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Correlation analysis of key economic traits in male and female of selected pure bivoltine breeds of silkworm *Bombyx mori* L

Abhishek BS and Rohith L ShankarDOI: <https://dx.doi.org/10.33545/26649926.2025.v7.i2a.298>**Abstract**

The economic traits selected for correlation analysis revealed a significant breed specific variations among selected six bivoltine silkworm pure breeds viz., APS12, J2, CSR53, A3, H281 and RB18 in both males and females. In APS-12, female larval weight correlates significantly with male larval weight (0.758*) and pupation rate (0.696), while males show strong correlations for larval weight (1.000) and pupation rate (0.746*). J2 females correlate with male cocoon weight (0.594*) and pupal weight (0.560*), and males with cocoon weight (0.653*) and pupation rate (0.976*) significantly. CSR53 shows high cocoon and shell weight in both sexes. A3 females show strong shell weight (0.831**) but males have no significant correlations. H281 exhibits strong significance for larval and cocoon trait and RB18 shows positive correlations in both sexes. APS-12, J2, and H281 have stronger variations among males and females while CSR53 shows notable cocoon and shell weight correlation indicating the importance of parental breed's contribution for crop improvement programme in fulfilling the specific breeding objectives.

Keywords: Silkworm, *Bombyx mori* L, pure breed/race, breeding, economic traits, correlation, analysis**Introduction**

Silkworm breeding has long been a focal point of sericulture research, with the goal of improving silk yield and quality. The increase in body size and dry weight of larvae is largely dependent on the rate of metabolism (Rao *et al.*, 2020) ^[11], nutrient absorption, and the stage of growth and development in the silkworm during the fifth instar which significantly contributes to the phenotypic expression of cocoon traits (Rajanna and Sree Rama Reddy, 1990) ^[9]. Some of these traits are heritable, while others are influenced by environmental factors (Kumar *et al.*, 2002) ^[5]. Since the environment affects the determination of phenotypic traits, the phenotype of an individual is often an inaccurate estimate of its genetic potential (Giridhar *et al.*, 1995) ^[3]. Therefore, the environment has a significant impact on many economically important traits, such as heritability and genetic advancement, which are responsible for improvements in filament length, single cocoon weight, single shell weight, etc. (Kumaresan *et al.*, 2000) ^[5]. Among the factors contributing to silk production, the larval weight of *Bombyx mori* L. is known to have a significant impact on various cocoon traits. These traits, including cocoon weight, shell weight, and silk filament length, are critical for the economic value of silk. Studies have shown a positive correlation between larval weight and cocoon traits in bivoltine silkworm breeds, which are preferred for their high silk yield and superior quality (Narasimharaju *et al.*, 1990) ^[7]. Understanding these correlations helps sericulturists optimize breeding practices and improve overall silk production.

In this study, we aim to examine the relationship between larval weight and cocoon traits in bivoltine pure breeds of *Bombyx mori* L., providing insights that can be applied in breeding programs to enhance cocoon quality, silk yield, and robustness to environmental conditions (Rohith L Shankar *et al.*, 2008) ^[13]. Previous studies have demonstrated the influence of environmental factors on the expression of economic traits, regardless of the silkworm races and breeds (Uma Shankar and Subramanya, 2002) ^[17]. The genotype of silkworm races selected for experimental hybridization or basic research must be systematically reared and

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evaluated under known environmental conditions to understand the expression of economic traits (Murakami, 1992; Tazima, 1998; Reddy *et al.*, 2005; Ding *et al.*, 2006) [6, 16, 8, 2]. This study aims to assess the selected economic traits of both sexes in selected bivoltine pure breeds and their suitability for breed improvement programme has been analyzed.

Materials and Methods

- **Silkworm breeds studied:** The following bivoltine pure breeds were selected for the study: APS12, J2 and CSR53, characterized by white dumbbell-shaped cocoons, and A3, H281, RB18, characterized by white oval cocoons. The replicate of 25 larvae of each sex were randomly picked from the cellular rearing beds.

Fed with mulberry leaves V1 variety in separate rearing beds up to the commencement spinning. Individually recorded the selected economic traits expression in all the breeds of males and females.

- **Economic traits studied:** six economic traits were studied in this analysis, viz., larval weight, cocoon weight, shell weight, shell percentage, pupal weight and pupation rate.
- **Statistical methods:** The analysis of variance (ANOVA) was performed following the methodology described by Snedecor and Cochran (1976). The mean data obtained on the seasonal performance of the males and females of bivoltine pure breeds were analyzed using the SPSS 2.0 statistical software package.

Table 1: Correlation of selected economic traits between males and females silkworm of selected pure bivoltine breeds

Breeds	Economic Characters/ and Sex	Larval weight		Cocoon weight		Shell weight (g)		Shell Percentage (%)		Pupal weight		Pupation Rate (%)	
		Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male
APS-12	Female	1.000**	-	----	----	----	----	----	----	----	----	----	----
	Male	0.758**	1.000**	----	----	----	----	----	----	----	----	----	----
J2	Female	0.233NS	0.523*	1.000**	----	----	----	----	----	----	----	----	----
	Male	0.636**	0.284NS	0.076NS	1.000**	----	----	----	----	----	----	----	----
CSR53	Female	0.062NS	0.196NS	0.594*	-0.027NS	1.000**	----	----	----	----	----	----	----
	Male	0.154NS	0.037NS	0.046NS	0.653**	0.098NS	1.000**	----	----	----	----	----	----
A3	Female	0.066NS	0.000NS	0.102NS	0.004NS	0.831**	0.159NS	1.000**	----	----	----	----	----
	Male	-0.453NS	-0.251NS	-0.028NS	-0.191NS	0.151NS	0.619**	0.201NS	1.000**	----	----	----	----
H281	Female	0.388NS	0.746**	0.560*	-0.002NS	0.369NS	-0.027NS	0.078NS	-0.041NS	1.000**	----	----	----
	Male	0.696**	0.320NS	0.076NS	0.976**	-0.060NS	0.474NS	-0.041NS	-0.398NS	0.006NS	1.000**	----	----
RB18	Female	0.006NS	-0.179NS	-0.132NS	0.135NS	-0.086NS	0.142NS	0.028NS	0.053NS	-0.267NS	0.116NS	1.000**	----
	Male	-0.141NS	-0.334NS	-0.313NS	0.161NS	-0.172NS	0.238NS	0.081NS	0.145NS	-0.508*	0.119NS	0.601*	1.000**
Mean		4.46	4.47	1.6	1.56	0.29	0.31	18.38	19.77	1.33	1.25	91.1	90.03
Variance		0.008	0.022	0.002	0.002	0	0	0.57	0.372	0.004	0.002	2.575	3.053
Std. Dev		0.091	0.148	0.047	0.05	0.014	0.012	0.755	0.61	0.064	0.043	1.605	1.747
Std. Error		0.022	0.036	0.011	0.012	0.003	0.003	0.183	0.148	0.015	0.01	0.389	0.424

Note: *=Significant at 0.5%, **= highly significant at 1% and NS = Non-significant

Results and Discussion

This study examined the correlation between key economic traits such as larval weight, cocoon weight, shell weight, shell percentage, pupal weight, and pupation rate in six different silkworm breeds (APS-12, J2, CSR53, A3, H281, and RB18) for both male and female silkworms. The analysis reveals breed-specific variations and statistically significant correlations across several traits.

In APS-12, a positive correlation was found between female larval weight and male larval weight (0.758*) as well as male pupation rate (0.696), indicating that females with higher larval weights contribute to improved male pupation success. Male larval weight was also strongly correlated with itself (1.000) and male pupation rate (0.746*), emphasizing the critical role of larval weight in successful pupation. These findings align with studies by Yokoyama, (1996), which emphasized the influence of larval weight on silkworm productivity. For J2, female cocoon weight showed a significant positive correlation with male cocoon weight (0.594*) and male pupal weight (0.560*), highlighting the genetic influence of females on male traits. Males exhibited strong correlations between cocoon weight (0.653*) and pupation rate (0.976*), suggesting cocoon weight as a reliable predictor of male pupation success. This is consistent with earlier research (Choudhary and Yadav, 2018) [1]. Which observed similar links between cocoon weight and improved economic traits in silkworms. In

CSR53, female cocoon weight was significantly correlated with both male cocoon weight (0.594*) and shell weight (0.831*), indicating a strong genetic link between these traits (Ramesh and Sudhakara Rao, 2010) [12]. Males also showed positive correlations between cocoon weight (0.653) and shell weight (0.619*). These results align with the work by Suresh Kumar *et al.* (2006) [14], which emphasized the importance of cocoon and shell weight in improving silkworm breed quality.

For A3, a significant correlation was observed between female and male shell weight (0.831**), while other traits showed no notable correlations. Males exhibited no significant correlations, except for a weak negative correlation between pupal weight and pupation rate (-0.398NS). This lack of significant correlations for males suggests other environmental or genetic factors may influence the economic traits in this breed (Reddy *et al.*, 2005) [8]. In H281, female larval weight was significantly correlated with male larval weight (0.746*) and male pupal weight (0.560), indicating that higher female larval weight positively affects male traits. Males displayed strong correlations between cocoon weight (0.976*) and larval weight (0.696*), demonstrating that heavier larvae produce better cocoons, leading to higher economic yields. This supports findings by Rao *et al.* (2020) [11], on the importance of larval weight in determining cocoon quality and yield. For RB18, pupation rates in both sexes were significantly

correlated (0.601*), suggesting a consistent influence of this trait across genders. However, no other significant correlations were found. The role of pupation rate in enhancing silk production has been documented in previous research (Reddy N and Yang Y, 2013) ^[10], justifies the overall healthiness of selected silkworm breeds.

Conclusion

The results of this study emphasize the importance of selecting breeds like APS12, J2, and H281 showed strong correlations between key traits such as larval weight, cocoon weight, and pupation rate, making them economically viable for silkworm farming. CSR53 exhibited significant potential for silk production through strong cocoon and shell weight. In contrast, A3 and RB18 displayed fewer correlations, requiring further study. Selecting breeds like APS-12, J2, CSR53, and H281 is crucial for improving productivity. Further research into genetic and environmental influences is recommended to optimize breeding strategies.

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