REARING PERFORMANCES OF INDIAN TEMPERATE TASAR SILKWORM, *ANTHERAEA PROYLEI* JOLLY FED ON *QUERCUS SERRATA* (CARRUTHER), *QUERCUS GRIFFITHII* (HOOK & THOMSON) AND *LITHOCARPUS DEALBATA* (HOOK & THOMSON) DURING AUTUMN CROP

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ABSTRACT: Studies were conducted to evaluate the rearing performances of Oak tasar silkworm, *Antheraea proylei* on three different food plants during autumn crop at Regional Tasar Research Station, Central Silk Board, Mantripukhri, Imphal. The rearing performances of *A. proylei* fed on *Quercus serrata* (1:24.26) had shown highest cocoon productivity than *Quercus griffithii* (1:21.33) and *Lithocarpus dealbata* (1:11.99). Though, the overall better rearing performance in terms of larval duration, cocoon yield , ERR % was observed with *Q. serrata* fed larvae, however in terms of economic parameters, *Q. griffithii* fed larvae recorded higher shell weight (1.01) and silk ratio (12.23%) than *Q. serrata* (0.91 shell wt.; 11.16 SR%). The highest growth rate in terms of length (6.181± 0.07), breadth (1.221 ± 0.003) and weight (7.470 ± 0.11) of the 5th instar larvae was also recorded with larvae fed on *Q. griffithii*.

KEY WORDS: *Antheraea proylei*, rearing performance, *Q. serrata*, *Q. griffithii*, *L. dealbata*, cocoon yield, ERR%

Oak tasar is a finest variety of tasar silk generated by the silk worm *A. proylei* which feed on food plants of oak, found naturally in abundance in the sub Himalayan belt of India. Manipur enjoys an enviable position as the main producer of Oak tasar in India. The state has a unique climatic condition where all types of oak plants are grown naturally. At present, 20 species of Oak plants are growing in Manipur of which *Q. serrata* (Local name - Uyung), *Q. griffithii* (Local name – Chakpauyung) and a species of tan oak *L. delbata* (Local name – Sahi) are in plenty covering around 40,000 hectares. Of these 20,000 hectares had been identified and exploited profitably for oak tasar culture while the rest were left untouched due to their inaccessibility and consequent inability in exploiting them. A number of families in Manipur are dependent on oak tasar culture for their livelihood, however, the cocoon productivity is quite low because of the number of constraints faced in taking up this culture. It is assured that the success of Oak tasar silkworm rearing depends mainly on choosing suitable locations and allocating to each location, the right season and food plant most likely to get success in the area selected for rearing. Kumar et al. (2013) reported that one of the main constraint in tasar culture is the inconsistency in crop success during summer and autumn season due to decline in quality foliage, fluctuation of environmental temperature, diseases etc. Singh (1992) opined that growth and development of a biological organism largely depend on the type of food taken by the organism. He further reported that silkworms particularly fed on oak, the type of food play an important role for its growth, development, cocoon yield and reproduction. Similarly, Jena (2016) reported that insects feeding on nutritionally enriched leaves directly influence the better growth and development of silkworm larva as well as the quality and quantity of silk production, establishment of food plant specificity of the silkworm along with evaluation of the commercial parameters in each food plant which is highly essential for increasing the cocoon yield and production of raw silk. Leaves are the sole food for the silkworm in commercial sericulture and quality and quantity of the leaf fed during rearing decide success of silkworm crop. Hence choice of leave suitable for healthy growth of silkworm is one of the most important factor in sericulture (Ranjan et al., 1996). The present study was taken up to evaluate the comparative effects of three different food plants on the rearing performance of *A. proylei* during autumn crop.

MATERIALS AND METHODS

The present work was taken up to analyze the impact of three different oak tasar food plants *viz. Quercus serrata*, *Quercus griffithii* and *Lithocarpus delbata* on larval duration, larval weight, effective rate of rearing (ERR), Cocoon yield and cocoon economic traits. The study was carried out at Regional Tasar Research Station, Mantripukhri, Imphal. Disease free layings (dfls) were obtained from Breeding and Genetics section of RTRS, Imphal. The rearing was conducted by following the recommended rearing technology for oak tasar culture developed by RTRS, Imphal. Rearing of early instars up to 2nd stage was done indoor (mean temperature & relative humidity at 24^{o}C and 80%) and the late age at outdoor (mean temperature & relative humidity at 27^{o}C and 85%) under nylon net cover on the bush plantation for protection of worm from pest and predator. 1.5 % of Urea (15 gm urea per liter of water) was sprayed on leaves of oak tasar food plants for increasing the production of leaves qualitatively and quantitatively. Urea application was done 15 days before brushing. Jeevan Sudha solution, a disinfectant (1 part of Jeevan Sudha : 100 part water) was sprayed on larvae for every instar in 1st to 3rd instar for prevention and control of diseases. The observations on different rearing parameters like larval weight, larval duration, ERR, cocoon yield, cocoon commercial traits *viz.* single cocoon weight, single shell weight, silk ratio percentage were recorded and the data were evaluated for the statistical significance.

RESULTS AND DISCUSSION

The study on comparative rearing performance of *A. proylei* on different food plants *viz. Q. serrata*, *Q. griffithii* and *L. delbata* was conducted at Entomology and Pathology laboratory of RTRS, Imphal. Considerable variations in the rearing performances were observed when fed on three different food plants (Table 1).

Cocoon Yield:

In oak tasar culture, food is a major contributing factor for successful rearing resulting in higher cocoon yield of better quality. The mean cocoon yield of *A. proylei* fed on *Q. serrata* was 24.26 cocoons/dfl with 27.27% ERR which was almost similar with larva fed with *Q. griffithii* producing 21.33 cocoons/dfl and 25.79% ERR. The rearing performance of the silkworm fed on *L. dealbata* was poor producing only 11.99 cocoons/dfls and 14.53% ERR. Less larval mortality was observed with larvae fed on *Q. serrata* and *Q. griffithii*. This indicated more cocoon yield with superiority of the food plants in oak tasar silkworm, *A. proylei*. Similar observations were made by Reddy *et al.* (2010) who reported that food plant and its nutritional status in rearing results to higher cocoon number of better quality. The F-value indicated that tasar culture play a pivotal role for the successful larval significant difference ($p<0.01$) in terms of cocoon yield and ERR which was observed from Anova test (Table 1).

Larval period:

There were five larval instars of *A. proylei* fed on the three food plants *viz. Q. serrata*, *Q. griffithii* and *L. dealbata*. The larval period took 38 days when fed on *Q. serrata* and *Q. griffithii* but it extended up to 43 days when fed on *L. dealbata*. Ojala et al. (2005), Behmer (2006) and Cizek et al. (2006) reported that any insect larva shortens its life span, if it gets required nutrition and can survive better with either improved defense system developed with superior nutrition or shorter chance of exposure to the pathogens. In the initial instars from 1st to 3rd instars the development of *A. proylei* larva had no significant difference. However, differences in this parameter were observed from 3rd instar onwards. The larval period took 6, 9, 13 days in 3rd, 4th and 5th instars with larva fed on *Q. serrata* and *Q. griffithi* whereas it was 4 to 5 days more with larva fed on *L. dealbata* (Table 2).

Length, Breadth and Weight of larva:

During the early instars the morphometric dimensions of the larvae was almost similar (Table 3). However, as the stage of the larva advances significant difference could be observed. The highest growth in terms of length (6.181± 0.07), breadth (1.221 ± 0.003) and weight (7.470 ± 0.11) of the 5th instar larvae was observed in *Q. griffithii* (Fig. 1). This clearly indicated that *A. proylei* silkworm grows better with larva fed on *Q. griffithi* which was at par with larva fed on *Q. serrata*. The weight of 5th instar larva was observed lowest when fed on *L. dealbata*. Similar observations were made by Dash et al. (1992) and reported that suitable host plant and the leaf nutrition of food plants enhances the growth of larvae.

Cocoon weight, Shell weight and Silk ratio:

The results indicated the highest value in terms of cocoon weight (8.35 ± 1.07) with larva fed on Q. *serrata* and highest shell weight (1.01 ± 0.22) and silk ratio (12.23 ± 0.95) with larva fed on Q. *griffithi*. Sinha *et al.* (2000) reported that the increase in silk as shell content in the tasar larva fed on *T. tomentosa* leaf, which might be with substantial food allocation required for silk production. In case of *L. dealbata*, grown larvae the lowest value of cocoon weight (7.35 ± 0.45), shell weight (0.65 ± 0.05) and silk ratio (8.84 ± 2.21) was observed (Table 4). The F-value indicated significant difference ($p<0.01$) in terms of cocoon weight and SR% and shell weight ($p<0.05$) as observed from Anova test (Table 4). The ranking of food plants in terms of comparatively better performance of cocoon weight of *A. proylei* was in the order *Q. serrata*> *Q. griffithii* > *L. dealbata* whereas in terms of shell weight and shell ratio it was *Q. griffithii* > *Q. serrata* > *L. dealbata*.

The rearing performances of *A. proylei* fed on *Q. serrata* have shown highest cocoon productivity than *Q. griffithii* and *L. dealbata*. In view of the comparatively superior cocoon productivity of *A. proylei*, *the* three food plants species were ranked in the order *Q. serrata* > *Q. griffithi* > *L. dealbata*. However, *Q. griffithii* fed plants recorded higher shell weight and silk ratio than *Q. serrata* fed plants and at par with all other rearing parameters with *Q. serrata*. The better rearing performance in *Q.griffithii* in terms of shell weight and SR % gives a clue that this food plant contains higher nutritional status which requires further detailed study. At present *Q. serrata* alone cannot meet the demand for production of oak tasar silk. So, it is necessary to utilize the alternative and abundant species of food plant for commercial rearing to fulfil the growing requirement of oak tasar. *Q. griffithii* which are available luxuriantly with good quality foliage in higher altitudes during autumn crop can be utilized as viable oak tasar food plant since *Q. serrata* foliage quality are poor during this season. This will surely increase the productivity of oak tasar culture by ensuring a successful autumn crop of oak tasar.

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Table 1. Comparative performance on rearing parameters of *A. proylei* fed on *Q. serrata*, *Q. griffithii* and *L. dealabata* [Mean±SD].

Parameter	***Q. serrata***	***Q. griffithii***	***L. dealbata***	**F-value**
Larval period (days)	38.33 ±0.57	43.00 ±1.00	43.00 ±1.00	**2031.11****
Cocoon yield /dfl	24.26 ±3.10	21.33 ±1.42	11.99 ±1.17	**75.60****
ERR %	27.27 ±1.39	25.79 ±1.39	14.53 ±0.32	**99.39****

** Significant at $p< 0.01$

Table 2. Duration of larval instars of *A.proylei* fed on different food plants.

Larval Instar	***Q. serrata* (days)**	***Q. griffithii* (days)**	***L. dealbata* (days)**
1st	5	5	5
2nd	5	5	5
3rd	6	6	6
4th	9	9	11
5th	13	13	16
Total	**38**	**38**	**43**

Table 3. Growth of larval instars of *A. proylei* reared on different food plants [Mean±SD].

Larval Instars	*Q. serrata*			*Q. griffithii*			*L. dealbata*		
	Length (cm)	Breadth (cm)	Weight (g)	Length (cm)	Breadth (cm)	Weight (g)	Length (cm)	Breadth (cm)	Weight (g)
1st Instar	0.820 ± 0.020	0.129 ± 0.002	0.005 ± 0.004	0.813 ± 0.020	0.125 ± 0.003	0.004 ± 0.0004	0.811 ± 0.020	0.110 ± 0.0009	0.004 ± 0.004
2nd Instar	1.81 ± 0.060	0.136 ± 0.002	0.090 ± 0.003	1.730 ± 0.07	0.143 ± 0.003	0.090 ± 0.004	1.480 ± 0.010	0.122 ± 0.002	0.051 ± 0.003
3rd Instar	3.064 ± 0.060	0.598 ± 0.009	1.002± 0.080	3.274 ± 0.050	0.625 ± 0.011	1.220 ± 0.120	2.708 ± 0.050	0.551 ± 0.010	0.280 ± 0.01
4th Instar	5.555 ± 0.100	1.128 ± 0.0006	3.690 ± 0.20	5.691 ± 0.100	1.190 ± 0.002	5.040 ± 0.040	4.250 ± 0.040	0.973 ± 0.020	2.09 ± 0.23
5th Instar	6.010 ± 0.050	1.167± 0.001	7.320 ± 0.460	6.181 ± 0.07	1.221 ± 0.003	7.470 ± 0.110	5.740 ± 0.060	1.135 ± 0.001	5.23 ± 0.08

Table 4. Comparative performance of cocoon economic traits of *A. proylei* fed on *Q. serrata*, *Q. griffithii* and *L. dealbata* [Mean±SD].

Parameter	***Q. serrata***	***Q. griffithii***	***L. dealbata***	***F-value***
Cocoon weight (g)	8.35 ±1.07	8.27 ±1.41	7.35 ±0.45	**53.98****
Shell weight (g)	0.91 ±0.05	1.01 ±0.22	0.65 ±0.05	**14.57***
Silk ratio (%)	11.16 ±1.94	12.23 ±0.95	8.84 ±2.21	**162.39****

* Significant at $p < 0.05$ ** Significant at $p < 0.01$

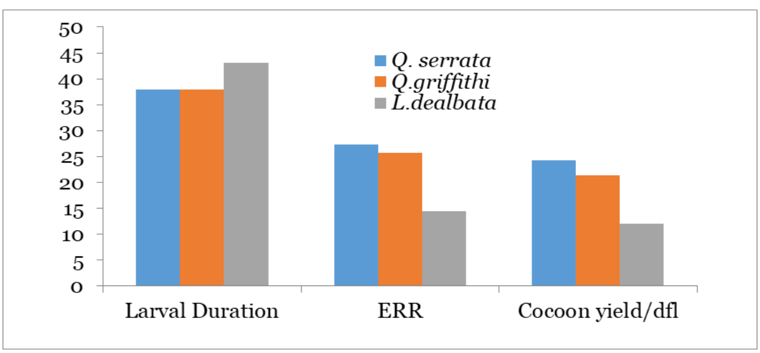

Figure 1. Performance on rearing parameters of *A. proylei fed* on *Q. serrata*, *Q. griffithii* and *L. dealbata*.

(a) (b) (c) (d) (e) (f)

Figure 2 (a-f). Early instars of *A. proylei* reared on (a) *Q. serrata*, (b) *Q. griffithii*, (c) *L. dealbata* and matured instars reared on (d) *Q. serrata*, (e) *Q. griffithii*, (f) *L. dealbata*.