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Host Plant Specificity of Indian Tasar Silk Insect *Antheraea mylitta* Drury (Saturniidae) during Different Seasons

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***Abstract** : The tasar (or tussore or tusser or tussur or tussah) silk that contributes substantially to the national economy of a number of countries and provides gainful occupation to lakhs of people is produced by different species of tasar silk insect of genus Antheraea Hubner belonging to family Satuniidae of order Lepidoptera. In the present investigation an experimental rearing of Antheraea mylitta Drury, the Indian tropical tasar silk insect was carried out during rainy, autumn and winter seasons at lower altitude in the rearing fields at Basic Seed Multiplication and Training Centre, Central Silk Board, Ministry of Textiles, Government of India, Palbani, Baripada, Mayurbhanj, Odisha, India to evaluate the growth performance of fifth instar male larva in terms of length, breadth and weight in eight different food plants. Significantly the highest value of each growth parameter was recorded from the larva raised on Asan (Terminalia alata W. & A.) food plant during autumn and winter seasons where as the highest growth was indicated by the larva grown on Sal (Shorea robusta Gaertn) food plant during rainy season. In view of the comparatively superior growth performances of the mature male larvae of A. mylitta at lower altitude, the eight species of food plants utilized were graded in the order Sal > Asan > Arjun > Ber > Sidha > Dha > Bahada >Jamun during rainy season; Asan > Sal > Arjun > Ber > Sidha > Dha > Bahada >Jamun during autumn season, but Asan followed by Arjun, Sal, Ber, Sidha, Dha, Bahada and Jamun during winter season. The present investigation also revealed that irrespective of the food plants, winter season was more ideal for tasar cocoon crop performances of A. mylitta in comparison to rainy and autumn seasons at lower altitude.Key words: Antheraea mylitta, fifth instar, altitude, growth, rainy, autumn*

1. Introduction

Antheraea mylitta Drury is a polyphagous semi-domesticated sericigenous insect which produces the world famous Indian tropical tasar silk. It is widely distributed in the natural forests located at different altitudes over central India between the range of 12 – 31^0 N latitude and 72 – 96^0 E longitude in the form of about 44 ecoraces. The fifth instar larva is the most decisive stage in its life cycle for growth and post larval life as well as for exploiting its genetic potency and dynamics to our best advantages. It is trivoltine (three broods in a year) at lower altitude (50 – 300 m ASL) but behaves as bivoltine (BV) at medium altitude being reared during July - August (first crop or rainy cocoon crop or seed crop) and September- October (second crop or autumn crop or commercial crop). Being polyphagous, the silkworm usually feeds on the leaves of primary food plants such as Asan (*Terminalia alata* W. & A.), Arjun (*Terminalia arjuna* W. & A.) and Sal (*Shorea robusta* Gaertn). However, more than two dozens of secondary host plants are also available in the natural forests of Indian tropical tasar belt of which Ber (*Ziziphus jujuba* Gaertn), Sidha (*Lagerstroemia parviflora* Roxb.), Dha (*Anogeissus latifolia* Wall.), Bahada (*Terminalia belerica* (Gaertn) Roxb.) and Jamun (*Syzygium cumini* (L.) Skeels) are the most abundant species. Since feeding of nutritionally enriched leaves directly influences better growth and development of silkworm larva as well as the quality and quantity of silk production, establishment of food plant specificity of silk insect along with evaluation of the commercial parameters of tasar culture in each food plant during different seasons is highly essential for increasing the production of raw silk and seed cocoons.

Literatures are available on Evaluation of Novel Tasar Silkworm Feed [12], performance of rearing of *A. mylitta* at lower altitude in some food plants [3], growth and leaf yield of Asan and Arjun [14], Comparative Study of the Effect of Different Food Plants [5], impact of environmental factors on the indoor rearing [12], induction of biomolecules in mature leaves of *T. arjuna* [1], voltinism of *A. mylitta* [13], altitudinal and seasonal Effects on Growth [9], effect of starvation on larva [2], larval energetics in different food plants [4], reproductive characteristics of Modal ecorace [6], development of fifth instar female larva of *A. mylitta* [10]. But no literature is available giving concrete information on the economics of cocoon crop of *A. mylitta* raised on different primary as well as unutilized secondary food plants which can be exploited sustainably by the local tribes for tasar culture. So in the present study, an attempt was made to evaluate comparative effects of eight different food plant species on rearing performance of *A. mylitta* during different rearing seasons at lower altitude in the tropical tasar belt of India.

2. Materials and Methods

A number of food plants having identical age and growth were selected at random from each of the eight species at lower altitude (50 – 300 m ASL). The food plants were kept under watch and ward activities throughout the rearing process. The cocoon crop experiment was started with hatchlings hatched from 5 B.V. dfls supplied by Research Extension Centre, Central Silk Board, Bangriposi, Mayurbahnj, Odisha. The larvae of *A. mylitta* were reared on each type of food plant during rainy, autumn and winter seasons as per recommendation of FAO manual and guidelines published by Regional Tasar Research Station, Central Silk Board, Baripada, Mayurbhaj, Odisha. At the late fifth instar stage, the growth of male larvae in terms of length (cm), breadth (cm) and weight (g) was evaluated in each food plant. The length and breadth of the male larvae were measured by using millimeter scale and slide caliper respectively. The weight of the larvae was determined gravimetrically by using 0.001 mg sensitive digital balance. The graphical presentation was also prepared by use of the experimental data to study and establish the correlationship of growth tendency of male larvae between different food plants and seasons. The data so obtained were statistically analyzed applying standard methods like 't' test and ANOVA test [19] for each type of larval growth parameter.

3. Results

The growth performance of mature male larvae of *A. mylitta* reared on different food plants during rainy season at lower altitude in terms of length (cm), breadth (cm) and weight (g) was compared. The results indicated the highest value of larval growth in terms of length (11.61 ± 0.02), breadth (1.84 ± 0.01) and weight (28.47 ± 0.71) in Sal food plant (Table 1). In case of Jamun grown male larva the lowest growth in length (7.56 ± 0.04), breadth (0.87 ± 0.03) and weight (14.13 ± 0.92) was observed (Table 1). The 't' test indicated significant ($p < 0.05$) difference in growth in terms of length, breadth and weight of the larvae raised on different food plants. Significant ($p < 0.01$) interaction between the food plants and the growth parameters of mature male larvae reared at lower altitude during rainy season was also observed from ANOVA test. The gradation of the food plants in terms of comparatively better performance of growth parameters of the larvae of *A. mylitta* during rainy season at lower altitude was in the order Sal > Asan > Arjun > Ber > Sidha > Dha > Bahada >Jamun.

The analysis of growth data of mature male larvae raised on different food plants during autumn season at lower altitude revealed that Asan grown larva acquired the highest growth in terms of length (11.72 ± 0.05), breadth (1.87 ± 0.01) and weight (33.91 ± 0.91) (Table 2). The lowest growth in length (8.37 ± 0.12), breadth (1.02 ± 0.03) and weight (16.13 ± 1.04) was observed from the larva reared on Jamun food plant (Table 2). Significant ($p < 0.05$) difference in growth in terms of length, breadth and weight of the larvae raised on different food plants was indicated from 't' test. The ANOVA test also showed significant ($p < 0.01$) interaction between the food plants and the growth parameters of fifth instar larvae reared at lower altitude during autumn season. In view of performance of all the larval growth parameters, the food plants utilized during autumn season at lower altitude were ranked in the order Asan > Sal > Arjun > Ber > Sidha > Dha > Bahada >Jamun.

Similarly, the comparison of different values of each growth parameter at lower altitude during winter season indicated the highest growth in terms of length (12.60 ± 0.04), breadth (2.12 ± 0.02) and weight (38.43 ± 0.94) in the male larva raised on Asan food plant (Table 3).The lowest growth in length (8.87 ± 0.08), breadth (1.11 ± 0.04) and weight (20.64 ± 1.78) was observed from the Jamun grown male larva. The 't' test showed significant ($p < 0.05$) difference in all the growth parameters of larvae grown on different food plants. Significant ($p < 0.01$) interaction between the food plants and growth of mature male larva at lower altitude during winter season was also observed from ANOVA test. Considering the overall performance of all the growth parameters of the male larvae during winter season at lower altitude the food plants were graded in the order Asan followed by Arjun, Sal, Ber, Sidha, Dha, Bahada and Jamun.

From the above observations it was revealed that the growth of mature male larva in terms of length, breadth and weight at lower altitude was the highest in Sal food plant during rainy season but in Asan plant during autumn as well as winter season and the lowest in the Jamun food plant during all the three rearing seasons (Fig. 1, Fig. 2 & Fig. 3).

4. Discussion

Essentiality of a quantitative nutrition for sericigenous insects for maintaining optimal physiological status has been reported [15, 7]. Similarly the leaf moisture content was also reported to have positive correlation with silkworm rearing performance [20]. During rainy season at lower altitude the growth of mature male larva in terms of length, breadth and weight was observed to be the highest in Sal (*S. robusta*) food plant. This indicates the superiority of Sal plant among all the food plants for growth and development of *A. mylitta*. It might be either due to adequate amount of essential nutrients in a required relative balance in the Sal leaves or might be due to greater leaf succulency favoured by optimum climatic conditions by which the tasar larva could exhibit the highest growth performance and attain maximum potential fitness.

The effect of seasonal changes in the nutritional quality of leaf on growth of herbivore insects has been reported [17]. Plant protease inhibitors have been known as anti-nutritional factors that negatively affect the growth of herbivore animals [8]. In the present investigation the performance of all the growth parameters of mature male larva was the highest in Asan (*T. alata*) food plant at lower altitude during autumn as well as winter season. The better rearing performance might be due to higher soluble leaf proteins and carbohydrate but less crude fibre contents of *T. alata* compared to the other food plant species, which is desirable for the healthy growth of silkworm larvae. Moreover, there might be minimum protease inhibitor and tannin content in the leaf of *T. alata* which might have reduced the chances of formation of complexes with plant proteins that cannot be attacked by plant proteases. The lowest larval growth performance in Jamun food plants at lower altitude during rainy, autumn and winter seasons might be due to inadequacy and imbalance in the nutrients as well as greater protease inhibitor activity leading to increased resistance against tasar silk worm.

Seasonal variation of larval weight of wild tasar silk moth *Antheraea frithi* M. and autumn season was found to give the highest value followed by spring and summer were earlier reported [16]. The results of this study with regard to growth performance of mature larva indicated significant variation during different rearing seasons. At lower altitude the highest larval body growth was recorded during winter season followed by autumn season and rainy season in all the eight different species of food plants. The highest growth performance of larva during winter season was found to be correlated with comparatively lowering of temperature (20.34 ± 0.37 ^{0}C), RH (67.27 ± 1.46 %), photoperiod (10.28 ± 0.12 hr) as well as rain fall (31.34 ± 8.18 mm). Thus, the seasonal variation of growth of larva is a function of change of different environmental parameters in a particular geographical region.

Asan, Arjun and Sal food plants are reported to be food plants of primary importance for cocoon crop performance of tasar silk insect [11]. But the present investigation indicated consideration of Ber, Sidha and Dha for rearing activities of *A. mylitta* when there is inadequacy of primary food plants in the rearing field without hampering much the economics of cocoon crop, although they are graded as secondary food plants [11]. The larval growth results on Ber food plant (*Ziziphus jujuba*) was much encouraging indicating that it can be also included under primary group of food plants of *A. mylitta*, since the overall performance on it remained very much at par with Arjun and Sal. However in case of acute shortage of food plants during peak period of rearing seasons, the consideration of food plants like Sidha and Dha for rearing purpose is suggested here, since the performance of cocoon crop on these food plants is commercially not too much impaired. Here the growth performance of larva on Bahada food plants indicated considerable results for its utilization at the time of severe scarcity of food plants. But the larval growth performance was unsuitable on Jamun food plant at the lower altitude during rainy, autumn and winter seasons which indicates the commercial non viability of this food plant for rearing activities. Further investigation on the above growth parameters at the other developmental stages of the insect at different altitudes on different food plants during different seasons may be carried out in order to draw a concrete conclusion.

5. Conclusion

Cocoon crop performances of *A. mylitta* on the available limited number of primary food plant species cannot meet the increasing demand for tasar silk at the present time. So it is absolutely necessary to find out the alternative and abundant species of food plants to fulfill the growing requirements of tasar silk. The present experimental study revealed that the rearing of *Antheraea mylitta* on *Ziziphus jujuba*, which is not included under primary group of food plant till date, is as per the profitable rearing on *T. alata, S. robusta* and *T. arjuna*, the primary food plants. The vast availability of this unutilized food plant in the natural forests of India can be exploited sustainably by the local tribes for successful cocoon crop performance of *A. mylitta***.** However, the rate of production and quantity of leaf and gestation period of this plant need special consideration in comparison with primary host plants for the commercial feasibility.

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Table 1. Growth ($\bar{x}$ ± SD) of fifth instar male larva of *A. mylitta* reared on different food plants at lower altitude during rainy season

Food Plants	Length (in cm)	Breadth (in cm)	Weight (in g)
Asan	11.54 ± 0.04	1.75 ± 0.01	26.24 ± 0.48
Arjun	11.46 ± 0.06	1.72 ± 0.02	24.55 ± 0.52
Sal	11.61 ± 0.02	1.84 ± 0.01	28.47 ± 0.71
Ber	11.43 ± 0.03	1.68 ± 0.01	24.26 ± 0.93
Sidha	10.92 ± 0.07	1.37 ± 0.03	20.76 ± 0.88
Dha	10.83 ± 0.02	1.28 ± 0.02	20.17 ± 0.34
Bahada	09.74 ± 0.03	1.12 ± 0.01	18.21 ± 0.76
Jamun	07.56 ± 0.04	0.87 ± 0.03	14.13 ± 0.92

Table 2. Growth ($\bar{x}$ ± SD) of fifth instar male larva of *Antheraea mylitta* reared on different food plants at lower altitude during autumn season

Food Plants	Length (cm)	Breadth (cm)	Weight (g)
Asan	11.72 ± 0.05	1.87 ± 0.01	33.91 ± 0.91
Arjun	11.51 ± 0.03	1.76 ± 0.03	29.09 ± 0.64
Sal	11.59 ± 0.04	1.81 ± 0.02	31.27 ± 0.78
Ber	11.46 ± 0.03	1.71 ± 0.01	28.82 ± 0.56
Sidha	11.14 ± 0.08	1.43 ± 0.03	24.19 ± 0.82
Dha	10.98 ± 0.06	1.34 ± 0.02	23.87 ± 0.23
Bahada	10.22 ± 0.09	1.19 ± 0.04	21.36 ± 0.67
Jamun	8.37 ± 0.12	1.02 ± 0.03	16.13 ± 1.04

Table 3. Growth ($\bar{x}$ ± SD) of fifth instar male larva of *Antheraea mylitta* reared on different food plants at lower altitude during winter season

Food Plants	Length (cm)	Breadth (cm)	Weight (g)
Asan	12.60 ± 0.04	2.12 ± 0.02	38.43 ± 0.94
Arjun	12.43 ± 0.03	1.95 ± 0.03	34.80 ± 0.61

Sal	12.02 ± 0.05	1.87 ± 0.01	34.21 ± 0.57
Ber	11.91 ± 0.03	1.78 ± 0.01	32.37 ± 0.73
Sidha	11.33 ± 0.06	1.54 ± 0.04	29.56 ± 0.62
Dha	11.16 ± 0.05	1.39 ± 0.03	27.32 ± 0.58
Bahada	10.54 ± 0.04	1.28 ± 0.02	25.48 ± 0.46
Jamun	8.87 ± 0.08	1.11 ± 0.04	20.64 ± 1.78

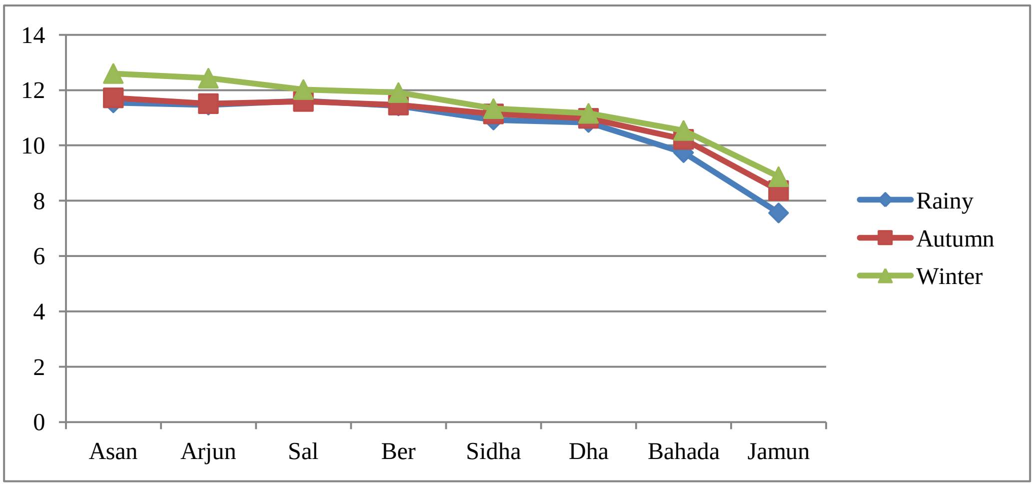

Fig. 1. Growth in length (cm) of fifth instar male larva of *A. mylitta* reared on different food plants at lower altitude during rainy, autumn and winter seasons

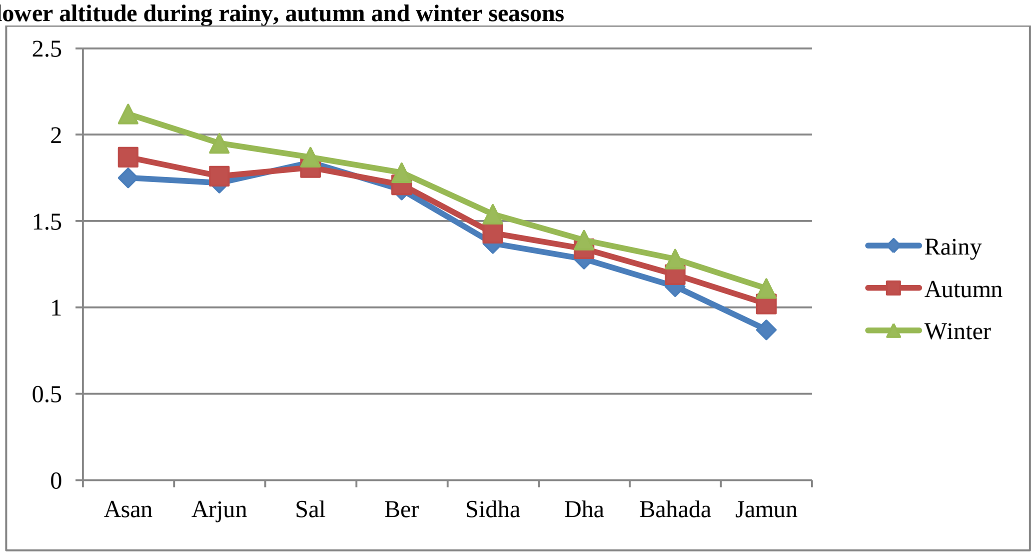

Fig. 2. Growth in breadth (cm) of fifth instar male larva of *A. mylitta* reared on different food plants at lower altitude during rainy, autumn and winter seasons

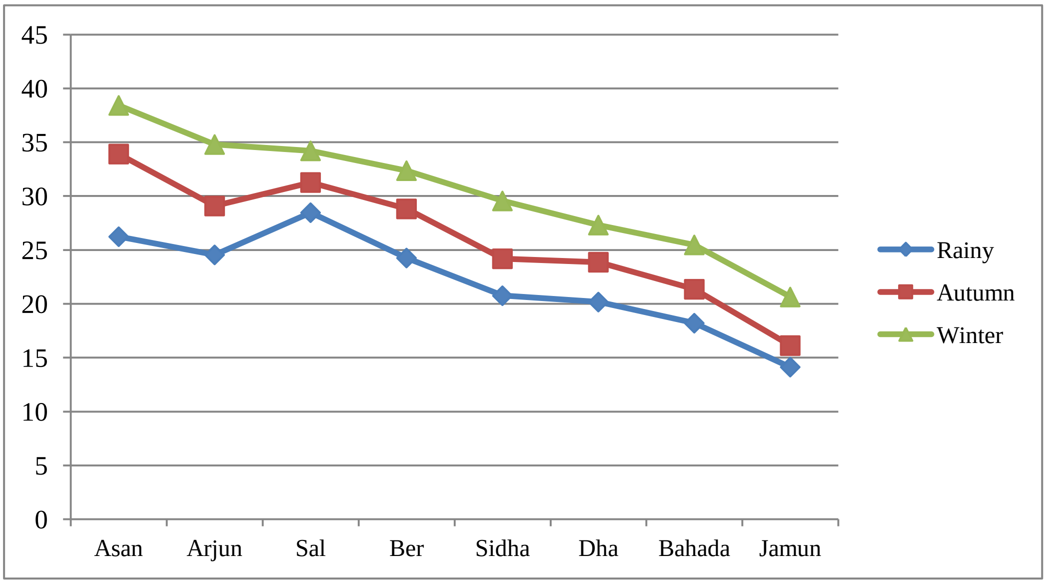

Fig. 3. Growth in weight (g) of fifth instar male larva of *A. mylitta* reared on different food plants at lower altitude during rainy, autumn and winter seasons