

Experimental Tasar Silkmoth (*Antheraea mylitta* Drury) Rearing in Search of an Alternate Food Plant

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Abstract: An experimental rearing of tropical tasar silkmoth, *Antheraea mylitta* Drury was conducted in search of an alternate food/host plant with six different food plant species viz. *Terminalia tomentosa*, *Terminalia arjuna*, *Terminalia belerica*, *Terminalia chebula* of Combretaceae family and *Lagerstroemia speciosa*, *Lagerstroemia parviflora* of Lythraceae family. The rearing performance of silkmoth on *L. speciosa* in terms of cocoons per DFL and silk ratio was found comparable with *T. tomentosa* and *T. arjuna*, the primary tasar silkmoth food plant species. These three plant species also possessed better results in terms of physiological (leaf moisture content and net photosynthesis rate) and biochemical (Chlorophyll, protein, carbohydrate and crude fibre contents) characteristics to support silkmoth rearing than *T. belerica*, *T. chebula* and *L. parviflora*. The correlation study between silkmoth rearing performance and food plant's constituents indicates commercial perspective of *L. speciosa* as an alternate food plant for tasar silkmoth rearing.

Key words: Tasar Silkmoth. Silkmoth Rearing • Disease Free Layings (Dfls) • Silk Ratio • Photosynthesis • Transpiration • Stomatal Conductance

INTRODUCTION

Antheraea mylitta Drury (Order: Lepidoptera, Family: Saturniidae) is a sericigenous semi-domesticated tropical tasar silkmoth, distributed all over India (12 - 31°N latitude and 72 - 96°E longitude). It is exploited commercially for production of tasar raw silk [1-3]. At lower altitude (30 - 50 above mean sea level), it behaves as bivoltine (Three crops in a year). However, it is exploited commercially as bivoltine reared two times in a year (July - August: Ist crop i.e. Rainy/seed cocoon crop; September - October: IInd crop i.e. Autumn/commercial crop). There are about forty four ecoraces of tasar silk insect distributed over Jharkhand, Orissa, Chhattisgarh, Madhya Pradesh andhra Pradesh, Bihar, Maharashtra, West Bengal and Uttar Pradesh of the country. Out of these ecoraces, only Daba and Sukinda are contributing in country's tasar raw silk [4-7] production.

Tasar silkmoth is polyphagous, feeding primarily on *Terminalia tomentosa*, *Terminalia arjuna* and *Shorea robusta* and secondarily on more than two dozen of food plant species [3, 5, 8]. It has food preference. The food plants, which silkmoth normally prefers are known as primary food/host plants. Other food plants, where

silkmoths can sustain its life, but normally do not prefer, are called secondary food/host plants [1].

The constituents food plant affect silk production of the insect profoundly, affecting on survival behaviour, rate of quantity of food-intake, digestion and assimilation, which directly influence the growth and development of the silkmoth [9-13]. In order to increase the tasar raw silk production, exploitation of all the ecoraces and/or their food plant specificity should be established through bio-assay study of tasar silkmoth on different food plant species. Therefore, for successful tasar culture both for commercial and seed crops; proper selection of food plant species is required. Through the present study, an attempt was made to search an alternate food plant for tasar silkmoth rearing through correlation study between silkmoth rearing performance and its food plant constituents.

MATERIALS AND METHODS

During the present study, rearing of Daba ecorace of tasar silkmoth (*Antheraea mylitta* Drury) was carried out in the plant's germ-plasm-bank at Central Tasar Research and Training Institute (23°4' N, 85°88' E and 708 m above

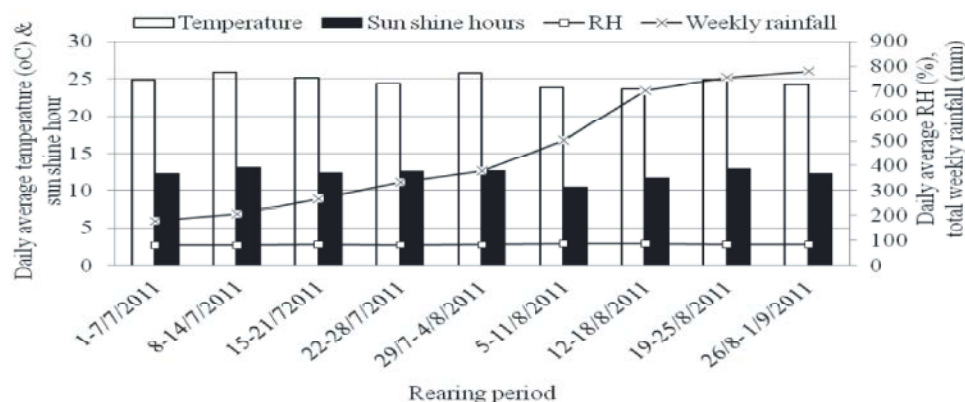


Fig. 1: Meteorological data during silkworm rearing period

mean sea level), Ranchi, India. Silkworm rearing was carried-out on six different food plant species viz. *Terminalia tomentosa*, *Terminalia arjuna*, *Terminalia belerica*, *Terminalia chebula* of Combretaceae family and *Lagerstroemia speciosa*, *Lagerstroemia parviflora* of Lythraceae family to evaluate the effects of food plant's constituents on rearing performance and cocoon characteristics. For this, 100 freshly hatched disease free silkworms were brushed on to each of the plant species during July - August following rearing protocol developed by CTR&TI, Ranchi, India [14]. The meteorological data during silkworm rearing period are illustrated in Figure 1.

Evaluation of Silkworm Rearing Performance: The silkworm rearing performance was evaluated by recording larval duration (from the date of brushing to cocoon formation), V^{th} stage larval weight, cocoon weight, shell weight, effective rate of rearing $[\text{ERR}\% = 100 \times (\text{Total number of cocoons harvested} / \text{Total number of larvae brushed})]$ and silk ratio $[\text{SR}\% = 100 \times (\text{Shell weight} / \text{Cocoon weight})]$.

Evaluation of Physiological Characteristics of Food Plant: Leaf moisture content (MC) was determined on fresh weight basis using following relation. To determine oven-dry weight, leaves were placed in an oven at 70°C for more than 24 h till the constant weight was obtained.

$$\text{MC} (\%) = [100 \times (\text{Fresh weight} - \text{Oven dried weight}) / \text{Fresh weight}]$$

Other physiological parameters viz. net photosynthesis rate, transpiration rate and conductance of stomata of leaf were evaluated using universally accepted CI-340 Photosynthesis System.

Evaluation of Biochemical Characteristics of Food Plant Chlorophyll a, Chlorophyll b and Total Chlorophyll Content: Chlorophyll extraction and estimation (mg/g fresh weight) of leaf tissue was carried out according to spectrophotometric method Anderson and Boardman [15].

Total Soluble Protein Content: Total soluble protein (mg/g dry-weight) in the leaf was determined following the spectrophotometric method Lowry *et al.* [16].

Total Carbohydrate Content: Total carbohydrate content (%) of leaf was determined following the Anthrone method Hedge and Hofreiter [17].

Crude Fibre Content: The crude fibre content in leaf was determined according to oxidative hydrolytic degradation process [18].

Statistical Analysis: All the observed data with five (5) replications were analyzed statistically using the analysis of variance [19]. The significance of treatment (Food plant species) differences was judged by 'F' test.

The standard error of the differences ($\text{SED}\pm$) was calculated by using following expression.

$$\text{SED}\pm = \sqrt{(\text{Error mean square} \times 2 / \text{pooled number of replications})}$$

The critical differences (C. D.) were calculated to test the significant differences of the treatments. Critical differences were calculated by using following formula.

$$\text{C. D. (5\%)} = (\text{SED}\pm) \times 't'$$

where, t = 5% tabulated value of 't' at error degree of freedom.

The correlation study between silkworm rearing performance and food plant's constituents was carried with standard statistical procedures.

RESULTS AND DISCUSSION

The rearing data of silkworm are presented in Table 1. It reveals that the lowest larval period of silkworm was recorded in *T. tomentosa* (27) followed by *T. arjuna* (28) and *L. speciosa* (31). Table 1 also reveals that though, *L. speciosa* is considered as secondary food plant, it resulted comparable numbers (80) of cocoons per DFL as that of the primary food plants, *T. tomentosa* (86) and *T. arjuna* (82). Likewise, number of cocoon per DFL was also higher for *T. belerica* than the nation's average value (50 - 60 cocoons/DFL).

The silkworms reared on different food plant species showed significant difference in rearing performance (Table 2). The correlation between silkworm rearing performance and food plant characteristics is depicted in Figure 2. It shows that there is strong positive correlation between silkworm rearing performance (V^{th} stage larval weight, cocoon weight, shell weight & silk ratio) and physiological (Leaf moisture content and net photosynthesis rate) and biochemical (Total chlorophyll, soluble protein and total carbohydrate contents) characteristics of food plants. However, rearing performance of the silkworm is negatively correlated to crude fibre content of leaf of the food plant species.

Comparatively, higher larval weights resulted higher cocoon weights in *T. tomentosa*, *T. arjuna* and *T. belerica*, which might be due to better rate of quantity of

food in-taken, digested and assimilated by silkworm [9-13]. However, the highest value of silk ratio was recorded for the silkworm reared on *L. speciosa* (13.05%) followed by *T. arjuna* (12.35%) and *T. tomentosa* (12.25%), which might be due to better conversion of assimilated food in to raw silk by the silkworms reared on these plant species. The cocoon characteristics of the silkworms reared on the rest of the plant species were found inferior than that of above mentioned species (Table 2).

In the present experiment, all plant species showed significant differences in respect to physiological properties (Table 3). The leaf moisture content, which is having positive correlation with silkworm rearing performance [20, 21] was recorded the highest in *T. tomentosa* (72.07%) followed by *L. speciosa* (71.21%) and *T. arjuna* (70.36%). Likewise, net photosynthesis rate was also found in higher side for the host plant species showing better rearing performance than other plant species, which indicates *T. tomentosa*, *L. speciosa* and *T. arjuna* provide better quantity of food to be assimilated by the silkworm (Tables 2, 3 & 4; Figure 2 & 3).

All the food plant species in the present experiment showed significant differences in respect to biochemical properties (Table 4). The highest value of total chlorophyll content of leaf was recorded in *T. tomentosa* (2.69 mg/g) followed by *T. arjuna* (2.59 mg/g) and *L. speciosa* (2.56 mg/g). The total soluble protein content of leaf was found the highest in *T. tomentosa* (15.94 mg/g) followed by *L. speciosa* (13.37 mg/g) and *T. arjuna* (13.20 mg/g). The highest value of total carbohydrate content of leaf for *T. tomentosa* (8.54%) followed by *L. speciosa*

Table 1: Rearing data of tasar silkworm

| Plant species | Date of brushing | Date of spinning | Larval period (Days) | No. of worm brushed | No. of cocoon harvested | No. of cocoon/DFL |
|----------------------|------------------|------------------|----------------------|---------------------|-------------------------|-------------------|
| <i>T. tomentosa</i> | 11/07/2011 | 06/08/2011 | 27 | 100 | 43 | 86 |
| <i>T. arjuna</i> | 11/07/2011 | 07/08/2011 | 28 | 100 | 41 | 82 |
| <i>T. belerica</i> | 11/07/2011 | 15/08/2011 | 36 | 100 | 38 | 76 |
| <i>T. chebula</i> | 11/07/2011 | 20/08/2011 | 41 | 100 | 11 | 22 |
| <i>L. speciosa</i> | 11/07/2011 | 11/08/2011 | 31 | 100 | 40 | 80 |
| <i>L. parviflora</i> | 11/07/2011 | 29/08/2011 | 50 | 100 | 9 | 18 |

Table 2: Tasar silkworm rearing performance on different food plant species

| Plant species | V^{th} Stage larval weight (g) | Cocoon weight (g) | Shell weight (g) | Silk ratio (%) |
|----------------------|---|-------------------|------------------|----------------|
| <i>T. tomentosa</i> | 41.98 | 12.82 | 1.57 | 12.25 |
| <i>T. arjuna</i> | 37.03 | 14.94 | 1.86 | 12.35 |
| <i>T. belerica</i> | 37.01 | 11.94 | 1.40 | 11.79 |
| <i>T. chebula</i> | 31.58 | 8.67 | 0.95 | 10.98 |
| <i>L. speciosa</i> | 31.91 | 9.25 | 1.21 | 13.05 |
| <i>L. parviflora</i> | 25.28 | 8.08 | 0.91 | 11.28 |
| SED (\pm) | 3.62 | 2.12 | 0.03 | 0.83 |
| CD (5%) | 6.24 | 3.66 | 0.05 | 1.43 |

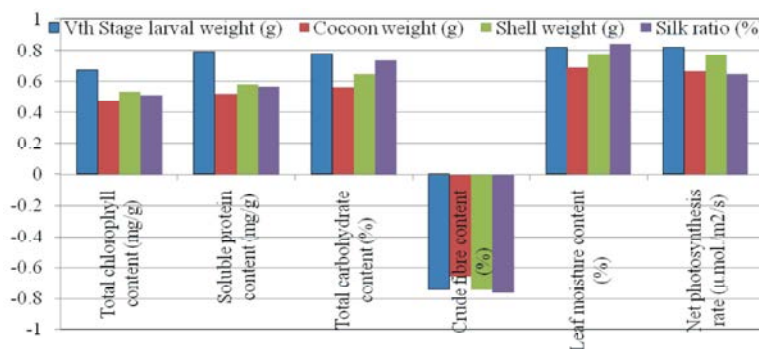


Fig. 2: Correlation between tasar silkworm rearing performance and food plant characteristics

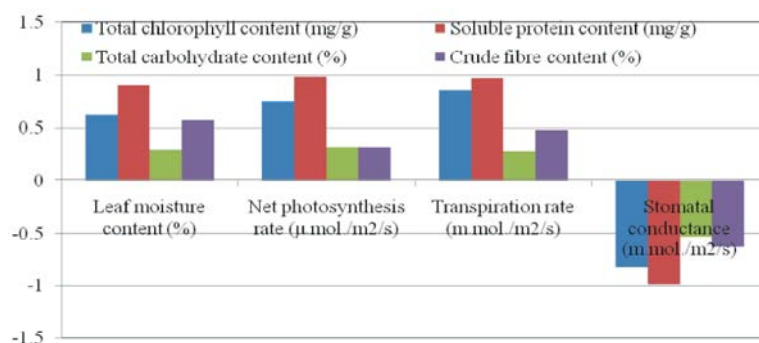


Fig. 3: Corellation between physiological and biochemical parameters of different food plant species

Table 3: Physiological parameters of different food plant species

| Plant species | Leaf moisture content (%) | Net photosynthesis rate (μmol/m ² /s) | Transpiration rate (mmol/m ² /s) | Stomatal conductance (mmol/m ² /s) |
|----------------------|---------------------------|--|---|---|
| <i>T. tomentosa</i> | 72.07 | 21.56 | 4.71 | 179.11 |
| <i>T. arjuna</i> | 70.36 | 18.32 | 6.11 | 449.19 |
| <i>T. belerica</i> | 70.21 | 15.71 | 3.21 | 109.66 |
| <i>T. chebula</i> | 65.24 | 16.12 | 3.39 | 188.94 |
| <i>L. speciosa</i> | 71.21 | 18.58 | 4.37 | 215.87 |
| <i>L. parviflora</i> | 64.23 | 12.86 | 4.63 | 103.98 |
| SED (±) | 0.44 | 2.12 | 0.03 | 1267.14 |
| CD (5%) | 0.76 | 3.66 | 0.05 | 2185.82 |

Table 4: Biochemical parameters of different food plant species

| Plant species | Total chlorophyll content (mg/g) | Soluble protein content (mg/g) | Total carbohydrate content (%) | Crude fibre content (%) |
|----------------------|----------------------------------|--------------------------------|--------------------------------|-------------------------|
| <i>T. tomentosa</i> | 2.69 | 15.94 | 8.54 | 9.49 |
| <i>T. arjuna</i> | 2.59 | 13.2 | 8.01 | 9.86 |
| <i>T. belerica</i> | 2.22 | 11.6 | 7.26 | 12.32 |
| <i>T. chebula</i> | 2.53 | 12.23 | 7.37 | 12.02 |
| <i>L. speciosa</i> | 2.56 | 13.37 | 8.27 | 10.23 |
| <i>L. parviflora</i> | 2.01 | 10.55 | 6.13 | 13.46 |
| SED (±) | 0.08 | 0.37 | 0.11 | 0.04 |
| CD (5%) | 0.13 | 0.64 | 0.20 | 0.07 |

(8.27%) and *T. arjuna* (8.01%) might be due to the highest values of net photosynthesis rate of these three plant species (Table 3 & 4) having positive correlation with silkworm rearing performance (Figure 2 & 3). From data, it can be inferred that these three plant species supplied

higher quantity of palatable food material to silkworm, which ultimately was reflected by better rearing performance of silkworm on these three plant species. However, crude fibre content of leaf, the higher dose of which causes detrimental effect on silkworm nutrition [20]

was found the lowest in *T. tomentosa* followed by *T. arjuna* and *L. speciosa* with a value of 9.49, 9.86 and 10.23%, respectively (Table 4).

Antheraea mylitta is an important economic insect and also a tool to convert leaf protein of food plants into silk protein. It was reported that the larvae of *Bombyx mori* fed with mulberry leaves enriched with protein, showed significant enhancement of larval, cocoon and shell weight [20, 22]. Carbohydrate, protein and lipid are the main sources of energy at the time of larval-larval, larval-pupal, pupal-adult transformation [20, 21].

In the present study, it was found that the leaf of food plant with more moisture, protein, carbohydrates and less crude fibre is the best from tasar silkworm nutritional point of view, which was reflected in terms of better rearing performance of the silkworm on *T. tomentosa*, *T. arjuna* and *L. speciosa*. Similar result was recorded in case of *Bombyx mori* silkworm nutrition, where the mulberry leaf with more moisture, protein, sugar and carbohydrates and less minerals and crude fibre content was found to be the best from silkworm nutrition point of view [20, 23]. Thus, the higher leaf protein and carbohydrate and less crude fibre contents of *T. tomentosa*, *T. arjuna* and *L. speciosa* in our experimental study are found to be desirable for the healthy growth of tasar silkworm larvae and more cocoon production. The higher value of silk ratio recorded for silkworm reared on *L. speciosa* (13.05%) than on *T. arjuna* (12.35%) and *T. tomentosa* (12.25%), might be due to better conversion of assimilated food in to raw silk by the silkworms reared on *L. speciosa*.

CONCLUSION

From the present study, it can be concluded that the rearing of tasar silkworm, *Antheraea mylitta* on *L. speciosa*, which is yet to consider as primary food plant, is as profitable as the rearing of silkworm on *T. tomentosa* and *T. arjuna*, the primary food plants. The numbers of cocoons harvested per DFL were found to be far higher than national benchmark from these three plant species. Silk ratio of cocoons, harvested from *L. speciosa*, was even found to be higher than the cocoons harvested from *T. tomentosa* and *T. arjuna*. The better rearing performance might be due to higher leaf protein and carbohydrate and less crude fibre contents of *T. tomentosa*, *T. arjuna* and *L. speciosa* compared to other plant species. This condition of food plants is undoubtedly desirable for the healthy growth of silkworm larvae thereby resulting more cocoon production and silk ratio. However, the present experimental study does not

advocate *Terminalia chebula* and *Lagerstroemia parviflora* to be used for tasar silkworm rearing. The present finding recommends mass tasar silkworm rearing trial at farmer's level on *Lagerstroemia speciosa* for validation of this plant species as primary food plant for tropical tasar silkworm (*Antheraea mylitta* Drury) rearing, commercially.

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