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Impact of Seasonal Variations on Cocoon Yield and its Attributed Traits of Eri Silkworm (*Samia ricini*, Donovan)

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ABSTRACT: Eri silkworm, *Samia ricini* (Donovan), is a domesticated multivoltine non-mulberry silk insect. The silkworm has been exploited commercially for its silk since time immemorial. Therefore, ericulture is an ideal subsidiary occupation in a country like India, providing supplementary income to a large number of rural hilly and tribal populations. Investigations had been conducted to learn the influence of seasonal variation on the growth, survival, and reproductive performance of eri silkworm (*Samia ricini*) eco-races to optimize sericulture productivity. Six eri silkworm eco-races (Borduar, Dhanubhanga, Genang, Khanapara, Nongpoh, and Titabar) were evaluated across four seasons (March-April, April-May, June-July and August-September) for key traits including larval weight, single cocoon weight (SCW), single shell weight (SSW), shell percentage, effective rate of rearing (ERR), pupation rate, fecundity and hatching percentage. The results demonstrated significant seasonal variations, with April-May and August-September being the most favourable for larval growth, while June-July provided optimal conditions for cocoon production. Genang and Titabar emerged as the most productive eco-races in terms of cocoon traits, while Khanapara and Nongpoh displayed the highest pupation and survival rates. Reproductive parameters such as fecundity and hatching percentage were also influenced by seasonal fluctuations, with peak values recorded in March-April and August-September. This study underscores the importance of season-specific eco-race selection and adaptive rearing strategies, including controlled environmental conditions, to enhance silk productivity. These findings provide valuable insights for sustainable eri silkworm farming and suggest future research directions for genetic and environmental optimization.

Keywords: Eri silkworm, seasonal variation, eco-race, effective rate of rearing, non-mulberry, domesticated.

INTRODUCTION

Eri silkworm (*Samia ricini*) is an important non-mulberry silk-producing species, primarily reared in India and other tropical regions. Ericulture is an age-old tradition and culture of weaker sections of the society particularly in NE India. Eri silkworms require comparatively minimum care as they are easy to handle (Chutia *et al.*, 2014) but the productivity and economic viability of eri sericulture largely depend on environmental factors such as temperature, humidity and seasonal fluctuations, which influence the growth, survival, and reproductive performance of different eco-races (Kumar and Elangovan 2014; Halagundegowda *et al.*, 2023). Shifa *et al.* (2015) also mentioned the importance of selection and utilization of the best suited strains of eri silkworm race that adapt to the varied ecological condition will help in increasing their productivity. Understanding these influences is critical for optimizing eri silk production and ensuring stable cocoon yield and fibre quality throughout the year.

Several studies have reported seasonal impacts on eri silkworm growth and cocoon yield, highlighting that different eco-races exhibit varying degrees of adaptability to climatic conditions (Swathiga *et al.*, 2019; Debaraj *et al.*, 2003; Sarmah *et al.*, 2012). However, comprehensive studies evaluating multiple eco-races across different seasons remain limited. This study aims to analyze the seasonal performance of six eri silkworm eco-races (Borduar, Dhanubhanga, Genang, Khanapara, Nongpoh, and Titabar) across four seasons (March-April, April-May, June-July and August-September). Key biological and economic traits, including larval weight, single cocoon weight (SCW), single shell weight (SSW), shell percentage, effective rate of rearing (ERR), pupation rate,

fecundity, and hatching percentage, were assessed to determine the most suitable eco-races for commercial rearing under varying seasonal conditions.

The findings of this study will contribute to the development of season-specific rearing strategies and eco-race selection programs to enhance eri silk production. Additionally, the results will provide insights into potential adaptive measures, such as controlled environmental conditions, for sustaining year-round sericulture and mitigating productivity losses due to adverse climatic conditions.

MATERIALS AND METHOD

The present investigation was conducted during the year 2021-22. Experiments were carried out in the well-equipped rearing room at Regional Sericultural Research Station (RSRS), Central Silk Board, Imphal, Manipur. The disease free layings (dfl)/eggs of six different eco-races of eri silkworm *viz*., Dhanubhanga, Genang, Nongpoh, Khanapara, Titabor and Borduar were collected from the stock maintained at RSRS, Imphal. The six different eco-races of eri silkworm were reared in four different seasons *viz.*, early spring (March-April), spring (April-May), summer (June-July) and early autumn (August- September) under the climatic conditions of Manipur. Eri silkworm larvae were reared on castor leaves under optimal environmental conditions as per the practices suggested earlier by Sarkar *et al.* (2015). Three replications of 100 larvae for each of the six eco-races were kept separately by using Completely Randomized Design (CRD). The rearing performances of different eco-races of eri silkworm was analyzed based on rearing parameters like hatching percentage (%), larval duration (d), weight of full grown larvae (g) and spinning larvae (g), cocoon yield (by number and weight), single cocoon weight (g), shell weight (g), shell ratio (%), effective rate of rearing (EER %), pupal period (d), pupal weight (g), pupation rate (%) following Krishnaswami *et al.* (1972); Singh *et al*. (1993); Debaraj *et al*. (2001).

RESULTS AND DISCUSSION

The bar plot illustrates (Fig. 1) the larval weight, Single Cocoon Weight, Single Shell Weight and Shell Percentage of six eri silkworm ecoraces across four different seasons. The highest larval weight is observed in April-May (11.49 g) and August-September (11.55 g), indicating that these seasons provide optimal environmental conditions for larval growth. The March-April season consistently shows lower larval weight (6.54 g), suggesting that the temperature and humidity during this period might not be favorable for growth. Khanapara and Titabar ecoraces exhibited the highest larval weight, particularly in the April-May and August-September seasons. The differences in larval weight across seasons indicate a significant genotype-environment interaction, which aligns with studies on the seasonal adaptability of eri silkworm strains (Baruah, 2012; Pallavi, 2018). June-July showed the highest cocoon weight, shell weight, indicating that this season provides optimal environmental conditions for better silk shell development unlike trends were reported by Wankhade *et al*. (2014). Genang and Titabar ecoraces exhibited the highest to moderate performance (3.99 g) for both these traits, showing stable shell weights across different seasons. The overall effective rearing rate is consistently high across all ecoraces and seasons, ranging from approximately 75% to 95%. This suggests that eri silkworms exhibit good adaptability and survival under varying seasonal conditions. March-April showed slightly lower rearing rates, suggesting possible environmental stressors affecting silkworm growth. Across all ecoraces and seasons, the pupation rate remains consistently high, close to 100%, indicating excellent larval health and environmental adaptation. The minimal fluctuation across seasons suggests that environmental factors have a limited impact on pupation success in these ecoraces (Mandali and Narayanamma 2015). June-July shows slightly higher pupation rates in most ecoraces, which could indicate that warm and humid conditions favor successful pupation. Fecundity, a key trait influencing silkworm egg production and overall breeding success, varied across the six eri silkworm ecoraces. The highest fecundity was recorded in the March-April (482) season along with August-September (474) season, particularly in Titabar and Genang, indicating favorable climatic conditions for egg-laying during this period. Overall, hatching percentage remained consistently high across all ecoraces and seasons, with values generally exceeding 85%. March-April and June-July seasons exhibited the highest hatching percentages, indicating favorable environmental conditions for egg incubation during these periods (Swathiga *et al.,* 2019). Similar trends were reported by Siddiqui *et al*. (2000) who found that summer heat stress affects egg diapause and hatching success in different strains. This finding suggests that genotype-environment interaction plays a crucial role in ERR (%). Previous studies have also highlighted that optimal temperature (25°C) and humidity (70% RH) significantly enhance cocoon production in silkworms with higher silk gland, larval, shell, and cocoon weight (Rahmathulla & Hiromani 2013). August-September showed a slightly lower hatching percentage, particularly in Borduar and Dhanubhanga, suggesting some seasonal constraints. Among ecoraces, Genang and Khanapara demonstrated the highest hatching percentages across all seasons, indicating superior egg viability and adaptation.

CONCLUSIONS

This study highlights the significant impact of seasonal variation on the growth, survival, and reproductive performance of eri silkworm ecoraces, emphasizing the importance of selecting the right ecoraces for the right season to maximize productivity. The findings indicate that April-May and August-September are the most favourable seasons for larval growth, while June-July provides optimal conditions for cocoon formation. Among the studied ecoraces, Genang and Titabar were identified as the best performers in terms of cocoon traits, whereas Khanapara and Nongpoh demonstrated the highest pupation and survival rates.

Overall, the results emphasize the potential of season-specific ecoraces selection and environmental control strategies to enhance the economic viability and sustainability of eri sericulture. These findings provide a valuable framework for improving silkworm breeding programs and large-scale eri silk production, ensuring year-round productivity and economic gains for farmers.

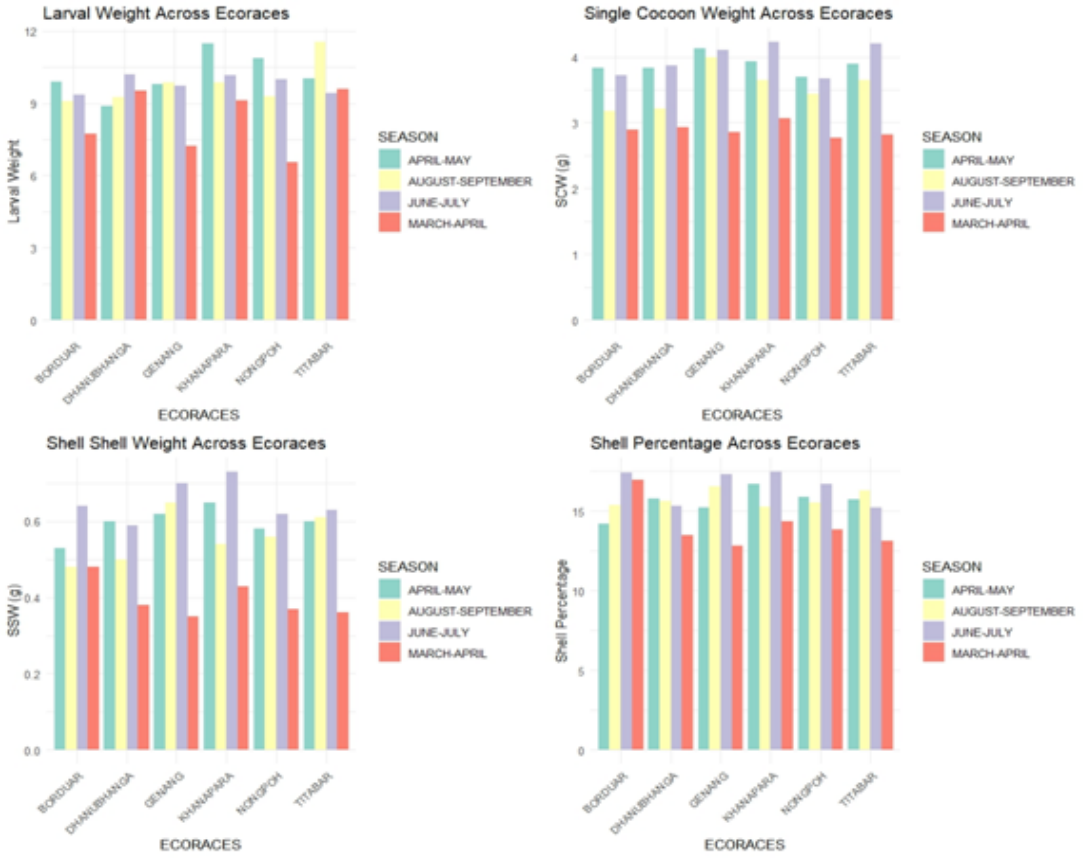

Fig. 1. Seasonal variation in traits of Larval weight, SCW, SSW, and Shell Percentage across six different ecoraces.

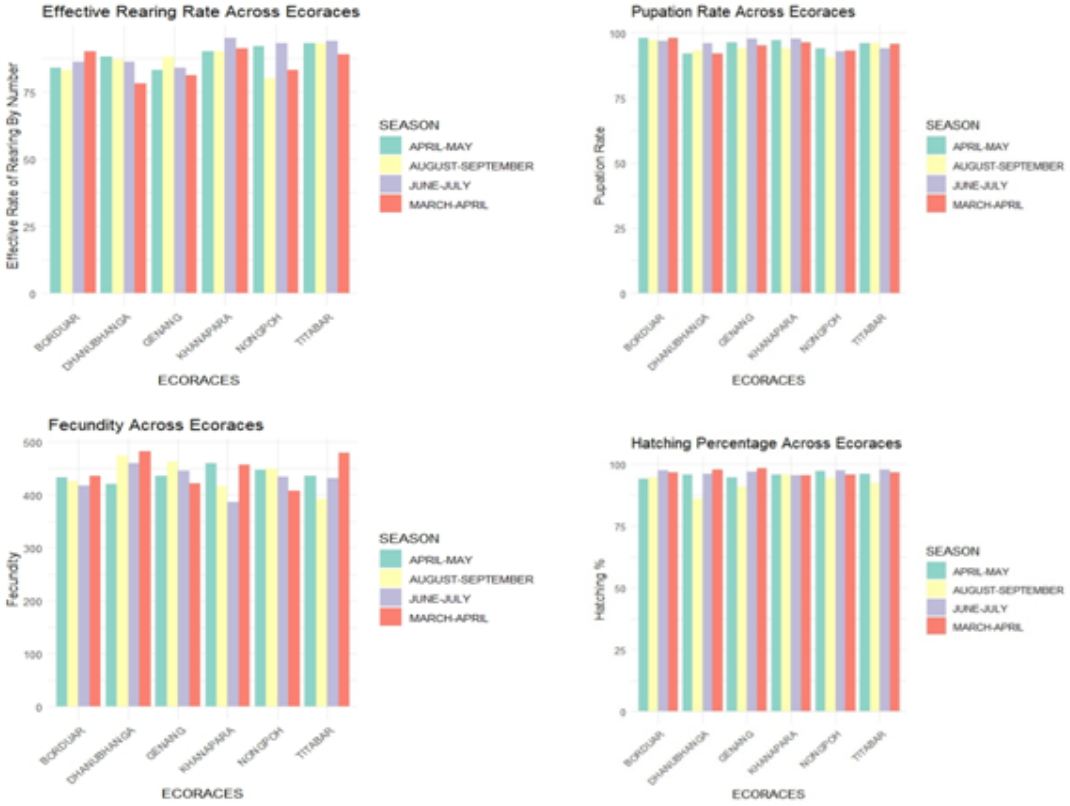

Fig. 2. Effects of Seasonal variation in traits of ERR, Pupation rate, Fecundity, and Hatching %.

Table 1: Descriptive Statistics of Quantitative Traits in Eri Silkworm Across Different Seasons.

Eco-Races	Season	LW (g)	SCW (g)	SSW (g)	SR (%)	ERR (%)	PR (%)	FEC (no.)	HA (%)
Dhanubhanga	Early Spring (March-April)	9.51	2.93	0.38	13.45	78	91.9	482	97.85
Genang		7.22	2.86	0.35	12.81	81	95.11	422	98.36
Nongpoh		6.54	2.77	0.37	13.83	83	93.08	408	95.69
Khanapara		9.12	3.07	0.43	14.32	91	96.21	456	95.63
Titabar		9.6	2.82	0.36	13.1	89	95.63	479	96.69
Borduar		7.73	2.9	0.48	16.96	90	97.93	435	96.65
Dhanubhanga	Spring (April-May)	8.87	3.84	0.6	15.78	88	92.03	420	95.71
Genang		9.78	4.13	0.62	15.22	83	96.19	435	94.72
Nongpoh		10.89	3.7	0.58	15.87	92	94.11	447	97.31
Khanapara		11.49	3.93	0.65	16.71	90	97.26	460	95.86
Titabar		10.04	3.9	0.6	15.71	93	95.93	435	96.09
Borduar		9.88	3.83	0.53	14.21	84	98.02	433	93.99
Dhanubhanga	Summer (June-July)	10.21	3.87	0.59	15.32	86	96.13	460	96.08
Genang		9.72	4.11	0.7	17.29	84	97.79	445	97.07
Nongpoh		10.01	3.68	0.62	16.68	93	92.8	434	97.46
Khanapara		10.16	4.23	0.73	17.45	95	97.86	386	95.6
Titabar		9.42	4.21	0.63	15.19	94	93.9	432	97.9
Borduar		9.37	3.72	0.64	17.41	86	97.01	417	97.56
Dhanubhanga	Early Autumn (August-September)	9.25	3.22	0.5	15.59	87	93.11	474	86.06
Genang		9.86	3.99	0.65	16.54	88	94.09	462	90.83
Nongpoh		9.3	3.44	0.56	15.5	80	90.68	449	94.37
Khanapara		9.87	3.65	0.54	15.24	90	93.93	416	95.78
Titabar		11.55	3.65	0.61	16.28	93	96.1	392	92.21
Borduar		9.08	3.18	0.48	15.36	83	97.23	425	94.58
	Mean	9.52	3.57	0.55	15.49	87.54	95.17	437.67	95.42
	Median	9.66	3.69	0.59	15.55	88.00	95.78	435.00	95.82
	SD	1.12	0.47	0.11	1.31	4.66	2.11	24.60	2.61
	CV%	11.76	13.13	19.46	8.43	5.33	2.22	5.62	2.74

N.B: LW- Larval Weight, SCW- Single Cocoon Weight, SSW- Single Shell Weight, SR- Shell Percentage, ERR%- Effective Rate of Rearing, PR- Pupation Rate, FEC- Fecundity, HA%- Hatching Percentage.

FUTURE SCOPE

This study will help in selecting the right eri silkworm ecoraces for the right season to maximize productivity and sustainability in ericulture. Also provide a valuable framework for improving silkworm breeding programs, uplift the socio-economy of rural areas of Manipur and improvement in silk industry in India.

Author contributions: This work was carried out with proper coordination among the authors to get the results. First author, Wahengbam Sapana and Y. Surjalata conceptualized the idea, performed the experiment rearing and collected the initial data. Author Wahengbam Sapana and Anowar Hossain formulated the manuscript. Author Debaraj Yumnam and Somdip Majumdar supervised and reviewed the manuscript. Author Subadas Singh and Somorjit Singh edit the manuscript and performed statistical analysis. All authors read and approved the final manuscript.

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Conflict of Interest. None.

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