

## Seasonal variation and effect of rearing *Samia ricini* on *Manihot esculenta* and *Heteropanax fragrans*

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### Abstract

*Samia ricini*, the only domesticated eri silkworm is polyphagous that feeds on a variety of host plants. *Ricinus communis*, castor being the primary host plant is superior in terms of growth parameters and quality silk production of the silkworm. However, the annual nature of castor plant and requirement of high maintenance cost makes it difficult for the poor eri farmers. Therefore, present study was undertaken to see the effect of rearing *S. ricini* on *Manihot esculenta* and *Heteropanax fragrans* during four different seasons (Spring, summer, autumn and winter). It is observed that the rearing performance of *S. ricini* on the combination of *R. communis* (1<sup>st</sup> to 2<sup>nd</sup> instar) with *M. esculenta* (3<sup>rd</sup> to 5<sup>th</sup> instar) and *R. communis* (1<sup>st</sup> to 2<sup>nd</sup> instar) with *H. fragrans* (3<sup>rd</sup> to 5<sup>th</sup> instar) is comparable to the performance of silkworms reared using *R. communis* alone (1<sup>st</sup>-5<sup>th</sup> instar). The lowest larval and pupal duration, highest fecundity (nos.), hatchability (%), effective rate of rearing (%), emergence rate (%), survival rate (%), larval weight (g), cocoon weight (g), shell weight (g) and shell ratio (%) was observed in the silkworms reared using the leaves of *R. communis* which was similar to the silkworms reared using combination of *R. communis* and *M. esculenta* as well as the combination of *R. communis* and *H. fragrans*. Therefore, it may be concluded that *Manihot esculenta* and *Heteropanax fragrans* are the potential host plants of eri silkworm that can be used to rear *S. ricini* during the crisis of primary host plant, *R. communis*.

**Keywords:** *Samia ricini*, economic parameters, *M. esculenta*, *H. fragrans*

### Introduction

Sericulture is an important agro-based industry which provides employment and plays a major role in the rural economy of our country. India has unique distinction in the world that produces all four varieties of silk, muga, tassar, mulberry and eri. According to the annual report of Central silk board 2019-2020, India produces about 35,820 MT of silk, out of which mulberry production was 25,239 MT and the production of Vanya silk (muga, tassar and eri) was about 10,581 MT. India is the largest producer of eri silk in the world and about 11.65 lakh hectares of eri food plants is available in India (Somprakash et al., 2008). The term 'Eri' is derived from the Sanskrit word 'Erranda', which refers to castor plant, the primary host plant of eri silkworm, *Samia ricini*. Eri culture is predominant among tribal inhabitants of Northeastern part of India and Assam is one of the main producers of eri silk.

Eri silkworm, *S. ricini* (Donovan) is a polyphagous and multivoltine sericeous insect which can be reared completely indoors. Castor, *R. communis* is the primary host plant of this silkworm but being polyphagous it feeds on a variety of other secondary host plants. Arora and Gupta (1979) [1] listed about 30 host plant species on which eri silkworm feeds. However, the quality of feed and temperature and climatic conditions during rearing affects the growth and development, survival rate, cocoon parameters as well as the silk quality (Gomma, 1972 and Hazarika et al., 2005) [4, 6]. Therefore, it is necessary to select a good host plant in order to improve the rearing performance and cocoon quality of the silk.

### Materials and methods

The present study was conducted at Department of Zoology, Bodoland University, Kokrajhar during four different seasons viz. Season 1 (Spring), Season 2 (Summer), Season

3 (Autumn) and Season 4 (Winter). The eggs of *S. ricini* was collected from Directorate of Sericulture, Kokrajhar which was tied on a cloth and incubated in room temperature for hatching. Rearing of the silkworms were done using method as recommended by Sarkar, 1980 [10]. The eggs were divided into three Samples containing 300 eggs in each Sample. Leaves of *R. communis*, *M. esculenta* and *H. fragrans* were used for the present experiment. Rearing of silkworms in Sample 1 represented as G2 reared using a combination of *R. communis* (1<sup>st</sup> to 2<sup>nd</sup> instar) and *M. esculenta* (3<sup>rd</sup> to 5<sup>th</sup> instar) and Sample 2, represented as G3 was reared using a combination of *R. communis* (1<sup>st</sup> to 2<sup>nd</sup> instar) and *H. fragrans* (3<sup>rd</sup> to 5<sup>th</sup> instar). Three replications of each Sample along with control were maintained in the laboratory. The rearing performance and cocoon parameters of eri silkworm reared using different food plants was done based on observation of larval weight (g) and duration (days), effective rate of rearing (%), cocoon weight (g), shell weight (g), shell ratio (%) and grainage parameters like pupal weight (g), pupal duration (days), rate of moth emergence (%), fecundity (nos.) and hatching (%). The data is analyzed statistically, and it is represented in mean and standard deviation (SD) and variance analysis at the level of 0.05% significance test.

### Results and discussion

The highest number of eggs laid (458±4.837) was recorded in the silkworms reared using a combination of *R. communis* (1<sup>st</sup> to 2<sup>nd</sup> instar) and *H. fragrans* (3<sup>rd</sup> to 5<sup>th</sup> instar) i.e., G3 during Season 3. In the silkworms reared using combination of *R. communis* (1<sup>st</sup> to 2<sup>nd</sup> instar) and *M. esculenta* (3<sup>rd</sup> to 5<sup>th</sup> instar) i.e., G2, the highest fecundity was observed during Season 2 (445.66±5.456). Overall, the fecundity was recorded higher during S3, followed by S1 and S2 while the lowest fecundity was observed during Season 4 (Table 1).

The hatching percentage ( $95.18 \pm 3.022$ ) was recorded to be higher in the silkworms reared using a combination of *R. communis* (1<sup>st</sup> to 2<sup>nd</sup> instar) and *H. fragrans* (3<sup>rd</sup> to 5<sup>th</sup> instar) i.e., G3 during Season 2 while in G2, it was found to be higher during S1 ( $94.07 \pm 1.987$ ). The lowest percentage of hatching was recorded during Season 4 in all Samples. (Table 1).

The larval and pupal duration (days) were recorded to be shorter in the silkworms reared using combination of *R. communis* (1<sup>st</sup> to 2<sup>nd</sup> instar) and *M. esculenta* (3<sup>rd</sup> to 5<sup>th</sup> instar) i.e., G2 and the longest larval duration ( $38.44 \pm 1.619$ ) and longest pupal duration ( $14.89 \pm 0.829$ ) was recorded in the silkworms reared using combination of *R. communis* (1<sup>st</sup> to 2<sup>nd</sup> instar) and *H. fragrans* (3<sup>rd</sup> to 5<sup>th</sup> instar) i.e. G3 during Season 4.

The weight of matured larva was found to be higher in G1 during all four seasons (previous study) which was followed by G2 and G3. The lowest larval weight (g) was recorded in the G3 silkworms which was reared using *R. communis* and *H. fragrans* during Season 4 ( $6.083 \pm 0.639$ ).

The effective rate of rearing (ERR%) of the silkworms reared using *R. communis* and *M. esculenta* also showed comparable result with that of the silkworms reared using *R. communis* from my previous study. However, the percent of effective rate of rearing was observed to be lower in the silkworms reared using *R. communis* and *H. fragrans* as compared to the silkworms in control Sample (G1). The percentage of emergence rate and survival rate also showed similar trend, the highest emergence and survival rate was observed in G2 (*R. communis* and *M. esculenta*) followed by G3 (*R. communis* and *H. fragrans*).

The cocoon weight (Table 3) was found to be higher in the silkworms reared using *R. communis* and *H. fragrans* (G3) while the silkworms reared using *R. communis* and *M. esculenta* (G2) showed lower cocoon weight during all seasons ( $3.07 \pm 0.010$ ,  $3.02 \pm 0.127$ ,  $3.10 \pm 0.55$ ,  $82.92 \pm 0.102$ ) respectively. The observation on the shell weight also showed similar trend. The highest shell was observed in the silkworms reared using *R. communis* and *H. fragrans* (G3) while lower shell weight ( $0.41 \pm 0.005$ ,  $0.40 \pm 0.016$ ,  $0.40 \pm 0.016$ ,  $0.38 \pm 0.010$ ) was observed in the silkworms reared using *R. communis* and *M. esculenta* (G2). The shell ratio was higher in the silkworms reared using *R. communis* and *H. fragrans* ( $13.62 \pm 0.325$ ,  $13.63 \pm 0.290$ ,  $13.63 \pm 0.269$ ,  $13.48 \pm 0.447$ ) during different seasons and lowest shell ratio was observed in the silkworms reared using *R. communis* and *M. esculenta* ( $13.19 \pm 0.300$ ) during S4.

The present study emphasizes on the growth and development, economic parameters, and cocoon traits of eri silkworm, *S. ricini* based on the host plants used for rearing

as well as based on seasonal variations. Biswas et al. (2001) reported that the food plant influences the larval growth and duration, weight of cocoon, pupa and shell, Survival rate and effective rate of rearing and fecundity. From the present and previous studies, it is evident that the host plant plays a great role in the overall growth and development as well as cocoon traits of the silkworm. It is also observed that the performance of eri silkworm reared using *R. communis* is better as compared to the other two Samples. The effect of different season on growth and performance is also observed, studies by Kumar and Elangovan, (2010) [8, 9] on the increase of larval weight, cocoon and pupal weight and survival rate exhibited by eri silkworm fed on *R. communis* leaves was explained due to the higher rate of food ingestion and assimilation. Similar observations on host plant preference of *S. ricini* was also made by Nangia et al., (2000) [7] who reported the preference of food in the order of castor followed by tapioca, papaya, barkessuru and gulancha, respectively. Similar findings were also reported by Thangavelu and Phukan (1983) [12], Devaiah and Dayashankar (1982) [3] and Kumar et al., (1993) [6]. Chakravorty and Neog (2006) [2] reported suitability of different eri food plants viz. castor, kesseru, tapioca and payam and appraised the suitability of castor in terms of fecundity, larval weight, cocoon weight and shell weight. In my previous study, it was observed that the parameters like fecundity, hatchability, larval and pupal duration, larval weight, emergence and survival rate, effective rate of rearing and cocoon characters like shell and cocoon weight and shell ratio in the silkworms reared using *R. communis* was higher however the observations recorded in the silkworms reared using combination of *R. communis* and *M. esculenta* (G2) and combination of *R. communis* and *H. fragrans* were also significant. Therefore, it may be concluded that host plants and seasons are the main factor that influences the economic parameters and cocoon characters of *S. ricini* and from the present study it is evident that *M. esculenta* and *H. fragrans* can be used as suitable host plants for the rearing of *S. ricini* during the crisis of *R. communis*, the primary host plant.

#### Acknowledgement

The authors would like to thank the Directorate of Sericulture, Kokrajhar for providing the seeds for rearing of silkworms and for providing valuable guidance during the rearing. We would also like thank Ministry of tribal affairs for providing financial help to carry out the research.

#### Conflict of interest

The authors declare that there is no conflict.

**Table 1:** Fecundity (Nos.) and hatchability (%) of *Samia ricini* reared using different host plants during four seasons

	Fecundity (Nos.)				Hatching (%)			
	S1	S2	S3	S4	S1	S2	S3	S4
G2	439 $\pm$ 3.687	445.66 $\pm$ 5.456	434 $\pm$ 6.228	336.77 $\pm$ 6.538	94.07 $\pm$ 1.987	92.59 $\pm$ 1.987	93.70 $\pm$ 3.784	85.18 $\pm$ 3.022
G3	436.55 $\pm$ 5.349	442.77 $\pm$ 6.289	458 $\pm$ 4.837	327.11 $\pm$ 5.430	94.81 $\pm$ 3.022	95.18 $\pm$ 2.165	92.96 $\pm$ 2.766	84.81 $\pm$ 3.975

Data presented in standard error of the mean (SD).

Note: G2: *Ricinus communis* (1<sup>st</sup>-2<sup>nd</sup> instar) and *Manihot esculenta* (3<sup>rd</sup>-5<sup>th</sup> instar), G3: *Ricinus communis* (1<sup>st</sup>-2<sup>nd</sup> instar) and *Heteropanax fragrans* (3<sup>rd</sup>-5<sup>th</sup> instar).

**Table 2:** Larval duration (days), pupal duration (days) and matured larval weight (g) of *Samia ricini* reared using different host plants during four seasons

	Larval duration (days)				Pupal duration (days)				Matured larval weight (g)			
	S1	S2	S3	S4	S1	S2	S3	S4	S1	S2	S3	S4
G2	23.67± 1	23.44± 0.906	25.11±0.82 9	37.11±0.69 9	12±0.632	11.89±0.94 2	13.78±0.74 5	14.22±0.59 6	6.110±0.95 5	6.140±0.79 1	6.210±0.85 6	6.093±1.00 5
G3	24.33± 1	21.66±0.7 74	23.44±0.78 8	38.44±1.61 9	12.77±1.07 4	11.55±0.78 8	12.66±0.89 4	14.89±0.82 9	6.065±1.84	6.180±0.89 8	6.142±0.89 9	6.083±0.63 9

Data presented in standard error of the mean (SD).

Note: G2: *Ricinus communis* (1<sup>st</sup> to 2<sup>nd</sup> instar) and *Manihot esculenta* (3<sup>rd</sup> to 5<sup>th</sup> instar), G3: *Ricinus communis* (1<sup>st</sup> to 2<sup>nd</sup> instar) and *Heteropanax fragrans* (3<sup>rd</sup> to 5<sup>th</sup> instar).

**Table 3:** Effective rate of rearing (%), emergence rate (%) and survival rate (%) of *Samia ricini* reared using different host plants during four seasons

	Effective rate of rearing (%)				Emergence rate (%)				Survival rate (%)			
	S1	S2	S3	S4	S1	S2	S3	S4	S1	S2	S3	S4
G2	81.52±2.4 81	81.19±2.4 04	81.45±4.6 69	76.72±5.9 20	91.35±3.3 48	90.24±3.8 43	92.77±3.4 29	89.79±3.0 56	86.23±1.8 05	84.27±3.0 95	88.17±4.2 84	82.81±5.44 1
G3	81.30±2.7 89	81.77±2.4 04	81±4.543	76.54±5.4 43	91.35±2.7 28	91.98±4.7 00	91.07±2.2 42	89.25±4.4 44	86±2.771	85.25±2.3 56	86.15±4.3 32	82.706±4.0 29

Data presented in standard error of the mean (SD).

Note: G2: *Ricinus communis* (1<sup>st</sup> to 2<sup>nd</sup> instar) and *Manihot esculenta* (3<sup>rd</sup> to 5<sup>th</sup> instar), G3: *Ricinus communis* (1<sup>st</sup> to 2<sup>nd</sup> instar) and *Heteropanax fragrans* (3<sup>rd</sup> to 5<sup>th</sup> instar).

**Table 4:** Cocoon weight (g), shell weight (g) and shell ratio (%) of *Samia ricini* reared using different host plants during four seasons

	Cocoon weight (g)				Shell weight (g)				Shell ratio (%)			
	S1	S2	S3	S4	S1	S2	S3	S4	S1	S2	S3	S4
G2	3.07±0.01 0	3.02±0.12 7	3.10±0.55 8	2.92±0.10 2	0.41±0.00 5	0.40±0.01 6	0.40±0.01 6	0.38±0.01 0	13.25±0.17 7	13.32±0.42 9	13.24±0.36 3	13.19±0.30 0
G3	3.12±0.04 0	3.12±0.01 5	3.12±0.04 7	3.03±0.13 9	0.42±0.01 0	0.43±0.00 8	0.43±0.00 8	0.40±0.00 9	13.62±0.32 5	13.63±0.29 0	13.63±0.26 9	13.48±0.44 7

Data presented in standard error of the mean (SD).

Note: G2: *Ricinus communis* (1<sup>st</sup> to 2<sup>nd</sup> instar) and *Manihot esculenta* (3<sup>rd</sup> to 5<sup>th</sup> instar), G3: *Ricinus communis* (1<sup>st</sup> to 2<sup>nd</sup> instar) and *Heteropanax fragrans* (3<sup>rd</sup> to 5<sup>th</sup> instar).



Sample G2: *S. ricini* reared in *M. esculenta*



Sample G3: *S. ricini* reared in *H. fragrans*

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