**International Journal of Advanced Scientific Research**
**ISSN: 2456-0421**
**Impact Factor: RJIF 5.32**
**www.allscientificjournal.com**
**Volume 2; Issue 5; September 2017; Page No. 43-46**

# Economic parameters in selected silkworm races/breeds of *Bombyx mori* L. using two mulberry varieties

**[1] BN Prashanth Kumar, [2] RS Umakanth**
Department of Studies in Sericulture Science, University of Mysore, Manasagangothri, Mysuru, Karnataka, India

**Abstract**
The present study was conducted to evaluate larval growth and economic characteristics of cocoon produced by silkworm, *Bombyx mori*, L. Two mulberry varieties namely, V-1 and M-5 was selected to feed on Multivoltine Pure Mysore, bivoltine CSR2 and multi-bi hybrid PMXCSR2. Further, three replications were maintained and 100 silkworm larvae were reared in each replication. Different larval parameters viz. larval duration, larval weight, were measured at different number of feeding of silkworm. Soon after, harvested the cocoon and same were used to find out cocoon weight, shell weight, shell ratio, filament length, filament weight, denier, reelability, renditta, fecundity and hatching percentage were recorded. Results of the present work noticed that significant differences among different mulberry varieties on larval growth and cocoon characteristics. The best performance was observed by feeding V1 variety @ 4 feedings/day in respect of larval duration, larval weight, cocoon weight, shell weight, filament length, filament weight, denier, reelability, renditta, fecundity and hatching percentage were performed superior as compared to the larvae fed on V1 variety @ 2 feedings/day and M5 variety @ 4 and 2 feedings/day. Therefore, it was concluded that V1 mulberry leaves @ 4 feedings/day is the best as compared to M5 mulberry variety.

**Keywords:** silkworm, *Bombyx mori* L, mulberry varieties, economic traits

## 1. Introduction
Silk is the most elegant textile in the world with unparalleled grandeur, natural sheen, and inherent affinity for dyes, high absorbance, light weight, soft touch and high durability and known as the "Queen of Textiles" the world over. On the other hand, it stands for livelihood opportunity for millions owing to high employment oriented, low capital intensive and remunerative nature of its production. The very nature of this industry with its rural based on-farm and off-farm activities and enormous employment generation potential has attracted the attention of the planners and policy makers to recognize the industry among one of the most appropriate avenues for socio-economic development of a largely agrarian economy like India.

Mulberry silkworm has several races/breeds falling under three voltine groups having distinct nutritional, developmental and cocoon characteristics. The races/breeds of the mulberry silkworm are known not only for their significant differences in the quantity and quality of the silk produced by them but also the response of the silkworm to the physical environment and food quality. Miyashita (1986) observed that the productivity of the silkworm is controlled by mulberry leaf (38.20%), climate (37.00%), silkworm rearing techniques (9.30%), silkworm race (4.20%), silkworm egg (3.10%) and other factors (8.20%). The two factors that affect the successful crop production are therefore environment and quality of mulberry leaf.

A major portion (about 70%) of the silk protein produced by the silkworm is directly derived from the protein of the mulberry leaves (Fukuda, 1963) [3]. Mulberry leaf should contain not less than 3 - 35 % of the total nitrogen and 5-8 % soluble carbohydrates. The nutritional and chemical composition of the mulberry leaf depends mainly on the variety of mulberry, agronomical practices and environmental factors (Datta, 1992) [2]. Though the breeds of the mulberry silkworm differ from genotype to genotype, yet it is not conclusively found in all cases how the difference is exactly reflected in cocoon parameters (Patil, 2001) [8]. The performance, growth rate, time required for development, final body weight and probability of survival (Murugan and George, 1992) [7], are influenced by the quantity and quality of leaf consumed during the larval stage.

The CSR hybrids and pure bivoltine breeds reared on V1 during June-July. 1999 recorded cocoon yield of 50 kg and 45 kg, respectively/100 layings (Koundinya and Suma, 2000) [5]. The degree of food assimilation and the quality of secreted silk differ from one race/breed to another even when fed with the same variety of mulberry (Hassanein *et al*, 1972) [4]. The genotypic potential of the race/breed on one hand and environment and nutritional factors on the other act to determine the quality and quantity of cocoon production. Therefore, it is important to study the interaction between the host plant and silkworm races/breeds on one hand and with the environment on the other to understand the complex relationship between gene and environment.

Venkatesha and Rayar (2003) [9] reported that the rearing performance of new bivoltine hybrids on M5 and V1 mulberry varieties. Five productive bivoltine × bivoltine, CSR18 × CSR19, performed well for the traits like silk productivity, shell weight, shell ratio, cocoon yield, longer filament length and the denier, when the larvae fed with V1 variety compared to M5 variety.

The impact of feeding schedule based on feeding potential in late-age larvae of PM × NB4D2 revealed that mulberry shoot

feeding with a frequency of 2, 3, 4, 3, 2 and 3, 3, 4, 5, 5, 4, 3 feeds on the respective day of 4th and 5th instars, respectively yielded better results with respective fifth instar larval duration and mature larval weight (Chandrasekhar *et al.*, 1999). Similarly, these frequencies during fourth and fifth instars recorded higher cocoon traits viz., cocoon weight, pupal weight, shell weight and shell ratio (Chandrasekhar *et al.*, 1999).

## 2. Materials and Methods

In the present study the disease free layings of multivoltine race PM, bivoltine $CSR_2$ and multi-bi hybrid $PM \times CSR_2$ were procured from N.S.S.P., NSSO, Mysuru and were reared following standard rearing methodology (Krishnaswami, 1978) [6]. In the present rearing $V_1$ and $M_5$ mulberry varieties were used to feed the silkworms twice and four times in a day. The studies were conducted during March, 2013 at the DoS in Sericulture Science, University of Mysore and the treatments comprised 3 replications. The temperature ranged between 26 -30 ºC and the relative humidity was in the range of 55 - 70 % during the conduct of rearing.

The larvae after brushing were divided into two batches, Batch I was fed with mulberry leaves of $M_5$ variety and the batch II was fed with $V_1$ variety. The performance of silkworm on larval weight, total larval duration, cocoon yield, cocoon weight, shell weight, shell ratio, fecundity and hatching percentage were recorded. In addition, the cocoons were subjected for reeling test to record filament length, denier, reelability, raw silk percentage and renditta were recorded and this data was subjected to standard deviation and standard error.

### Mulberry varieties used for the present study: $V_1$ and $M_5$ variety

To understand the importance of mulberry which is fed, ingested/digested and the amount of protein and carbohydrates accumulated and diverted to various tissues of the body of silkworm, two feedings at 9 am and 5 pm, and four feedings at 6 am, 11 am, 4 pm and 9 pm were given to the silkworm races/breeds.

### Materials

**Mulberry varieties:** V1 and M5

**Silkworm races:** PM (Pure Mysore - Multivoltine), $CSR_2$ (Bivoltine) and $PM \times CSR_2$ (Cross Breed)

### Economic traits recorded

Weight of the larvae (g), larval duration (hours), Cocoon weight (g), shell weight (g), shell ratio, filament length (m), reelability (%), denier, renditta, fecundity (No of eggs) and hatching percentage (%):

## 3. Experimental Results

The data pertaining to the influence of feeding frequencies of $V_1$ and $M_5$ varieties of mulberry on the selected traits of PM, $CSR_2$ and $PM \times CSR_2$ is presented in Table 1 and 2. The data of all the three batches investigated using V1 variety is presented in table 1 and M5 variety table 2.

### 3.1 Economic parameters

For PM race, a similar trend was noticed with the tetra feedings recording higher values for all the traits compared to the larvae with 2 feedings day, significant differences were observed in the traits Renditta and reelability. It is interesting to note that the larval duration reduced in the larvae with 4 feedings similarly, the $PM \times CSR_2$ hybrid exhibited improved economic traits in case of the larvae fed 4 times a day compared to those fed with 2 feedings, significant differences were noticed for the traits larval weight and hatching percentage.

For $CSR_2$ breed, the larvae fed with 4 feedings a day clearly recorded higher values for all the economic traits when compared to the larvae fed with 2 feedings a day. The larvae fed with 4 feedings showed larval weight of 2.234 g, cocoon weight of 1.549 g, shell weight of 0.292 g, shell ratio of 18.869 %, filament length of 963.37 m, filament weight 0.293 g, reelability 83.33 %, Renditta 5.307 kg, fecundity of 586 eggs/laying and 93 % hatching percentage. Between the significant differences were observed in traits like two types, hatching percentage (95% to 88%), reelability (83 to 79%), and filament length (963 to 920m).

The data presented in table 2 pertaining to the influence of feeding frequency on the economic characters in $CSR_2$, PM and their hybrids, $PM \times CSR_2$ fed with $M_5$ variety mulberry leaves.

In $CSR_2$ breed, feeding frequency greatly influenced the traits namely cocoon weight, shell weight, filament length, denier, hatching percentage and larval duration, where 4 feedings improved the above mentioned traits. In PM race, similar trend was exhibited with significant improvement in the traits shell ratio, filament length and hatching percentage. In $PM \times CSR_2$ hybrids, considerable improvement was exhibited for larval weight, shell ratio, filament length, reelability and renditta.

For all the three strains, there was a significant improvement in the traits, viz. cocoon weight, shell weight and shell ration and hatching percentage. There was no significant difference noticed in the trait larval duration.

The data presented in table 1 and 2 highlights the improvement of most of the characters when fed with $V_1$ variety compared to $M_5$ mulberry variety. $PM \times CSR_2$ hybrid has exhibited to be highly influenced by $V_1$ variety when compared to $M_5$ variety. Where most traits improved when fed with $V_1$ variety leaves, while PM showed decreased hatching percentage when fed with $V_1$ leaves compared to $M_5$ variety.

**Table 1:** Influence of feeding frequency of $V_1$ mulberry variety on the economic characters in multivoltine, bivoltine and Multi × bi hybrid of the silkworm *Bombyx mori.*

| Race | Schedule | Mature larval weight (g) | Larval duration (hours) | Cocoon weight (g) | Shell weight (g) | Shell ratio (%) | Filament length (m) | Filament weight (g) | Denier (d) | Reelability (%) | Renditta (kg) | Fecundity (number) | Hatching Percentage (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $CSR_2$ | 2 Feedings | 2.132 ± 0.15 | 592 ± 6.928 | 1.471 ± 0.02 | 0.276 ± 0.00 | 18.738 ± 0.20 | 919.82 ± 18.15 | 0.267 ± 0.01 | 2.603 ± 0.07 | 79.360 ± 6.88 | 5.453 ± 0.08 | 565 ± 25.42 | 88.288 ± 2.032 |
| | 4Feedings | 2.234 ± 0.18 | 580 ± 6.928 | 1.549 ± 0.02 | 0.292 ± 0.01 | 18.869 ± 0.40 | 963.37 ± 56.31 | 0.293 ± 0.02 | 2.737 ± 0.06 | 83.330 ± 4.30 | 5.307 ± 0.39 | 586 ± 23.69 | 93.152 ± 1.24 |
| PM | 2 Feedings | 1.660 ± 0.05 | 676 ± 6.928 | 0.822 ± 0.01 | 0.087 ± 0.00 | 14.036 ± 0.36 | 595.29 ± 2.57 | 0.093 ± 0.01 | 1.330 ± 0.08 | 48.883 ± 5.77 | 8.826 ± 0.45 | 401 ± 5.00 | 81.442 ± 0.449 |
| | 4 Feedings | 1.708 ± 0.02 | 664 ± 6.928 | 0.862 ± 0.01 | 0.095 ± 0.00 | 14.493 ± 0.38 | 610.56 ± 6.76 | 0.103 ± 0.01 | 1.446 ± 0.09 | 52.183 ± 5.83 | 8.360 ± 0.40 | 417 ± 3.00 | 84.234 ± 2.083 |
| PM × $CSR_2$ | 2 Feedings | 2.351 ± 0.08 | 548 ± 6.928 | 1.357 ± 0.03 | 0.204 ± 0.00 | 15.017 ± 0.54 | 712.49 ± 11.71 | 0.193 ± 0.01 | 2.277 ± 0.09 | 68.363 ± 5.29 | 7.313 ± 0.34 | 459 ± 7.51 | 94.930 ± 1.105 |
| | 4 Feedings | 2.599 ± 0.03 | 544 ± 6.928 | 1.380 ± 0.05 | 0.208 ± 0.00 | 15.088 ± 0.54 | 715.87 ± 24.45 | 0.200 ± 0.02 | 2.393 ± 0.19 | 71.420 ± 3.63 | 7.263 ± 0.16 | 454 ± 23.46 | 96.002 ± 1.607 |

**Table 2:** Influence of feeding frequency of $M_5$ mulberry variety on the economic characters multivoltine, bivoltine and multi × bi hybrid of the silkworm *Bombyx mori.*

| Race | Schedule | Mature larval weight (g) | Larval duration (h) | Cocoon weight (g) | Shell weight (g) | Shell ratio (%) | Filament length (m) | Filament weight (g) | Denier (d) | Reelability (%) | Renditta (kg) | Fecundity (number) | Hatching Percentage (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $CSR_2$ | 2 Feedings | 1.801 ± 0.10 | 616 ± 13.856 | 1.221 ± 0.06 | 0.223 ± 0.01 | 18.322 ± 1.36 | 871.12 ± 30.82 | 0.203 ± 0.02 | 2.107 ± 0.08 | 75.390 ± 6.88 | 6.020 ± 0.39 | 514 ± 12.77 | 81.47 ± 1.708 |
| | 4 Feedings | 1.941 ± 0.07 | 592 ± 13.856 | 1.447 ± 0.02 | 0.272 ± 0.00 | 18.820 ± 0.42 | 925.12 ± 21.47 | 0.240 ± 0.01 | 2.330 ± 0.04 | 79.360 ± 6.88 | 5.950 ± 0.24 | 542 ± 6.66 | 85.01 ± 3.401 |
| PM | 2 Feedings | 1.423 ± 0.06 | 692 ± 6.928 | 0.760 ± 0.01 | 0.062 ± 0.00 | 11.707 ± 0.15 | 546.33 ± 15.63 | 0.077 ± 0.01 | 1.262 ± 0.06 | 48.817 ± 5.83 | 9.946 ± 0.67 | 386 ± 10.69 | 93.44 ± 2.208 |
| | 4 Feedings | 1.591 ± 0.03 | 680 ± 6.928 | 0.819 ± 0.04 | 0.074 ± 0.00 | 13.395 ± 0.87 | 581.91 ± 11.64 | 0.083 ± 0.01 | 1.221 ± 0.10 | 48.817 ± 5.83 | 9.853 ± 0.67 | 407 ± 4.93 | 96.02 ± 0.481 |
| PM × $CSR_2$ | 2 Feedings | 1.806 ± 0.08 | 556 ± 6.928 | 1.160 ± 0.04 | 0.155 ± 0.02 | 13.411 ± 1.58 | 657.00 ± 19.51 | 0.163 ± 0.01 | 2.110 ± 0.01 | 60.840 ± 9.16 | 8.030 ± 0.22 | 429 ± 10.00 | 93.86 ± 1.961 |
| | 4 Feedings | 2.143 ± 0.15 | 548 ± 6.928 | 1.227 ± 0.01 | 0.184 ± 0.00 | 14.973 ± 0.20 | 694.87 ± 17.48 | 0.183 ± 0.01 | 2.160 ± 0.05 | 65.473 ± 5.15 | 7.333 ± 0.20 | 451 ± 7.55 | 95.82 ± 0.298 |

## 4. Discussion

The silkworm *Bombyx mori*, being a monophagous insect, draws all its nutrition from mulberry leaves. Therefore, the growth and development of the silkworm depends on the quantity and quality of leaves provided to them. In addition the silkworm genotype also contributes to the growth and development of the insect interacting with the environment.

Genotypic factors and nutritional factors have a clear bearing on the economic characters of this insect. In this context, the differential performance of the genotypes based on the nutritional factors is of high practical significance. Perusal of literature demonstrates that effect of different quality mulberry leaves and differential feeding frequencies is important for the expression of productive and viability traits.

The present findings of the study on the performance of PM, $CSR_2$ and PM×$CSR_2$ for the twelve economic traits, viz., mature larval weight, cocoon weight, shell weight, shell ratio, filament length, denier, reelability, renditta, fecundity, larval duration and hatching percentage yield interesting results.

A close scrutiny of the data with respect of feeding frequency of $V_1$ mulberry leaves (Table 1) reveals that PM × $CSR_2$ showed highest larval weight with 4 feedings followed by $CSR_2$ and PM. For the traits viz, cocoon weight, shell weight, shell ratio, filament length, reelability and fecundity, $CSR_2$ performed better than PM and PM × $CSR_2$. Being a productive bivoltine $CSR_2$ breed was highly influenced with the number of feedings and the mulberry leaf variety, compared to the multivoltine PM and the hybrid PM × $CSR_2$. It is interesting to note that hatching increased from 88 % (for 2 feedings) to 93 (for 4 feedings) in case of $CSR_2$ whereas PM×$CSR_2$ hybrid showed only a 1.1% increase for the same trait when the feeding frequency was increased. Thus, it can be opined that the hybrid, derived from $V_1$ was less influenced by the nutritional factor, than the pure races.

The data with regard to feeding frequency of $M_5$ variety clearly indicated that PM × $CSR_2$ hybrid showed a maximum increase in larval weight compared to $CSR_2$. When Pure Mysore was given 4 feedings using $M_5$ variety the productive traits increased significantly, for $CSR_2$ race followed by PM and PM × $CSR_2$. However, shell ratio and renditta improved considerably in the hybrid PM × $CSR_2$. It is clear that the productive traits in PM also showed a drastic improvement for the traits like shell ratio of the breed $CSR_2$ improved significantly with an increase in the feeding frequency of $M_5$ leaves, whereas the hybrid PM × $CSR_2$ improved considerably only for some specific traits.

A comparative analysis of the data presented in table 1 and 2 clearly shows that the expression of the economic traits not only depends on the feeding frequency (quantity of leaves fed) but more so on the quality of mulberry leaves provided. In this context, it can be drawn that $V_1$ mulberry variety aided in the better expression of productive traits when compared to $M_5$ variety of leaves. In addition, the results indicates that $CSR_2$ is a better productive breed when it comes to absorption and conversion efficiency of nutrition than PM and PM × $CSR_2$ hybrid.

## 5. Conclusion

- The $CSR_2$ breed larvae fed V1 mulberry leaf with 4 feedings a day clearly recorded higher values for all the economic traits *i.e,* larval weight, cocoon weight, shell weight, shell ratio, filament length, filament weight, reelability, Renditta, fecundity, and hatching percentage when compared to the larvae fed with 2 feedings a day.
- For PM race, a similar trend was noticed with the tetra feedings recording higher values for all the traits compared to the larvae with 2 feedings day, significant differences were observed in all the traits. It is interesting to note that the larval duration reduced in the larvae with 4 feedings similarly, the PM × $CSR_2$ hybrid exhibited improved economic traits in case of the larvae fed 4 times a day compared to those fed with 2 feedings, significant differences were noticed for the traits larval weight and hatching percentage.

## 6. References


1. Chandrashekar S, Govindan R, Narayanaswamy TK. Larval traits of *Bombyx mori* L. as influenced by feeding schedules during summer. Natl. Sem. Tropic Seric., UAS, Bangalore, 1999, 137.
2. Datta RK. Influence of mulberry varities and seasons on the economic traits of popular hybrids of silkworm, *Bombyx mori* L. fed with different mulberry varieties. Environment and Ecology. 1992; 13(2):263-268.
3. Fukuda T, Kameyama, Matsuda M. A correlation between the mulberry leaves consumed by the larvae in different ages of the larval growth and the production of cocoon fiber spun by the silkworm larva and of the eggs laid by the silkworm moth. Bull. Seri. Exp. Stn., 1963; 18(3):165-171.
4. Hassanein Mh, Sharaway MF, elgarha AT. Food assimilation and the out put of silk in the different races of the silkworm *Bombyx mori* L. Bull. Soc. Entomol. Egypt., 1972; 56, 33-337.
5. Koundinya PR, Suma AS. Performance of $V_1$ variety in Chitradurga. Indian Silk. 2000; 39(6):13.
6. Krishnaswami S. New Technology of Silkworm Rearing. CSR & TI Bulletin No.2, Central Silk Board, Bangalore, 1978, 23.
7. Murugan K, George A Sr. Feeding and nutritional influence on the growth and reproduction of *Daphnis nerii* L. J. Insect Physiol. 1992; 38:961-968.
8. Patil RR, Kusugal SN, Banakar BR, Hipparagi GD, Kazi MM, Srinivasan R. Performance of mulberry silkworm, *Bombyx mori* L. on few varieties of mulberry. Proc. Natl. Sem. Mulb. Seri. Res. India, 2001, 620-626.
9. Venkatesha M, Rayar SG. Evaluation of bivoltine × bivoltine hybrids of silkworm, *Bombyx mori* L. on V1and $M_5$ mulberry varieties under Dharwad conditions. Indian J. Seric. 2003; 42(2):183-185.
10. Yakayama T. sericulture. Annual Review of Entomology, 1963; 8:287-298.