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# Evaluation of $FC_1 \times FC_2$ Silkworm Hybrid Performance on Diverse Mulberry Varieties

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**Abstract**

The experiment was conducted during *rabi*, October, 2024–January, 2025 at the College of Agriculture, V. C. Farm, Mandya, to assess the effect of different mulberry (*Morus* spp.) varieties on the biological and economic performance of the silkworm *Bombyx mori* ($FC_1 \times FC_2$ double hybrid). Sericulture productivity was strongly dependent on the nutritional composition and palatability of mulberry leaves; therefore, the identification of suitable mulberry cultivars was considered essential for enhancing cocoon yield and silk quality. A laboratory-based Completely Randomized Design consisting of eight treatments with three replications was followed, with each replication comprising 50 larvae. The mulberry varieties evaluated included Mysore Local, Sahana, S36, DD, AR12, $V_1$, $G_2$ and $G_4$, all of which were cultivated under uniform agronomic and maintenance practices to ensure experimental consistency. Statistically significant differences were observed among the varieties for larval weight, cocoon weight, shell weight, shell ratio, and filament denier. Among the tested cultivars, $V_1$, DD and $G_4$ produced significantly heavier cocoons and higher effective rearing rates, whereas Mysore Local recorded the lowest values for most economic traits. Cocoon shell weight and shell ratio were highest in $V_1$, $G_2$ and DD, indicating superior silk deposition efficiency and better nutrient utilization. Filament denier also varied considerably, with $V_1$ yielding relatively thicker and stronger filaments. Overall, the results revealed that high-yielding mulberry varieties such as $V_1$, $G_2$, DD, and $G_4$ markedly improved cocoon productivity and filament quality, demonstrating their suitability for commercial rearing of the $FC_1 \times FC_2$ silkworm hybrid under controlled rearing conditions.

***Keywords:*** *Bombyx mori*, mulberry varieties, $FC_1 \times FC_2$ hybrid, cocoon weight, shell ratio

## 1. Introduction

Sericulture is one of the most ancient and economically significant agro-based industries, sustaining millions of rural households across Asia, particularly in India, China, Japan, Thailand, and Korea. Beyond its cultural and historical importance, sericulture plays a vital role in rural development because of its high employment generation potential, relatively low initial investment, and year-round income opportunities (Mohuiddin et al., 2026; Andadari et al., 2026). India holds the unique distinction of being the only country producing all four commercially important natural silks- mulberry, tasar, eri, and muga, with mulberry silk alone contributing nearly 70% of the total national raw silk production (Kaushik et al., 2025; Lee et al., 2026). The mulberry silkworm, *Bombyx mori* L., is a fully domesticated and monophagous species that depends exclusively on mulberry (*Morus* spp.) foliage throughout its life cycle, making leaf quality the single most critical determinant of biological performance and silk output (Islam et al., 2020). The mulberry leaves contain essential proteins, free amino acids, carbohydrates, lipids, vitamins, and minerals required for optimal larval growth, silk gland development, and cocoon spinning (Tian et al., 2025; Xue et al., 2025). However, considerable inter-varietal variability exists in leaf biochemical characteristics such as crude protein, nitrogen content, soluble sugars, moisture level, mineral composition, and secondary metabolites. These biochemical differences significantly influence larval feeding efficiency, digestibility, metabolic utilization, and ultimately the economic traits of *B. mori*, including larval weight, cocoon weight, shell weight, shell ratio, filament length, denier, and reelability

(Hao et al., 2025; Zhou et al., 2025). Mulberry varieties with higher protein and moisture content generally promote rapid larval growth, efficient feed conversion, and better silk gland development, while adequate carbohydrates support energy metabolism during spinning. Leaves rich in essential amino acids enhance fibroin and sericin synthesis, improving cocoon shell weight and filament quality. In contrast, excessive fibre, high phenolic content, or low moisture reduces palatability, nutrient assimilation, larval survival, and cocoon yield (Lin et al., 2025; Alagumanikumaran et al., 2025; Chartvivatpornchai and Okahisa, 2025). Given these multifactorial influences, evaluation of mulberry varieties through silkworm bioassays has emerged as one of the most reliable and integrative approaches for assessing their practical suitability under both controlled and field conditions. Bioassay-based varietal screening provides comprehensive information on larval consumption rate, assimilation efficiency, nutrient utilization, survivability, and overall economic performance, thereby offering dependable indicators for selecting superior cultivars for commercial exploitation (Luo et al., 2025; Liu et al., 2025; Li et al., 2025). The $FC_1 \times FC_2$ double hybrid of *B. mori* is widely preferred in India owing to its robust larval vigour, high survivability, adaptability to varied rearing conditions, and superior cocoon characteristics. Nevertheless, its performance is highly responsive to leaf quality, necessitating systematic evaluation of suitable mulberry varieties to exploit its genetic potential fully. Despite the availability of numerous mulberry genotypes, comparative information on their suitability for $FC_1 \times FC_2$ rearing under standardized laboratory conditions remains limited (Saad and Aldabagh, 2025; Li et al., 2025). Therefore, the present investigation was undertaken to assess the influence of selected mulberry varieties on the biological and economic traits of the $FC_1 \times FC_2$ hybrid. The study aimed to generate comprehensive insights into varietal differences in cocoon productivity, shell characteristics, and filament quality, thereby identifying the most efficient mulberry genotype for commercial rearing.

## 2. Materials and Methods

The experiment on the rearing performance of the mulberry silkworm *Bombyx mori* L. on different mulberry varieties was conducted during *rabi*, October, 2024–January, 2025 at the College of Agriculture, V. C. Farm, Mandya, Karnataka (12°32' N, 76°53' E; 690 m above mean sea level). The experimental location falls under the Southern Dry Zone (Zone-6) of Karnataka and is characterized by semi-arid climatic conditions with an average annual rainfall of about 751 mm. The mean maximum and minimum temperatures ranged from 28–35°C and 24–26°C, respectively, which are considered favourable for mulberry cultivation and controlled silkworm rearing.

Eight mulberry varieties, namely Mysore Local, Sahana, S36, DD, AR12, $V_1$, $G_2$ and $G_4$, were maintained under uniform agronomic and cultural practices recommended for rainfed mulberry cultivation. The commercial bivoltine double hybrid $FC_1 \times FC_2$ of *B. mori* was used as the test silkworm breed. The experiment was laid out in a Completely Randomized Design (CRD) comprising eight treatments with three replications, each replication consisting of 50 larvae. Silkworm rearing was carried out under standardized laboratory conditions of temperature (25±1°C) and relative humidity (70–75%). Larvae were reared from the brushing to spinning stage and were supplied with fresh leaves of the respective mulberry varieties throughout the larval period.

Cocoons were harvested on the seventh day of spinning and used for the assessment of quantitative and qualitative economic parameters. Cocoon weight was recorded by randomly selecting ten cocoons from each replication and weighing them individually using a digital precision balance. Cocoon shell weight was determined by carefully cutting open the same cocoons, removing the pupae and exuviae, and weighing the dried shells. Cocoon shell ratio was calculated using the formula:

Shell ratio (%)=(Shell weight/Cocoon weight)×100

Denier, an indicator of filament thickness, was estimated using the standard relation:

Denier=(Weight of filament in g/Length of filament in m)×9000

where *W* represents the weight of a single cocoon filament in grams, and *L* denotes its length in metres.

The recorded data were compiled and subjected to statistical analysis using one-way analysis of variance under a Completely Randomized Design at a 5% level of significance. Treatment means were compared using the critical difference (CD) test. Statistical computations were performed using OPSTAT online statistical software developed by Chaudhary Charan Singh Haryana Agricultural University, Hisar, to determine varietal differences in the biological and economic traits of the silkworm hybrid.

Table 1: Influence of mulberry varieties on cocoon parameters of $FC_1 \times FC_2$ double hybrid silkworm

| Mulberry varieties | Cocoon Parameters | | | |
|---|---|---|---|---|
| | Cocoon weight (g/10) | Cocoon shell weight (g/10) | Cocoon shell ratio (%) | Denier |
| Mysore local | 22.02 | 3.77 | 17.11 | 2.18 |
| Sahana | 23.05 | 3.95 | 18.49 | 2.63 |
| S36 | 22.57 | 4.34 | 19.25 | 2.52 |
| DD | 24.01 | 4.49 | 18.71 | 2.27 |
| AR12 | 22.38 | 3.95 | 18.40 | 2.65 |
| $V_1$ | 24.23 | 4.65 | 19.17 | 2.97 |
| $G_2$ | 23.56 | 4.58 | 19.61 | 2.42 |
| $G_4$ | 23.69 | 4.36 | 18.40 | 2.47 |
| SEm± | 0.28 | 0.12 | 0.31 | 0.11 |
| CD ($p$=0.05) | 0.85 | 0.35 | 0.94 | 0.32 |

@ Significant differences at the 5% level

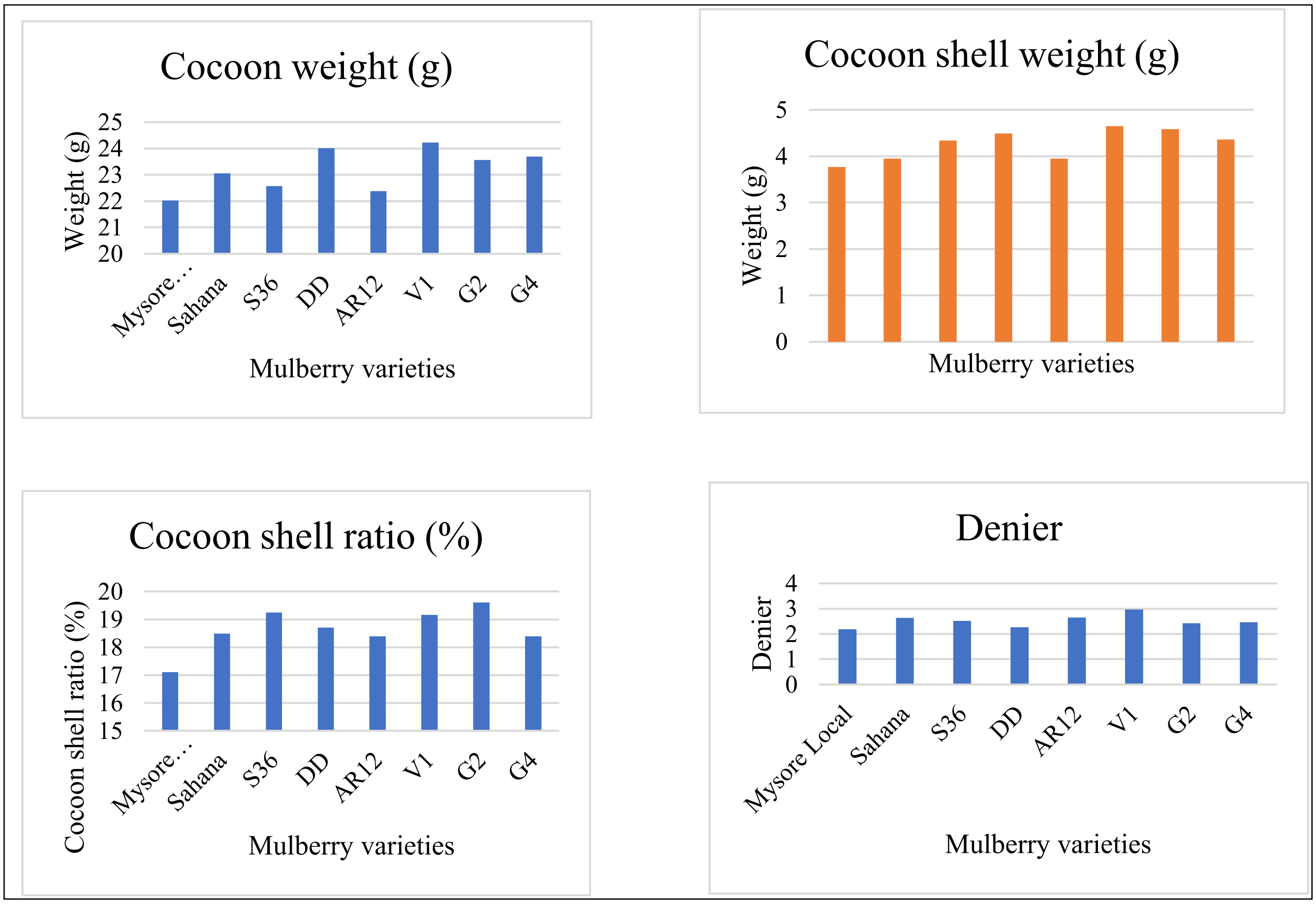


Figure 1: Performance of $FC_1 \times FC_2$ double hybrid for various cocoon parameters across different mulberry varieties

### 3. Results and Discussion

The results of the present investigation revealed that the performance of the $FC_1 \times FC_2$ silkworm hybrid varied significantly when reared on different mulberry varieties, clearly demonstrating the influence of leaf nutritional quality on major economic traits. The pooled data for cocoon weight, shell weight, shell ratio, and denier (Table 1; Figure 1) showed statistically significant differences at the 5% level, indicating strong varietal effects on both cocoon productivity and filament characteristics.

#### *3.1. Cocoon weight*

Cocoon weight differed significantly across mulberry varieties, clearly demonstrating the nutritional influence of host plants on the growth performance of the $FC_1 \times FC_2$ hybrid. The highest cocoon weight was recorded in silkworms fed on $V_1$ (24.23 g/10 cocoons), followed closely by DD (24.01 g) and $G_4$ (23.69 g). Improved varieties such as $V_1$ and DD consistently outperformed traditional varieties, particularly Mysore Local, which recorded the lowest cocoon weight (22.02 g). These findings agree with those of Kumar et al. (2018) and Thaosen et al. (2025), who reported significantly higher cocoon weights in silkworms reared on improved varieties due to their superior protein, moisture, and digestibility profiles, which enhance larval metabolism and silk gland development.

#### *3.2. Cocoon shell weight*

A similar trend was observed in cocoon shell weight, which is a direct indicator of silk yield. The highest shell weight was recorded in the $V_1$-fed batch (4.65 g 10 shells$^{-1}$), followed by $G_2$ (4.58 g) and DD (4.49 g). Intermediate performance was recorded in S36 and $G_4$, whereas Mysore Local exhibited the lowest shell weight (3.77 g). The superiority of $V_1$, $G_2$ and DD corresponds with earlier reports by Khan et al. (2025) and Habeanu et al. (2026), who indicated that improved mulberry varieties enhance fibroin biosynthesis due to higher nutrient concentration and better leaf digestibility. The stable performance across these varieties suggests their reliable nutritive potential for commercial rearing.

#### *3.3. Cocoon shell ratio*

Cocoon shell ratio also varied significantly among mulberry varieties, reflecting differences in silk gland efficiency and nutrient utilization efficiency. The highest shell ratio was recorded in $G_4$ (19.61%), followed by S36 (19.25%), $G_2$ (19.17%), and $V_1$ (19.14%). These improved varieties showed superior silk productivity potential, whereas Mysore Local exhibited the lowest shell ratio (17.11%). Similar trends were reported by Shafique et al. (2025), Nguyen et al. (2025), and Gull et al. (2025), who emphasized that mulberry varieties with high protein and moisture content enhance fibroin deposition, leading to higher shell ratios. The present findings further reinforce the role of improved mulberry varieties in promoting superior silk yield.

*3.4. Denier*

Denier, representing filament thickness, showed considerable variability across treatments. $V_1$ recorded the highest denier value (2.97), followed by AR12 (2.65) and Sahana (2.63), indicating that these varieties promote the formation of relatively coarser silk filaments. Conversely, Mysore Local yielded the finest filaments (2.18), followed by DD (2.27) and $G_2$ (2.42). This aligns with the findings of Ruth et al. (2019) and Marin et al. (2023), who observed thicker filaments in silkworms fed on nutrient-rich varieties such as $V_1$ and S36. In contrast, varieties with moderate nutrient content, such as Mysore Local, tend to produce finer silk, consistent with observations by Muzamil et al. (2014).

The overall results clearly demonstrate that improved mulberry varieties, especially $V_1$, $G_2$, DD, and $G_4$, significantly enhanced cocoon weight, shell weight, and shell ratio due to their superior nutritional profiles. While $V_1$, AR12, and Sahana favored the production of coarser filaments, Mysore Local and DD supported the formation of finer denier silk. These findings reaffirm the pivotal role of mulberry genotype in determining the economic traits of the $FC_1 \times FC_2$ hybrid and highlight the importance of adopting improved varieties to maximize cocoon productivity, filament quality, and economic profitability in commercial sericulture.

## 4. Conclusion

The study demonstrated that the rearing performance and economic traits of *Bombyx mori* ($FC_1 \times FC_2$) were significantly influenced by the mulberry varieties used as larval feed. Varieties $V_1$, $G_2$, DD, and $G_4$ recorded superior cocoon weight, shell weight, shell ratio, and denier, indicating better nutrient utilization and silk deposition efficiency. In contrast, Mysore Local and AR12 showed comparatively lower performance. The findings confirmed that adoption of improved mulberry cultivars substantially enhanced cocoon productivity, filament quality, and overall sericulture profitability.

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