pradesh, Madhya Pradesh, Tamil Nadu, Karnataka, Maharashtra, Uttaranchal, Uttar Pradesh, Jharkhand, Bihar, West Bengal, Orissa and Sikkim have taken up eri culture.
Eri (*Samia cynthia ricini*) under the family Saturniidae is the only completely domesticated polyphagous multivoltine silkworm among the vanya silks in North Eastern Region of India. The wooly white silk is often referred to as the fabric of peace when it is processed without the killing of the silk worm, this process results in a silk called Ahimsa silk. Moths leave the cocoon and then the cocoons are harvested to be spun. The eri silk worm is the only completely domesticated silkworm other than *Bombyx mori*.

Eri silkworm

The name eri derives from the Assamese word 'era', which means castor-oil plant, the main food plant of this silkworm. *Samia cynthia ricini* a multivoltine silkworm commonly called as 'eri silkworm' is known for its white or brick-red eri silk.

The primary food plant of this polyphagous insect is castor (*Ricinus communis* L.), but it also feeds on a wide range of food plants such as *Heteropanax fragrans*, *Manihot utilissima*, *Evodia flaxinifolia*, *Ailanthus gradulosa* etc (Sirimungkararat., 2005) [27]. The wild *Samia cynthia ricini* silkworm completes one to three generations per year depending on geographical position and climatic conditions of the region, however, up to six generations occur in the domesticated cultures (Neupane *et al*., 1990) [18]. Populations of *Samia cynthia ricini*, that have been commercially exploited and are present in different regions of north-east India show wide morphological and quantitative variations (Siddiqui *et al*., 2000) [28].

The white or brick red eri silk (*endi, errandi*) is produced by *Philosamia ricini*, a domesticated multivoltine silkworm. It is widespread in Assam and also practiced in Bihar, West Bengal, Manipur, Orissa and Tripura. The Indian Eri silkworm *Samia cynthia ricini* has several isolated populations, geographically separated (eco races) in the states of Assam and Meghalaya. Three of them, *viz*., Borduar, Mendipathar, Titabar are commercially exploited for the production of Eri silk in North eastern States.

Materials and Methods

The present investigation deals with the commercial F1 hybrid of Eri silkworm, studies on morphological and biological characters and economic parameters under western zone conditions of Tamil Nadu. The various methodologies applied are described in this chapter.

Collection of commercial F1 hybrid of Eri silkworm

Eggs of commercial F1 hybrid of Eri silkworm were obtained from Central Sericultural Germplasm Research Centre, Hosur, Tamil Nadu.

Rearing of eri silkworm

In order to study the influence of castor and cassava foliage on growth and economic traits of eri silkworm. Each treatment was replicated five times with 50 larvae each. Standard rearing techniques (Singh and Benchamin, 2002) [29] were adopted during the experimentation and the economic traits of eri silkworm *viz.*

The different economic parameters recorded were larval weight (g), larval duration (d), Single cocoon weight (g), Shell ratio (%), and Shell weight (g). Effective Rate of Rearing (ERR %), Mortality (%), Survival rate (%), were also estimated.

Larval weight (g)

5th instar matured larva before ripening selected randomly and calculated in the following expression:

$$\text{Single Larval weight (g)} = \frac{\text{10 nos. of matured larval weight before ripening}}{10}$$

Single cocoon weight (g)

Randomly selected male and female cocoon after harvest were weighed and calculated in the following expression

$$\text{Single cocoon weight (g)} = \frac{\text{10 nos. of live cocoon with pupa}}{10}$$

Shell weight (g)

After crop harvest, randomly selected male and female cocoon (1:1ratio) were cut open, pupae was removed and shell weight was calculated using the formula.

$$\text{Single shell weight (g)} = \frac{\text{10 nos. of cocoon shell}}{10}$$

Shell ratio (%)

The shell ratio indicates the quality of the silk that can be spun from a lot of live cocoons. The cocoon weight (including live pupa, 1:1 ratio male and female) and cocoon shell weight of the same lot (without pupa) were recorded individually and the shell ratio was calculated in percentage using following expression (Krishna swami *et al*., 1972) [17].

$$\text{Shell ratio (\%)} = \frac{\text{Weight of cocoon shell without pupa}}{\text{Weight of cocoon with live pupa}} \text{ X } 100$$

Effective Rate of Rearing (ERR %)

Effective Rate of Rearing was calculated from the total number of larvae brushed and number of cocoons harvested using the following expression:

$$\text{Effective Rate of Rearing (ERR\%)} = \frac{\text{Number of cocoons harvested}}{\text{Number of larvae brushed}} \text{ X } 100$$

Survival rate (%)

Survival rate (%) is calculated using the following expression (Singh and Benchamin, 2002) [29].

$$\text{Survival rate (\%)} = \frac{\text{No. of survived larvae}}{\text{No. of larvae brushed}} \text{ X } 100$$

Mortality (%)

Mortality (%) is calculated as Per Singh and Benchamin (2002) [29].

$$\text{Mortality (\%)} = \frac{\text{No. of dead larvae}}{\text{No. of larvae brushed}} \text{ X } 100$$

Hatching (%)

Hatching is very important character for rearing and cocoon crop harvest. Hatching (%) is calculated in the following expression:

$$\text{Hatching (\%)} = \frac{\text{Number of egg hatched}}{\text{Number of egg kept for brushing}} \text{ X } 100$$

Pupal weight (g)

After crop harvest, male and female cocoon (1:1 ratio) randomly selected and removed the pupa by cutting the cocoon shell. The naked pupae were weighed and calculated using the following expression:

$$\text{Single pupal weight (g)} = \frac{\text{Weight of 10 nos. of male and female live pupa in grams}}{10}$$

Results and Discussion

Data on impact of feeding of *Samia cynthia ricini* reared on different host plants (Castor and Cassava) were shown in the following tables.

Larval duration (Days)

The larval duration of cassava fed worms were found to be higher (27 days) when compared to the worms fed with castor (20 days). The larval duration of first and second instar worms were found to be the same. The prolonged larval duration was seen in the third, fourth and fifth instar of cassava fed worms (Table 1).

Moulting duration (Days)

The moulting duration of eri silkworms fed with Castor and cassava leaves were found to be similar. There is no significant difference in moulting duration (Table 1).

Table 1: Larval and moulting duration of *Samia cynthia ricini* fed with different food plants

Instar	Larval duration (days)		Moulting duration (days)	
	Castor host plant	cassava host plant	Castor host plant	Cassava host plant
I	4	4	1	1
II	2	2	1	1
III	3	6	1	1
IV	4	7	1.5	1.5
V	7	8		

Total life cycle

The total life cycle (i.e., from hatching of egg to moth emergence) of eri worms fed with castor were found to have shorter life span/duration than those worms fed with cassava leaves.ie., 48 days for castor fed worms and 56 days for cassava fed worms (Table 2).

Table 2: Total life cycle of *Samia cynthia ricini* fed with different host plants

Life stages	Total developmental period (days)	
	Castor host plant	Cassava host plant
Egg	10	10
Larva	20	27
Pupa	11	12
Adult	7	7
Total	48	56

Economic parameters

Larval weight (g)

The larval weight of castor fed worms was found to have higher larval weight (4.083 gm) than the worms fed with cassava leaves (2.044 gm) (Table 3).

Cocoon weight (g)

The average cocoon weight of castor fed eri silkworms were found to have higher weight (2.2 gm) than the worms fed with cassava (0.98 gm) (Table 3).

Pupal weight (g)

The average pupal weight of Castor fed eri silkworms was also found to be (1.85 gm) higher than the worms fed with cassava (1.2 gm) (Table 3).

Shell weight (g)

The average shell weight of Castor fed eri silkworms were found to have higher shell weight (0.49 gm) when compared to the worms fed with cassava leaves (0.15 gm) (Table 3).

Shell ratio (%)

The average shell ratio of Castor fed eri silkworms were found to have higher ratio (22.27%) than the worms fed with cassava (15.30%) (Table 3).

Effective rate of rearing

The ERR of Castor fed eri silkworms were found to have higher percentage (77.19%) when compared to the worms fed with cassava (68.96%) (Table 3).

Survival rate (%)

The survival rate of Castor fed eri silkworms were found to be higher (84.21%) than the worms fed with cassava (75.86 %) (Table 3).

Mortality (%)

The mortality rate of Castor fed worms was found to have lower mortality rate (15%) than the worms fed with cassava (23.33%) (Table 3).

Table 3: Economic parameters of *Samia cynthia ricini* fed with different host plants

S. No.	Particulars	Castor host plant	Cassava host plant
1	Larval weight (g)	4.083	1.044
2	Cocoon weight (g)	2.2	0.98
3	Pupal weight (g)	1.852	1.2
4	Shell weight (g)	0.49	0.15
5	Shell ratio (%)	22.27	15.30
6	Effective rate of rearing (%)	77.19	68.96
7	Survival rate (%)	84.21	75.86
8	Mortality (%)	15	23.33

Eri silkworm rearing, being a subordinate crop is considered as mere source of additional income and is no way comparable with return of mulberry silkworm (Singh and Benchamin, 2002) [29]. Eri culture is an off- farm activity that ensures gainful family employment with 55 per cent woman participation (Jayaprakash *et al*., 2021) [32]. In this research it was found that the worms fed with Castor leaves showed better performance than the worms fed with cassava. From these results it is obvious that the performance of eri silkworm was better on castor (Suryanarayana *et al*., 2003) [4] which is the primary host plant than cassava (Secondary food plant).

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