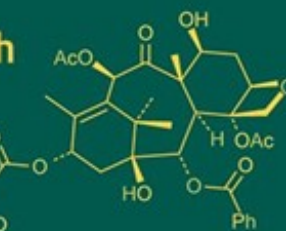
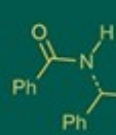


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Comparison of cocoon and pupal characteristics between male and female eri silkworm (*Samia Ricini* Donovan)

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ABSTRACT

The eri silkworm, *Samia ricini* Donovan, is an important non-mulberry silkworm widely reared in Assam. Cocoon and pupal traits are important indicators of silkworm productivity; however, these characteristics may vary between males and females. The present study was conducted in sericulture oriented villages in Jorhat district of Assam, India, to evaluate sex-wise variation in cocoon and pupal characteristics of *S. ricini*. A total of 2,185 individual cocoons were analysed, comprising 765 female and 1,420 male cocoons. Cocoon length, cocoon width, cocoon weight, shell weight, pupal weight and shell ratio were recorded for individual cocoons. Female cocoons showed significantly higher mean cocoon length (4.479 ± 0.470 cm), width (3.045 ± 0.678 cm), cocoon weight (3.899 ± 0.166 g) and pupal weight (3.518 ± 0.160 g) compared with male cocoons. In contrast, male cocoons recorded significantly higher shell weight (0.470 ± 0.059 g) and shell ratio ($12.428 \pm 2.018\%$) than female cocoons, which had mean values of 0.381 ± 0.047 g and $9.774 \pm 1.185\%$, respectively. Welch's *t*-test showed significant differences between the sexes for all the measured traits ($P < 0.05$). The results indicate a clear difference in the pattern of cocoon biomass allocation between male and female eri silkworms. While females produced heavier cocoons and pupae, males showed a greater contribution of shell material to the total cocoon weight. The findings highlight the importance of considering sex while evaluating cocoon productivity in *S. ricini* Donovan.

Keywords: *Samia ricini* Donovan, Eri silkworm, Pupal weight, Shell ratio

1. Introduction

The eri silkworm, *Samia ricini* (Donovan), is an important non-mulberry silkworm reared mainly in the northeastern part of India. Assam has a long association with eri culture, where eri silk holds both cultural and economic importance. The silkworm is also valued for its adaptability to different host plants, particularly castor, making it suitable for rearing under diverse local conditions.

The productivity and performance of eri silkworms are generally assessed through several cocoon and pupal characters. Among these, cocoon weight, shell weight, pupal weight and shell ratio are commonly considered important. Each of these characters provides different information. Cocoon weight represents the total mass of the cocoon, while shell weight indicates the actual quantity of shell material. Shell ratio shows the proportion of shell in relation to the total cocoon weight, whereas pupal weight reflects the mass of the developing pupa. Therefore, evaluating these traits together provides a more complete picture of cocoon characteristics than considering a single trait alone.

Cocoon and pupal characters in *S. ricini* Donovan are known to vary under different biological and environmental conditions. Factors such as genetic makeup, host plant, season and rearing environment can influence the growth and performance of the silkworm. Another factor that may contribute to variation is the sex of the individual. Since male and female silkworms differ in their biological development and physiological requirements, differences in cocoon and pupal characteristics may also occur between the two sexes.

In general, female silkworms may have greater body mass because of the resources required for reproductive development. As a result, female individuals may produce heavier pupae and, in some cases, heavier cocoons. However, a higher cocoon weight does not necessarily mean that the cocoon contains more shell material. A heavier cocoon may result from a greater pupal mass rather than an increase in shell weight. For this reason, it is important to examine shell weight and shell ratio along with total cocoon weight when comparing male and female individuals.

Although cocoon characters are widely used to assess the performance of eri silkworms, information on how these traits differ between males and females remains useful, particularly when individual-level observations are available. Understanding such differences can help in the proper interpretation of cocoon data and may also be relevant for evaluating productivity-related characters.

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Therefore, the present study was carried out in sericulture oriented villages in Jorhat district of Assam to examine the variation in selected cocoon and pupal characteristics between male and female *Samia ricini* Donovan. The study focused on cocoon dimensions, cocoon weight, shell weight, pupal weight and shell ratio to determine whether consistent differences exist between the two sexes.

The objectives of the study

1. To compare cocoon length and cocoon width between male and female *S. ricini*.
2. To examine differences in cocoon weight, shell weight and pupal weight between the two sexes.
3. To compare the shell ratio of male and female cocoons.
4. To assess the importance of sex while interpreting cocoon and pupal characteristics of the eri silkworm.

2. Materials and Methods

2.1 Study area

The study was conducted in sericulture oriented villages in Jorhat district of Assam, India, an important region for eri silkworm rearing and sericulture research.

2.2 Study material and data collection

Individual cocoons of *Samia ricini* Donovan were examined. A total of 2,186 observations were available, of which one record with an unclear sex designation was excluded. Thus, the final analysis included 2,185 cocoons, comprising 765 females and 1,420 males.

Figure 1. 3rd instar larvae of *Samia ricini* Donovan during rearing.

Figure 2: 4th instar larvae of *Samia ricini* Donovan during rearing.



Cocoon length and width were measured using a vernier calliper, while cocoon weight, shell weight and pupal weight were recorded using a digital balance. Each cocoon was measured individually. Cocoon weight was recorded before opening, after which the shell and pupa were separated and weighed.

2.3 Shell ratio

Shell ratio was calculated as:

$$\text{Shell ratio (\%)} = \frac{\text{Cocoon weight}}{\text{Shell weight}} \times 100$$

2.4 Statistical analysis

The data were grouped according to sex. Mean and standard deviation (SD) were calculated for cocoon length, cocoon width, cocoon weight, shell weight, pupal weight and shell ratio. Differences between male and female individuals were analysed using Welch's independent-samples *t*-test, with statistical significance considered at $P < 0.05$.

3. Results

3.1 Sex-wise variation in cocoon and pupal characteristics

Differences were observed between male and female eri silkworms in all the measured traits. Female cocoons showed slightly higher length, width, cocoon weight and pupal weight. In contrast, male cocoons had higher shell weight and shell ratio.

Table 1. Sex-wise variation in cocoon and pupal characteristics of *Samia ricini* Donovan.

Character	Female (n = 765)	Male (n = 1,420)
Cocoon length (cm)	4.479 ± 0.470	4.424 ± 0.471
Cocoon width (cm)	3.045 ± 0.678	2.982 ± 0.606
Cocoon weight (g)	3.899 ± 0.166	3.794 ± 0.204
Shell weight (g)	0.381 ± 0.047	0.470 ± 0.059
Pupal weight (g)	3.518 ± 0.160	3.324 ± 0.197
Shell ratio (%)	9.774 ± 1.185	12.428 ± 2.018

Values are presented as mean ± SD.

Figure 3. Measurement of individual cocoon weight of *Samia ricini* Donovan using a digital weighing balance. **Figure 4.** Measurement of

individual pupal weight of *Samia ricini* Donovan using a digital weighing balance.



3.2 Comparison of cocoon dimensions

Female cocoons had a mean length of 4.479 ± 0.470 cm, which was slightly higher than that of males (4.424 ± 0.471 cm). Similarly, the mean cocoon width was higher in females (3.045 ± 0.678 cm) than in

males (2.982 ± 0.606 cm). The differences in both length ($P = 0.008$) and width ($P = 0.032$) were statistically significant.

3.3 Comparison of cocoon and pupal weight

Female cocoons had a significantly higher mean cocoon weight (3.899 ± 0.166 g) than male cocoons (3.794 ± 0.204 g) ($P < 0.001$). Female pupae were also significantly heavier (3.518 ± 0.160 g) than male pupae (3.324 ± 0.197 g) ($P < 0.001$).

3.4 Comparison of shell weight and shell ratio

Male cocoons showed significantly higher shell weight and shell ratio than females. The mean shell weight was 0.470 ± 0.059 g in males and 0.381 ± 0.047 g in females. Similarly, the mean shell ratio was $12.428 \pm 2.018\%$ in males, compared with $9.774 \pm 1.185\%$ in females. Both differences were highly significant ($P < 0.001$).

4. Discussion

The study showed clear differences in cocoon and pupal characteristics between male and female *Samia ricini* Donovan. Females had slightly larger and heavier cocoons and higher pupal weight, whereas males showed higher shell weight and shell ratio.

The greater cocoon weight in females appears to be mainly associated with their higher pupal weight. However, this pattern was not observed for shell-related traits. Although male cocoons were lighter overall, they contained more shell material and had a higher shell ratio than female cocoons.

These findings show that cocoon weight alone may not be sufficient to evaluate cocoon productivity. Female cocoons were heavier, but male cocoons had a greater proportion of shell material. Therefore, cocoon weight, shell weight and shell ratio should be considered together.

Table 2. Statistical comparison of cocoon and pupal characteristics between female and male *Samia ricini* Donovan.

Trait	Female mean	Male mean	t value	P value
Cocoon length (cm)	4.479	4.424	2.636	0.008
Cocoon width (cm)	3.045	2.982	2.146	0.032
Cocoon weight (g)	3.899	3.794	13.033	< 0.001
Shell weight (g)	0.381	0.470	-38.697	< 0.001
Pupal weight (g)	3.518	3.324	24.967	< 0.001
Shell ratio (%)	9.774	12.428	-38.703	< 0.001

The observed differences may reflect biological and physiological variation between the two sexes. However, further studies under controlled conditions are needed to understand the reasons behind these differences. Since cocoon characteristics may also be influenced by factors such as host plant, season and rearing conditions, the results should be interpreted within the conditions of the present study. Overall, the findings suggest that sex is an important factor to consider when evaluating cocoon and pupal characteristics of eri silkworm.

5. Conclusion

The present study revealed significant sex-wise variation in the cocoon and pupal characteristics of *Samia ricini* Donovan in Jorhat district of Assam. Females had slightly larger and heavier cocoons and higher pupal weight, while males showed higher shell weight and shell ratio.

The results indicate that a heavier cocoon does not necessarily contain more shell material. Therefore, cocoon weight alone should not be used to assess cocoon productivity. Considering cocoon weight, shell weight, pupal weight and shell ratio together can provide a better understanding of the performance of male and female eri silkworms.

Figures



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