Uttar Pradesh Journal of Zoology

Volume 45, Issue 20, Page 343-352, 2024; Article no.UPJOZ.4149
ISSN: 0256-971X (P)

Optimizing Eri Silkworm Productivity: Evaluating the Performance of Ecoraces of *Samia ricini* (Donovan) in the East Coastal Condition of Tamil Nadu, India

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.56557/upjoz/2024/v45i204589

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://prh.mbimph.com/review-history/4149

Original Research Article

Received: 24/08/2024
Accepted: 27/10/2024
Published: 02/11/2024

ABSTRACT

This study investigated raising Eri silkworms, *Samia ricini* (Donovan) a multi-voltine, domestic moth, traditionally bred indoors and known for its spun silk, in the eastern coast of Tamil Nadu, India. Eri silkworms typically thrive in the northeast regions, but the growing demand for Eri silk has led to exploring new locations for their production. The eight ecoraces of Eri silkworm *i.e.* C2, Borduar, Khanapara, Mendipathar, Dhanubanga, Nongpoh, Borduar and Titabar were selected for this study reared on castor plants under varied climatic conditions in Tamil Nadu. The economic and grainage

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Cite as: *Anujaa.B, and Arivudainambi.S. 2024. "Optimizing Eri Silkworm Productivity: Evaluating the Performance of Ecoraces of Samia Ricini (Donovan) in the East Coastal Condition of Tamil Nadu, India". UTTAR PRADESH JOURNAL OF ZOOLOGY 45 (20):343-52. https://doi.org/10.56557/upjoz/2024/v45i204589.*

characters such as larval duration, matured larval weight, survival rate, cocoon weight, shell weight, shell ratio, effective rearing rate, rate of pupation, rate of moth emergence, fecundity and hatchability were analyzed. This study revals that C2 ecorace consistently outperformed the other ecoraces, exhibiting superior growth parametrics, cocoon quality, and silk production potential.Findings indicate that optimal temperature and humidity conditions are crucial for enchancing performace, particularly for sensitive ecoraces like Barpathar and Nongpoh, highlighting the importance of ecorace selection and environmental management for sustainable eri silk production.

Keywords: Eri silkworm; Eri silk; ecoraces; qualitative characters; cocoon.

1. INTRODUCTION

India's diverse climatic conditions support the rearing of four types of silkworms: the mulberry silkworm, *Bombyx mori* (Linnaeus), and the non-mulberry silkworms: Eri (*Samia ricini*, Donovan), Muga (*Antheraea assamensis*, Helfer), and Tasar (*Antheraea mylitta*, Drury). Together, these silkworms contributed to the production of 38,913 metric tons (MT) of silk in 2023-24 (CSB, 2024). Mulberry silk dominates the industry, accounting for 74% of the total silk production. Following this, Eri silk ranks highest among the non-mulberry silks, with a production of 1,586 MT(CSB, 2024).

Eri silkworms are notable for producing a unique, durable silk. Unlike other silks, Eri silk is spun from open-ended cocoons rather than being reeled, which gives it a distinctively soft, cotton-like feel. Eri silk production is not only a significant economic activity but also promotes environmentally friendly and sustainable textile manufacturing. Additionally, Eri silk is often referred to as “Ahimsa silk” due to its ethical production process, which allows the silkworm to emerge naturally from its cocoon, avoiding harm to the insect.

Eri silkworm rearing is predominantly practiced in the northeastern states of Assam, Meghalaya, Nagaland, Manipur, Mizoram, and Arunachal Pradesh. However, its cultivation is gaining traction in non-traditional states such as Andhra Pradesh, Tamil Nadu, Karnataka, Gujarat, Jharkhand, and Chhattisgarh. Eri silkworms can be reared year-round in temperatures between 25°C and 30°C, with relative humidity levels of 75% to 80%. As a polyphagous species, Eri silkworms consume a variety of host plants, with castor (*Ricinus communis*, Linn.) and kesseru (*Heteropanas fragrans*, Roxb.) being the primary host plants. Secondary hosts include tapioca (*Manihot esculenta*, Crantz), borkesseru (*Ailanthus excelsa*, Roxb.), barpat (*Ailanthus grandis*, Roxb.), gulancha (*Plumeria acutifolia*, Poir.), payam (*Evodia flaxinifolia*, Hook.), jatropha (*Jatropha curcas*, Linn.), and papaya (*Carica papaya*, Linn.) (Directorate of Sericulture, 2024).

Among these, castor has proven to be the most suitable host in terms of larval weight, cocoon weight, shell weight, and effective rearing rate (ERR). Therefore, this study utilizes castor as the host plant (Chakravaorty and Neog,2006;Singh and Das,2006;Hazarika et al.,2003). The aim of this study is to explore the potential of Eri silk production in the East Coast of Tamil Nadu, tapping into the growing demand for this eco-friendly and ethical textile. With careful planning and strategic development, ericulture has the potential to evolve into a major industry.

2. MATERIALS AND METHODS

Eight ecoraces of Eri silkworm such as Borduar, Khanapara, Mendipathar, Dhanubanga, Nongpoh, Barpathar and Titabar from Assam and Borduar and C2 race from Hosur were collected. The larvae of collected ecoraces were fed with castor variety YRCH 1 were reared throughout the year in six different periods (Table 1) by following the standard rearing method of (Debaraj et al.,2003) in Ericulture Unit, Department of Entomology, Faculty of Agriculture, Annamalai University, Chidambaram. The performance of collected ecoraces were assessed with economic parameters like total larval duration, matured larval weight, survival rate, cocoon weight, shell weight, shell ratio, ERR and grainage parameters like rate of pupation, rate of moth emergence, fecundity and hatchability (Naik et al.,2010).

The larval duration (days) was obtained by adding the duration of all the five instars in each treatment. The weight of five larvae (g) in the fifth instar fifth day was recorded by collecting the worms randomly in each treatment, and single larval weight was computed. The larval mortality was recorded and expressed in percentage. Ten cocoons were randomly selected from each treatment, and single cocoon weight (g) was computed. Five cocoons per replication were randomly picked up on the fifth day of spinning and cut open to see any mortality or malformation of the pupa. The rate of pupation (%) was recorded. After removing the pupa and larval exuviae from the cocoons, the five-shell weight (g) per replication was recorded in each treatment and a single shell weight was computed. The shell ratio (%) was calculated in each treatment, using the formula.

$$\text{Shell ratio (\%)} = \frac{Shell\ weight\ (g)}{Cocoon\ Weight(g)} \text{ X } 100$$

The rate of moth emergence (%) was recorded in each treatment. Male and female pupa were sorted out and paired, the eggs laid by the female were recorded. The eggs laid by the female were collected and incubated at optimum temperature and the hatchability was calculated by the following formula.

$$\text{Hatchability (\%)} = \frac{No.of\ eggs\ hatched}{Total\ no.of\ eggs\ by\ female} \text{ x } 100$$

The number of larvae brushed and number of cocoons harvested were taken into account for determining Effective Rearing Rate

$$\text{ERR (\%)} = \frac{No.of\ cocoon\ harvested}{No.of\ larvae\ brushed} \text{ x } 100$$

The recorded data were analyzed using technique of analysis of variance (ANOVA) and critical difference (CD) calculated at 5% for interpretation.

3. RESULTS AND DISCUSSION

The rearing performance of eight ecoraces of Eri silkworm *Samia ricini* (Donovan) namely as Borduar, Khanapara, Mendipathar, Dhanubanga, Nongpoh, Barpathar, Titabar and C2 were evaluated across various seasons shown in Tables 2 to 7. Significant differences were observed in rearing parameters including larval duration, matured larval weight, larval survival, cocoon weight, shell weight, shell ratio, effective rate of rearing (ERR), pupation rate, moth emergence rate, fecundity, and hatchability across different crops (C1 to C6).

Larval duration is considered to be an important characteristic since it lowers the total amount of food needed without affecting cocoon yield. The larval duration varied significantly among different ecoraces as well as across seasons. The shortest larval duration was recorded in the C2 ecorace, ranging from 20.43 to 21.78 days across the different crops. In contrast, the longest larval duration was observed in the Barparthar ecorace, which ranged from 26.16 to 28.32 days. The prolonged larval period in certain ecoraces could be attributed to variations in environmental conditions and genetic factors.

The matured larvae weight was significantly higher in C2 across all crops, with a maximum of 9.45g during C1 crop. This was followed by Borduar and Mendipathar, which consistently showed higher larval weights compared to the other ecoraces. The lowest matured larval weight was recorded in Barpathar, with values ranging from 4.74 to 5.30g across different crops. This parameter directly correlates with the silk yield potential, as heavier larvae tend to produce better-quality cocoons.

The shorter larval duration observed in the C2 ecorace (20.43 to 21.78 days) is consistent with the findings of Roy et al. (2016), who noted the faster development could lead to increased productivity in silkworms. The maximum mature larval weight in C2 (upto 9.45g) suggests better nutritional utilization and growth potential compared to Barpathar which had significantly lower weights (4.74g). This aligns with the work of Kaur et al. (2017), who reported that the larval weight is a crtical indicator of health and growth rate, directly influencing cocoon production.

High rate of survival implies high cocoon rate, hence it’s a crucial factor to be noted. The survival rate was maximum in C2 ranging from 86.47 to 90.85% indicating a superior adaptability of this ecorace to different environmental conditions. The lowest survival rate was recorded in Barpathar which limited to 79.18% during the C5 crop. The high survival rates recorded in C2 (upto 88.39%) further affirm its robustness, corroborating earlier studies by Mandal et al. (2021) the highlighted the importance of ecoraces selection for improving larval survival in variable environmental conditions. Conversely, the lower survival rates of Barpathar suggest a potential vulnerability to stressors, which could be linked to genetic predisposition or suboptimal rearing conditions (Dutta & Saikia,2020).

The prime product of Eri silkworm rearing is cocoon, the price of cocoon depends upon the quality, the quality indirectly governed by cocoon weight per unit and the shell weight contributes to the quantity of silk that can be obtained from cocoon. The highest cocoon and shell weights were consistently observed in C2 reaching maximum values of 3.93g and 0.600g respectively, during the C1 crop. Borduar and Mendipathar ecoraces also performed well in terms of cocoon and shell weights. However, Barpathar and Nongpoh exhibited the lowest values, with cocoon weights falling to 1.55g in Barpathar and 0.278 g for shell weight during C4. The superior cocoon weight (3.93g) and shell weight (0.600g) in the C2 suggest enhanced silk production capabalities, corroborating findings by Choudhury et al. (2020), which demonstrated a positive correlation between larval growth and cocoon yield.

The shell ratio, a key indicator of cocoon quality, was significantly higher in C2, Borduar and Mendipathar with maximum values of 12.47% observed during C1. Barpathar and Nongpoh had the lowest shell ratios, around 10% indicating lesser silk yield potential. The shell ratio of C2 (12.47%) highlights of its efficiency in silk production, further supporting the assertion by Pavan et al. (2018) than higher shell ratios are indicative of better silk quality and quantity.

Effective rearing rate (ERR) plays a key role in selecting the best ecorace. ERR followed a similar trend, with the C2 exhibiting the highest values across all crops, peaking at 84.18% during C1. Barpathar consistently showed the lowest ERR values, indicating a lower conversion efficiency of larvae into the silk producing cocoon. The high ERR in C2 (84.18%) aligns with the studies by Jha et.al. (2021), emphasizing the significance of ecoraces selection in achieving optimal rearing efficiency. The lowest ERR in Barpathar (72.65%) indicates challenges in rearing this ecoraces, possibly due to lower larval survival and growth rate, which align with the research indicating that low ERR results from pooe larval performance Choudhury et al. (2022).

As the Eri pupae rich in protein source, its consumed by tribes of Northern States of India. Moth emergence is a crucial stage in silkworm rearing because it marks the transition from the larval to the reproductive stage of the silkworm life cycle. The highest rate of pupation and moth emergence was noticed in C2 with 95.30% and 96.02% respectively during the C1 crop. In contrast Barpathar and Nongpoh exhibited the lowest pupation rates, suggesting lower vitality and potential reproductive success in these ecoraces. The enhanced rates of pupation (95.30%) and moth emergence (96.02%) in the C2 ecorace are critical for successful silk production. Studies by Saha et al. (2019) suggest that successful pupation and emergence are heavily influenced by larval health and nutrition, which C2 seems to optimize effectively compared to Barparthar.

Fecundity directly impacts the number of eggs produced by the female moth, which in turn influences the scale of silk production later on. It was highest in C2 ecorace, with a maximum of 325.63 eggs recorded during the C1 crop. Hatchability ensures that a larger percentage of eggs develop into healthy silkworm larvae, which is essential for maintaining a steady supply of silkworms for silk production. It was notably high in C2 and Borduar ecoraces reaching upto 95.1% during C6, indicating high reproductive potential. Barpathar and Nongpoh displayed significantly lower fecundity and hatchability, dropping to 267.73 eggs and 88.36% respectively.

The fecundity of C2 being significantly higher than Barpathar (267.73 eggs) supports the finding of Shikha et al. (2020) who found that high egg production is often associated with the healthy moths from robust ecoraces. The hatchability of C2(97.72%) compared to Barpathar (92.73%) further indicate the reproductive advantages of the C2 strain, supporting the research of Kumari et al. (2018), which emphasizes the importance of genetic factors in hatchability.

Table 1. Meteorological data recorded at different crops

Crops	Periods	Temperature (^{0}C)	Relative Humidity (%)
C1	January- February	24.10	73.50
C2	March - April	27.85	73.50
C3	May- June	30.40	66.00
C4	July- August	29.20	69.50
C5	September- October	28.78	69.50
C6	November- December	25.08	85.00

Table 2. Rearing performance of Eri Silkworm *Samia ricini* (Donovan) during crop C1 (January-February)

Ecoraces	Larval Duration	Matured larval weight	Larval Survival	Cocoon weight	Shell weight	Shell ratio	ERR	Rate of pupation	Rate of moth Emergence	Fecundity	Hatchability
C2	21.56±0.14^{a}	9.45±0.11^{a}	90.85±0.14^{a}	3.93±0.06^{a}	0.600±0.01^{a}	12.47±0.20^{a}	84.18±0.14^{a}	95.3±0.14^{a}	98.1±0.09^{a}	331.01±1.52^{a}	97.72±0.14^{a}
Borduar	23.01±0.14^{b}	8.89±0.14^{b}	89.91±0.14^{b}	3.68±0.06^{b}	0.565±0.01^{b}	11.76±0.20^{b}	83.49±0.14^{b}	93.96±0.14^{b}	96.76±0.09^{b}	325.34±1.33^{b}	97.16±0.14^{b}
Titabar	24.95±0.14^{d}	7.49±0.11^{d}	87.55±0.14^{d}	3.09±0.11^{d}	0.493±0.02^{d}	10.32±0.37^{d}	82.05±0.14^{d}	91.74±0.14^{d}	94.94±0.09^{d}	311.6±1.12^{d}	96.2±0.15^{d}
Dhanubanga	26.02±0.15^{e}	6.45±0.17^{e}	86.05±0.14^{e}	2.76±0.07^{e}	0.458±0.01^{e}	9.59±0.25^{e}	81.47±0.14^{e}	90.6±0.14^{e}	93.01±0.09^{e}	302.63±1.8^{e}	94.27±0.14^{e}
Khanapara	25.91±0.14^{e}	6.75±0.07^{e}	86.28±0.09^{e}	2.86±0.03^{e}	0.460±0.01^{e}	9.61±0.01^{e}	81.52±0.14^{e}	90.9±0.14^{e}	93.06±0.09^{e}	296.28±1.74^{e}	94.64±0.15^{e}
Mendipathar	24.09±0.14^{c}	7.96±0.26^{c}	88.86±0.74^{c}	3.35±0.05^{c}	0.529±0.01^{c}	11.02±0.17^{c}	82.97±0.14^{c}	93.4±0.14^{c}	95.68±0.09^{c}	319.94±1.45^{c}	96.64±0.15^{c}
Nongpoh	26.99±0.15^{f}	6.00±0.24^{f}	85.39±0.28^{f}	2.52±0.08^{f}	0.355±0.01^{f}	8.85±0.28^{f}	80.36±0.14^{f}	89.54±0.14^{f}	90.77±0.09^{f}	302.82±2.4^{f}	93.4±0.14^{f}
Barpathar	28.32±0.14^{g}	5.39±0.11^{g}	84.95±0.14^{g}	2.20±0.05^{g}	0.319±0.01^{g}	8.12±0.18^{g}	79.23±0.14^{g}	87.86±0.14^{g}	89.16±0.09^{g}	287.16±1.84^{g}	92.73±0.14^{g}
SE(m)	0.144	0.156	0.537	0.068	0.011	0.228	0.144	0.144	0.087	1.689	0.145
SE(d)	0.204	0.220	0.759	0.096	0.015	0.323	0.204	0.204	0.124	2.389	0.205
CD(0.05%)	0.437	0.471	0.409	0.206	0.032	0.690	0.436	0.436	0.265	5.109	0.438

Table 3. Rearing performance of Eri Silkworm *Samia ricini* (Donovan) during crop C2 (March-April)

Ecoraces	Larval Duration	Matured larval weight	Larval Survival	Cocoon weight	Shell weight	Shell ratio	ERR	Rate of pupation	Rate of moth Emergence	Fecundity	Hatchability
C2	20.51±0.14^{a}	9.15±0.14^{a}	88.29±0.14^{a}	3.82±0.06^{a}	0.586±0.01^{a}	12.15±0.18^{a}	81.68±0.14^{a}	92.56±0.14^{a}	95.25±0.14^{a}	322.13±1.52^{a}	94.86±0.14^{a}
Borduar	21.53±0.14^{b}	8.68±0.13^{b}	87.64±0.15^{b}	3.59±0.06^{b}	0.553±0.01^{b}	11.83±0.17^{b}	81.06±0.14^{b}	91.12±0.14^{b}	93.93±0.14^{b}	316.36±1.33^{b}	94.34±0.14^{b}
Titabar	22.24±0.14^{d}	7.27±0.26^{d}	85.78±0.14^{d}	2.99±0.11^{d}	0.486±0.02^{d}	11.56±0.34^{d}	79.98±0.14^{d}	89.46±0.14^{d}	91.96±0.14^{d}	303.71±1.12^{d}	93.06±0.14^{d}
Dhanubanga	23.51±0.14^{e}	6.23±0.16^{e}	84.36±0.14^{e}	2.68±0.07^{e}	0.444±0.01^{e}	10.88±0.23^{e}	78.83±0.14^{e}	88.13±0.14^{e}	89.95±0.14^{e}	293.73±1.8^{e}	92.44±0.14^{e}
Khanapara	24.11±0.14^{e}	6.53±0.07^{e}	84.36±0.14^{e}	2.72±0.03^{e}	0.455±0.01^{e}	10.98±0.09^{e}	79.11±0.14^{e}	88.42±0.14^{e}	90.2±0.14^{e}	296.52±1.74^{e}	92.60±0.14^{e}
Mendipathar	24.47±0.14^{c}	7.79±0.12^{c}	86.37±0.14^{c}	3.26±0.05^{c}	0.519±0.01^{c}	11.63±0.16^{c}	80.57±0.14^{c}	90.56±0.14^{c}	93.24±0.14^{c}	310.5±1.45^{c}	93.56±0.14^{c}
Nongpoh	25.91±0.15^{f}	5.65±0.18^{f}	83.51±0.14^{f}	2.38±0.08^{f}	0.337±0.01^{f}	10.45±0.26^{f}	77.73±0.14^{f}	87.33±0.15^{f}	87.82±0.14^{f}	285.45±2.4^{f}	91.90±0.14^{f}
Barpathar	26.42±0.14^{g}	5.20±0.10^{g}	82.84±0.14^{g}	2.16±0.05^{g}	0.302±0.01^{g}	10.34±0.15^{g}	77.25±0.14^{g}	86.79±0.14^{g}	87.22±0.14^{g}	279.55±1.84^{g}	91.26±0.14^{g}
SE(m)	0.144	0.156	0.145	0.068	0.010	0.228	0.145	0.144	0.144	1.689	0.144
SE(d)	0.204	0.220	0.204	0.096	0.013	0.323	0.204	0.204	0.203	2.389	0.204
CD(0.05%)	0.436	0.471	0.437	0.206	0.031	0.690	0.437	0.436	0.435	5.109	0.436

Table 4. Rearing performance of Eri Silkworm *Samia ricini* (Donovan) during crop C3 (May-June)

Ecoraces	Larval Duration	Matured larval weight	Larval Survival	Cocoon weight	Shell weight	Shell ratio	ERR	Rate of pupation	Rate of moth Emergence	Fecundity	Hatchability
C2	20.43±0.14^{a}	8.99±0.14^{a}	86.47±0.14^{a}	3.71±0.06^{a}	0.568±0.01^{a}	11.87±0.18^{a}	80.1±0.14^{a}	90.67±0.14^{a}	93.34±0.14^{a}	315.62±1.21^{a}	92.97±0.14^{a}
Borduar	21.38±0.14^{b}	8.36±0.13^{b}	85.54±0.14^{b}	3.48±0.06^{b}	0.538±0.01^{b}	11.57±0.16^{b}	79.24±0.14^{b}	89.4±0.14^{b}	92.06±0.14^{b}	309.49±1.13^{b}	92.44±0.14^{b}
Titabar	23.28±0.14^{d}	6.63±0.24^{d}	82.75±0.14^{d}	2.72±0.11^{d}	0.446±0.02^{d}	11.11±0.34^{d}	77.15±0.14^{d}	82.72±0.14^{d}	88.07±0.14^{d}	279.62±1.16^{d}	90.86±0.14^{d}
Dhanubanga	24.54±0.14^{e}	5.86±0.15^{e}	81.45±0.14^{e}	2.52±0.07^{e}	0.408±0.01^{e}	10.25±0.23^{e}	74.15±0.14^{e}	83.03±0.15^{e}	86.65±0.14^{e}	276.43±1.12^{e}	89.51±0.14^{e}
Khanapara	24.35±0.14^{e}	6.06±0.06^{e}	81.86±0.14^{e}	2.51±0.03^{e}	0.412±0.01^{e}	10.65±0.09^{e}	74.64±0.14^{e}	86.14±0.14^{e}	86.97±0.14^{e}	288.62±1.28^{e}	89.86±0.14^{e}
Mendipathar	22.45±0.14^{c}	7.59±0.12^{c}	83.56±0.14^{c}	3.10±0.05^{c}	0.496±0.01^{c}	11.16±0.16^{c}	77.95±0.14^{c}	87.24±0.14^{c}	89.85±0.14^{c}	299.48±1.16^{c}	91.86±0.14^{c}
Nongpoh	25.03±0.14^{f}	5.35±0.17^{f}	80.22±0.14^{f}	2.26±0.08^{f}	0.311±0.01^{f}	9.93±0.25^{f}	73.42±0.14^{f}	82.04±0.14^{f}	85.34±0.14^{f}	271.37±0.97^{f}	88.3±0.14^{f}
Barpathar	26.16±0.14^{g}	4.74±0.10^{g}	79.18±0.14^{g}	2.05±0.05^{g}	0.280±0.01^{g}	9.95±0.15^{g}	72.65±0.14^{g}	81.06±0.14^{g}	84.1±0.14^{g}	267.73±1.32^{g}	88.36±0.14^{g}
SE(m)	0.144	0.147	0.146	0.061	0.010	0.211	0.144	0.144	0.145	1.167	0.144
SE(d)	0.204	0.207	0.207	0.087	0.013	0.298	0.204	0.204	0.204	1.650	0.204
CD(0.05%)	0.436	0.443	0.443	0.185	0.029	0.634	0.436	0.436	0.437	3.528	0.271

Table 5. Rearing performance of Eri Silkworm *Samia ricini* (Donovan) during crop C4 (July-August)

Ecoraces	Larval Duration	Matured larval weight	Larval Survival	Cocoon weight	Shell weight	Shell ratio	ERR	Rate of pupation	Rate of moth Emergence	Fecundity	Hatchability
C2	21.72±0.14^{a}	9.08±0.14^{a}	87.35±0.14^{a}	3.74±0.06^{a}	0.574±0.01^{a}	11.98±0.18^{a}	80.91±0.14^{a}	91.59±0.14^{a}	94.46±0.14^{a}	318.43±1.11^{a}	93.92±0.14^{a}
Borduar	22.88±0.14^{b}	8.45±0.13^{b}	86.39±0.15^{b}	3.50±0.05^{b}	0.539±0.01^{b}	11.69±0.17^{b}	80.25±0.14^{b}	90.31±0.14^{b}	93.25±0.14^{b}	312.66±1.15^{b}	93.46±0.14^{b}
Titabar	24.59±0.14^{d}	6.82±0.26^{d}	84.98±0.14^{d}	2.73±0.10^{d}	0.472±0.02^{d}	11.25±0.35^{d}	79.12±0.14^{d}	88.41±0.14^{d}	91.36±0.14^{d}	298.5±1.23^{d}	92.15±0.14^{d}
Dhanubanga	25.51±0.14^{e}	5.91±0.16^{e}	84.01±0.14^{e}	2.28±0.70^{e}	0.434±0.01^{e}	10.62±0.23^{e}	78.29±0.14^{e}	86.71±0.14^{e}	89.72±0.14^{e}	289.66±1.03^{e}	91.5±0.14^{e}
Khanapara	25.53±0.14^{e}	6.49±0.06^{e}	84.2±0.14^{e}	2.34±0.03^{e}	0.441±0.01^{e}	10.74±0.09^{e}	78.52±0.14^{e}	86.87±0.14^{e}	89.8±0.14^{e}	292.36±1.25^{e}	91.45±0.15^{e}
Mendipathar	23.97±0.14^{c}	7.69±0.12^{c}	85.91±0.14^{c}	3.13±0.05^{c}	0.504±0.01^{c}	11.38±0.16^{c}	79.67±0.14^{c}	89.23±0.14^{c}	92.64±0.14^{c}	307.74±1.14^{c}	91.9±0.14^{c}
Nongpoh	26.06±0.14^{f}	5.38±0.18^{f}	82.56±0.14^{f}	1.98±0.07^{f}	0.314±0.01^{f}	10.31±0.26^{f}	76.92±0.14^{f}	85.5±0.14^{f}	87.02±0.14^{f}	282.43±1.18^{f}	90.47±0.14^{f}
Barpathar	26.73±0.14^{g}	4.95±0.10^{g}	82.03±0.14^{g}	1.55±0.04^{g}	0.278±0.01^{g}	10.09±0.15^{g}	75.52±0.14^{g}	84.85±0.14^{g}	86.58±0.14^{g}	276.48±1.22^{g}	89.65±0.14^{g}
SE(m)	0.144	0.149	0.145	0.061	0.010	0.210	0.144	0.144	0.144	1.099	0.436
SE(d)	0.204	0.211	0.205	0.092	0.014	0.297	0.204	0.204	0.204	1.555	0.204
CD(0.05%)	0.436	0.452	0.438	0.185	0.030	0.634	0.436	0.436	0.436	3.324	0.436

Table 6. Rearing performance of Eri Silkworm *Samia ricini* (Donovan) during crop C5 (September-October)

Ecoraces	Larval Duration	Matured larval weight	Larval Survival	Cocoon weight	Shell weight	Shell ratio	ERR	Rate of pupation	Rate of Moth Emergence	Fecundity	Hatchability
C2	21.78±0.14^{a}	9.15±0.14^{a}	88.05±0.14^{a}	3.78±0.06^{a}	0.575±0.01^{a}	11.99±0.18^{a}	81.58±0.14^{a}	92.02±0.14^{a}	94.46±0.14^{a}	319.5±1.15^{a}	94.65±0.14^{a}
Borduar	22.34±0.14^{b}	8.52±0.13^{b}	86.42±0.14^{b}	3.53±0.06^{b}	0.545±0.01^{b}	11.7±0.17^{b}	80.78±0.14^{b}	90.89±0.15^{b}	93.25±0.14^{b}	314.26±0.84^{b}	94.01±0.14^{b}
Titabar	24.83±0.14^{d}	7.11±0.26^{d}	84.12±0.14^{d}	2.98±0.11^{d}	0.475±0.01^{d}	11.34±0.35^{d}	79.39±0.14^{d}	88.98±0.14^{d}	91.36±0.14^{d}	301.72±1.12^{d}	92.75±0.14^{d}
Dhanubanga	25.97±0.14^{e}	6.15±0.16^{e}	83.14±0.14^{e}	2.63±0.07^{e}	0.431±0.01^{e}	10.74±0.23^{e}	77.88±0.14^{e}	87.61±0.14^{e}	89.72±0.14^{e}	291.62±1.10^{e}	91.89±0.15^{e}
Khanapara	25.74±0.14^{e}	6.11±0.06^{e}	83.43±0.14^{e}	2.69±0.03^{e}	0.438±0.01^{e}	10.87±0.09^{e}	78.08±0.14^{e}	87.9±0.14^{e}	89.8±0.14^{e}	294.59±1.12^{e}	92.25±0.14^{e}
Mendipathar	23.22±0.14^{c}	7.73±0.12^{c}	85.13±0.14^{c}	3.23±0.05^{c}	0.507±0.01^{c}	11.5±0.16^{c}	80.03±0.14^{c}	90.04±0.14^{c}	92.64±0.15^{c}	309.64±1.19^{c}	93.24±0.14^{c}
Nongpoh	26.42±0.14^{f}	5.60±0.18^{f}	82.1±0.14^{f}	2.36±0.08^{f}	0.327±0.01^{f}	10.35±0.25^{f}	77.42±0.14^{f}	85.85±0.14^{f}	87.02±0.14^{f}	283.6±1.27^{f}	90.65±0.14^{f}
Barpathar	26.97±0.14^{g}	5.12±0.10^{g}	81.56±0.4^{g}	2.15±0.05^{g}	0.294±0.01^{g}	10.16±0.15^{g}	77.0±0.14^{g}	85.27±0.14^{g}	86.58±0.15^{g}	279.63±0.95^{g}	89.78±0.14^{g}
SE(m)	0.144	0.154	0.144	0.065	0.005	0.212	0.144	0.144	0.144	1.079	0.440
SE(d)	0.204	0.218	0.204	0.092	0.006	0.299	0.204	0.203	0.204	1.526	0.206
CD(0.05%)	0.436	0.466	0.435	0.197	0.014	0.640	0.436	0.435	0.436	3.262	0.440

Table 7. Rearing performance of Eri Silkworm *Samia ricini* (Donovan) during crop C6 (November-December)

Ecoraces	Larval Duration	Matured larval weight	Larval Survival	Cocoon weight	Shell weight	Shell ratio	ERR	Rate of pupation	Rate of moth Emergence	Fecundity	Hatchability
C2	21.44±0.14^{a}	9.21±0.14^{a}	88.39±0.14^{a}	3.93±0.06^{a}	0.595±0.01^{a}	12.25±0.19^{a}	81.94±0.14^{a}	92.98±0.14^{a}	96.02±0.14^{a}	325.63±1.23^{a}	95.1±0.14^{a}
Borduar	22.35±0.14^{b}	8.84±0.13^{b}	87.84±0.14^{b}	3.64±0.06^{b}	0.562±0.01^{b}	11.9±0.17^{b}	81.34±0.14^{b}	91.65±0.14^{b}	94.65±0.14^{b}	317.223±0.66^{b}	94.63±0.14^{b}
Titabar	24.39±0.14^{d}	7.47±0.27^{d}	86.81±0.14^{d}	3.08±0.11^{d}	0.496±0.02^{d}	11.74±0.35^{d}	80.16±0.14^{d}	89.73±0.14^{d}	93.06±0.14^{d}	306.56±1.19^{d}	92.1±0.14^{d}
Dhanubanga	25.24±0.14^{e}	6.42±0.17^{e}	86.03±0.14^{e}	2.75±0.07^{e}	0.456±0.01^{e}	10.91±0.23^{e}	79.36±0.14^{e}	88.57±0.14^{e}	90.98±0.14^{e}	293.63±1.12^{e}	91.39±0.15^{e}
Khanapara	24.99±0.14^{e}	6.68±0.07^{e}	86.28±0.14^{e}	2.74±0.03^{e}	0.455±0.01^{e}	10.98±0.09^{e}	79.72±0.14^{e}	88.78±0.14^{e}	90.77±0.14^{e}	296.58±1.08^{e}	91.64±0.15^{e}
Mendipathar	23.22±0.14^{c}	7.89±0.12^{c}	87.25±0.14^{c}	3.29±0.05^{c}	0.528±0.01^{c}	11.65±0.16^{c}	80.86±0.14^{c}	90.84±0.14^{c}	93.56±0.14^{c}	312.15±1.08^{c}	93.64±0.15^{e}
Nongpoh	26.21±0.14^{f}	5.98±0.19^{f}	83.56±0.14^{f}	2.47±0.07^{f}	0.350±0.01^{f}	10.59±0.26^{f}	78.56±0.14^{f}	86.9±0.14^{f}	88.53±0.14^{f}	289.5±1.03^{f}	90.13±0.14^{f}
Barpathar	27.51±0.14^{g}	5.30±0.11^{g}	82.75±0.14^{g}	2.17±0.05^{g}	0.315±0.01^{g}	10.35±0.15^{g}	77.69±0.14^{g}	86.15±0.14^{g}	87.43±0.14^{g}	282.58±1.14^{g}	89.45±0.15^{f}
SE(m)	0.144	0.160	0.145	0.065	0.011	0.215	0.144	0.144	0.144	1.079	0.146
SE(d)	0.204	0.226	0.204	0.092	0.015	0.304	0.204	0.204	0.204	1.526	0.206
CD(0.05%)	0.436	0.483	0.437	0.197	0.032	0.649	0.436	0.436	0.436	3.324	0.440

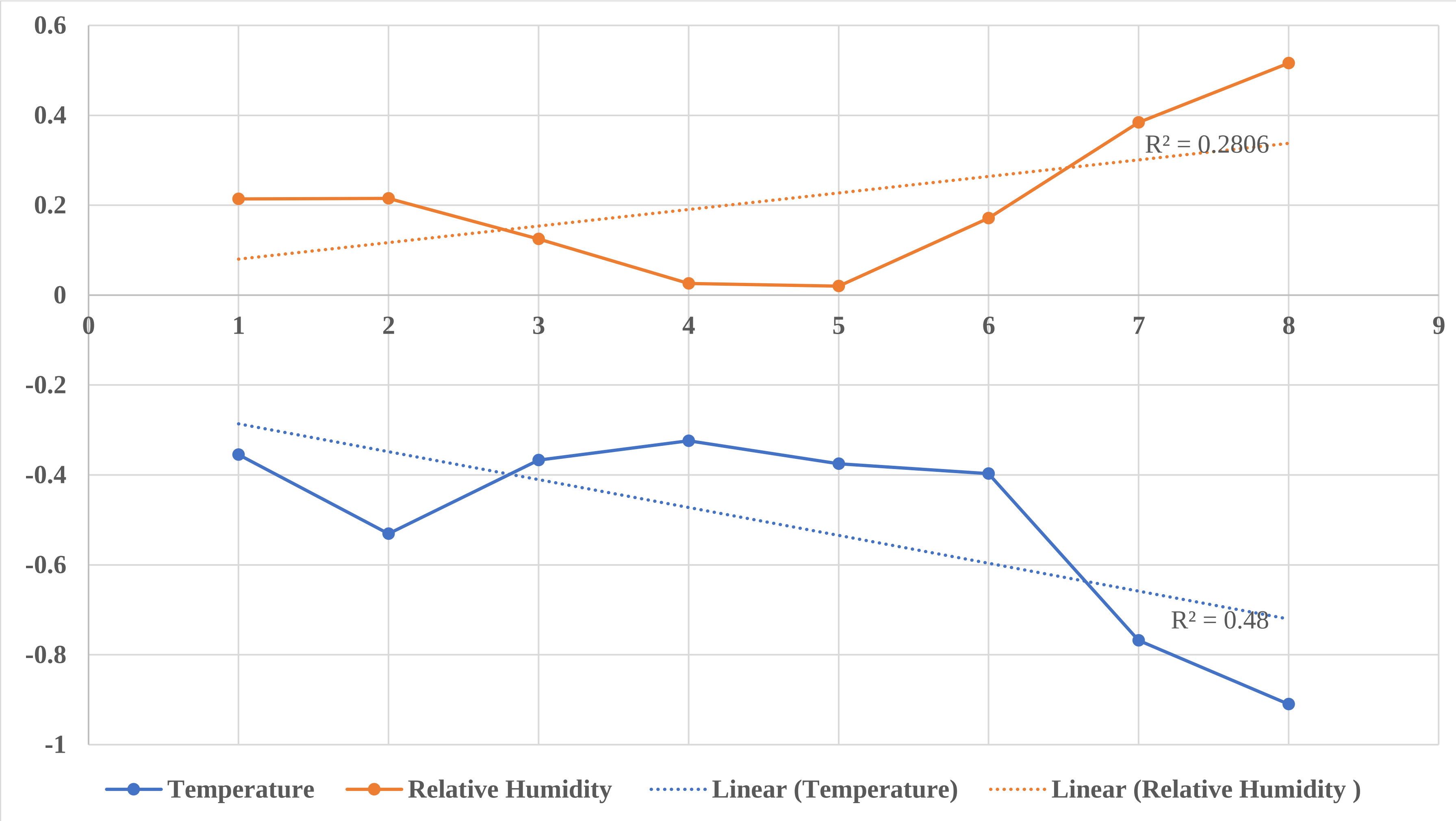

Fig. 1. Correlation between temperature and relative humidity with larval duration of Eri silkworm, Samia ricini (Donovan) throughout the year i.e. in six crops (C1-C6)

Coefficient of correlation between temperature and relative humidity with larval duration of eight ecoraces were calculated and found strong negative correlation with temperature and positive correlation with relative humidity presented in Fig. 1. It revealed than an average temperature 24.10^0 C and relative humidity 73.5% during C1 showing short larval duration of Eri silkworm helps in maturing larvae in short period of time.

The results show a consistent negative correlation between temperature and the ecoraces performance, with higher temperature impairing performance across all ecoraces studied. Barpathar showed strongest negative correlation (r=-0.91), indicating severe impairment in performance due to increased temperatures, which aligns with studies showing temperature stress adversely impacts physiological followed by Nongpoh and Borduar, while Dhanubanga exhibited the weakest (r=-0.324), indicating greater tolerance. In contrast, relative humidity had a generally positive impact, enhancing performance, especially in Barpathar (r=0.516), Nongpoh, and Borduar, while Khanapara and Dhanubanga showed minimal sensitivity to RH. These finding highlights the need to manage both temperature and humidity to optimize performance in sensitive ecoraces like Barpathar and Nongpoh.

There was a clear seasonal variation observed in the rearing performance. Generally, crops reared during C1 and C6 (colder season) exhibited higher cocoon and shell weights, improved survival rate, and better overall performance compared to those reared in C3 and C4(warmer season). This could be attributed to favourable environmental conditions such as lower temperature and humidity levels during the colder season, which enhance rearing performance.

4. CONCLUSION

This study highlights the significant variations in the performance of eight Eri silkworm ecoraces *Samia ricini* (Donovan) under different seasonal conditions, revealing important insights into their rearing potential. The C2 ecorace consistently outperformed others across multiple parameters, including larval duration, survival rate, cocoon weight, shell weight, and effective rearing rate (ERR). Its shorter larval period, higher cocoon quality, and better adaptability to varying environmental conditions make it a prime candidate for commercial Eri silk production, especially in regions with favourable temperature and humidity. In contrast, the Barpathar and Nongpoh ecoraces exhibited lower performance metrics, particularly in warmer seasons, suggesting potential vulnerability to environmental stressors such as high temperatures.

The findings underscore the importance of selecting robust ecoraces like C2, which demonstrate high fecundity, hatchability and silk yield potential, to optimize silk production. Additionally, the strong correlation between environmental factors and rearing success emphasizes the need for careful management of temperature and humidity to improve silkworm rearing outcomes. The potential for expanding Eri silk production, particularly in non- traditional areas like Tamil Nadu, can be realizes through strategic cultivation and ecorace selection, thereby contributing to the sustainable and ethical growth of the sericulture industry.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the financial support provided by the Department of Science and Technology (DST), Government of India, under the INSPIRE Fellowship scheme. This support has been instrumental in conducting the research presented in this paper.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
https://prh.mbimph.com/review-history/4149