

PERFORMANCE OF PROMISING ECORACES OF ERI (*PHILOSAMIA RICINI*) IN AGROCLIMATIC CONDITIONS OF WESTERN ODISHA

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ABSTRACT

Culturing non-mulberry silkworm Eri (*Philosamia ricini*) is a traditional vocation in Eastern and North Eastern part of India. At present the variety of Eri silkworm cultured by farmers of Odisha has very low silk yield potential. The Eri eggs supplied to the farmers of Odisha are from a mixed population of several varieties. However in Assam and Meghalaya of North East India exist several ecoraces of *Philosamia ricini* in isolated pockets, separated by cultural and geographical barriers. The objective of the project is to examine the ecoraces of North east India namely Borduar, Titabar and Mendipathar in order to augment Eri silk production in Odisha. Assessment of these ecoraces was done under the local agro-climatic conditions taking morpho-developmental parameters. For this larval and cocoon characteristics, fecundity, mortality and silk production were investigated. Further the performance of rearing, cocoon and grainage performance were studied. The one way ANOVA analysis reveals that the SR% of the three ecoraces is significantly higher than present mixed variety of unknown genetic origin ($p < 0.05$). The data suggests that these ecoraces can be used for higher silk yield by the Eri farmers of Odisha.

INTRODUCTION

Culturing of non-mulberry silkworm *Philosamia ricini* (Eri) is believed to be originated from Assam. (Sarkar, 1988). But it has been in practice traditionally in Odisha, an eastern state of India for ages. (Kar, 2004) In Odisha, the non-mulberry silkworms, *Antheraea mylitta* and *A. paphia* are usually cultured in Mayurbhanj, Keonjhar and some other places (Nayak and Dash, 1991; Mohanty and Mitra, 1991; Nayak and Dash, 1999). The present day Eri cultivation is done under the patronage and supervision of the Government of Odisha, in order to assure a sustainable source of income. The Directorate of Textiles and Handloom, Government of Odisha supplies disease free laying (DFLs) of *P. ricini* to the rearers by their own network (Hota et al., 2005). The layings are generally collected from a place Mirza, Assam and after being nurtured at government farms and the F-1 seeds are supplied to the farmers for commercial rearing. The rearing performance of the layings (eggs) of Eri supplied by the agency to the farmers is not very attractive. The under-performance by the present Eri culture practice is evident in the larval characters, silk yield, pupation rate, moth emergence and fecundity of the silkworm. One of the reasons which can be attributed for the low yield is that the F1 seeds supplied to the farmers are not performing well in the climatic condition of western Odisha. The dwindling returns of *P. ricini* DFLs supplied to the farmers need to be reevaluated in terms of new gene type.

The objective of the present piece of work is to investigate whether some of the ecoraces of *P. ricini* which are confined to only some isolated places such as Borduar, Titabar and

Mendipathar can be tried in the agro climatic conditions of Western Odisha for better silk yield.

MATERIALS AND METHODS

Collection and rearing of ecoraces: Three ecoraces of *Philosamia ricini* namely Borduar, Titabar and Mendipathar were collected from the CSR and TI, (Central Sericultural Research and Training Institute), Berhampore, West Bengal and cultured in the Ericulture Lab of School of Life Sciences, Sambalpur University and in the field by Eri farmers of Sundergarh district of Western Odisha. This region has an annual temperature range of 7-47°C and mean rainfall regime of about 100 – 140cm and RH range of 45-85%. The Eri worms were fed with adequate amount of castor leaves collected from the naturally grown castor plants in the vicinity. The cocoons harvested out of three DFLs reared in the first crop and the cocoons were processed for seed in the unit and their performance was assessed. The data was compared with the published results of Hota et al., (2005) of Directorate of Textiles, Government of Odisha, which is considered as reference. In the rearing and grainage, procedures recommended by Jolly et al., (1979) and Sarkar (1988) were followed.

Larval characters- hatchability, body weight and ERR: The hatching percentage of the eggs under aseptic conditions was scored for each lot of eggs and the duration of incubation was recorded. Larval body weight of the 5th instar larvae was recorded on the sixth day for five consecutive rearing. The average duration of the entire larval period was recorded basing on the visible morphological characters from the day of

hatching to the day of spinning. Effective Rate of Rearing (ERR) was calculated by the following formula and expressed as the average of the five rearing.

$$ERR\% = \frac{\text{Total no. of cocoons formed}}{\text{Total no. of worms brushed}} \times 100$$

Cocoon Characters: Cocoon characters like color, shape, single cocoon weight, and single shell weight were recorded for each of the ecoraces. The single shell weight, single cocoon weight and shell ratio percentage was calculated from the 30 randomly collected samples of the ecorace (10 of each ecorace).

$$\text{Shell ratio (\%)} = \frac{\text{Shell weight}}{\text{Cocoon weight}} \times 100$$

Grainage Performance: The grainage performance of the ecoraces of *Philosamia ricini* was calculated by measuring the rate of pupation, percentage of moth emergence and fecundity of the worms, average of five consecutive rearing. Pupation rate was calculated by counting the number of worms which spin cocoons and undergo pupation and the percentage of moth emergence was calculated as per the number of moths emerged per 100 cocoons. Fecundity was measured by random sampling of the number of eggs laid by the mother moth.

All the five rearing was done during July 2008 to April 2009 in laboratory as well in the field. In the field, rearing was done as per the prevailing climatic conditions without any manipulation.

RESULTS AND DISCUSSION

Ecoraces of insects are variants in terms of subtle morphological and genetic variations. Many of them are isolated in pockets of geographically separated but contiguous climatic zones. In this project the Borduar, Titabar and Mendipathar ecoraces of *P. ricini* were examined under lab and field conditions. These ecoraces are named after their location of their origin. The Borduar ecorace is found in Borduar a place in lower Assam, the Titabar ecorace in Titabar of Upper Assam and the Mendipathar in Meghalaya. All these ecoraces exhibit little morphological variations in larval color and cocoon characteristics but are genetically polymorphic which might have enabled the silkworms to survive under a restricted geographical location. This is the first report on the collection and documentation of all these ecoraces in the climatic conditions of Odisha. In terms of hatching percentage, all three ecoraces had similar ranges from 96% to 98% (Table 1). Eri like any other Saturnid worm has the larval stage as the

only feeding stage in its life cycle. During this period the voracious larvae keep on consuming castor leaves and lead to the formation of cocoon in the pupae stage. Hence the larval growth and larval duration are the two important parameters for the economic evaluation of the any silkworm (Joshi, 1984). In our observation the average body weight of the larva of the three ecoraces ranged from 9.2g to 9.8g (Table 1; Fig. 1 to 6) in field conditions of and the F values were found to be highly significant (p=0.05).

Table 2(a): Rearing of eri ecoraces at field level at Sundergarh district (mean of 5 crops); Details of the rearing of the ecoraces Borduar, Titabar and Mendipathar

| | | |
|----|--|----------------------|
| 1 | Name of the zone | Sundergarh |
| 2 | No. of DFLs used | 500 |
| 3 | No. of farmers covered | 5 |
| 4 | Date of hatching | 16-17/10/2008 |
| 5 | Hatching % | 96 |
| 6 | Total larval period | 25 days |
| 7 | Single mature larval wt.(day 5 of 5 th instar) | 9.8gms |
| 8 | Leaf consumption per DFLs | 85Kg |
| 9 | Total quantity of green cocoon harvested | 225Kg |
| 10 | No. of cocoon per Kg | 347 |
| 11 | Pupation percentage | 98% |
| 12 | Percentage of pupa emerged as moth | 98 |
| 13 | Mortality if any | |
| | (a)During larval period | Nil |
| | (b)During cocooning | Nil |
| | (c)During pupation | 2% |
| | (d)During emergence | Nil |
| 14 | Missing larval % during bed cleaning | 27360 |
| 15 | Occurrence of any disease (noticed) | |
| | (a)Bacteria | Nil |
| | (b)Fungal | Nil |
| | (c)Viral | Nil |
| | (d)Protozoa | Nil |
| 16 | Any other/mixed appearance of any two | Nil |
| 17 | Food plants used | Castor |
| 18 | Leaves collected from own garden or available abundantly | available abundantly |
| 19 | Type of rearing used | bamboo tray on racks |

Similarly the larval duration for all the three eco races ranged from 21-22 days except Borduar where it show the average of 24 days as compared to that of the mixed races supplied to the farmers which takes about 25days. Moreover, our findings in terms of cocoon weight, shell weight and effective rate of rearing (ERR) clearly suggest that they perform better than the present variety supplied to the farmers. In our observation the ERR (Table 1) for all the three eco races are 95.6-98% compared to 96.7% of the existing one (Hota *et al.*, 2005). As per the cocoon characters, single cocoon weight of the three ecoraces

Table 1: Characteristics of rearing of ecoraces of *Philosamia ricini* (eri silkworm) - Borduar, Titabar and Mendipathar at ericulture lab School of Life Sciences Sambalpur University (mean of 5 crops; Reference- Hota *et al.*, 2005)

| Ecorace | Fecundity No/worm | Hatch % | Larval wt(g) | ERR(%) | Cocoon wt(g) | Shell wt(g) | S.R% | Larval period |
|-------------|-------------------|-------------------|--------------|--------|--------------|-------------|--------|---------------|
| Borduar | 402 | 98 | 9.8 | 98 | 3.8 | 0.70 | 18.42 | 24 days |
| Titabar | 395 | 98 | 9.5 | 97.6 | 3.5 | 0.55 | 16.7 | 22 days |
| Mendipathar | 390 | 96 | 9.2 | 95.6 | 3.4 | 0.55 | 16.17 | 21 days |
| *Reference | 385 | 96.98 | 8.6 | 96.7 | 3.33 | 0.53 | 16.20 | 25 days |
| F -value | 140.3** | 3.12 [†] | 80.7** | 9.63** | 21.8** | 48.8** | 89.4** | 6.9** |

** Highly significant at pd*0.05; † not significant

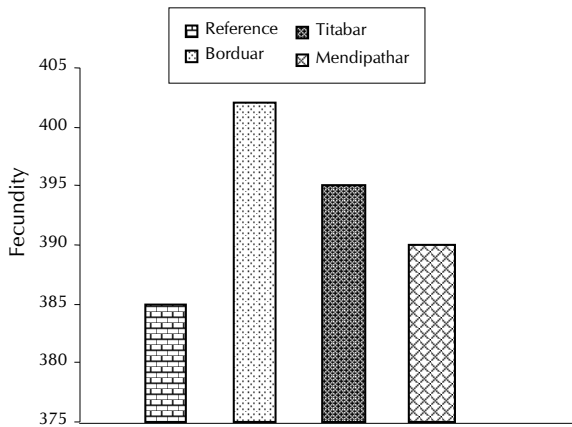


Figure 1: Histogram of fecundity (number of eggs laid/worm)

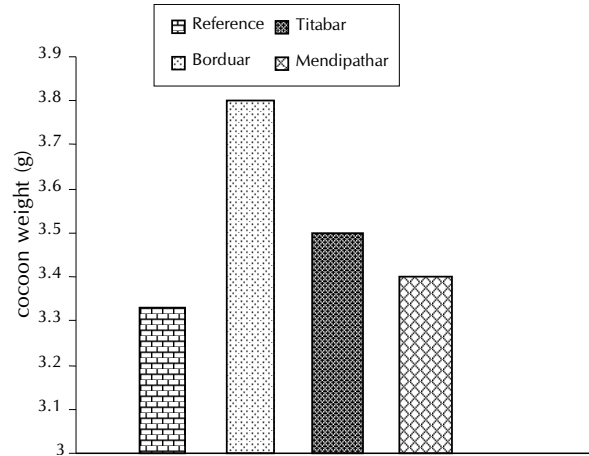


Figure 4: Histogram of cocoon weight (g)

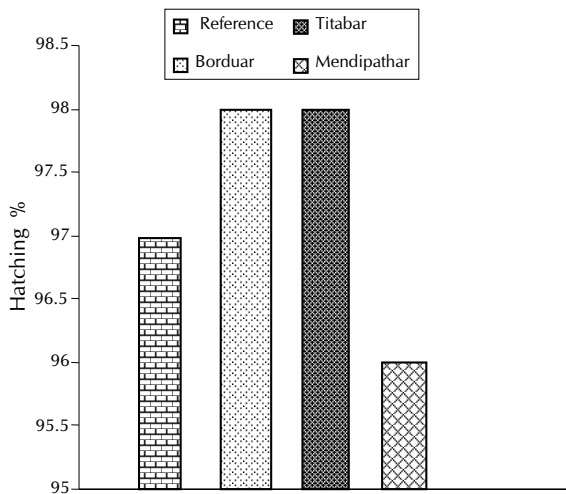


Figure 2: Histogram of hatching percentage

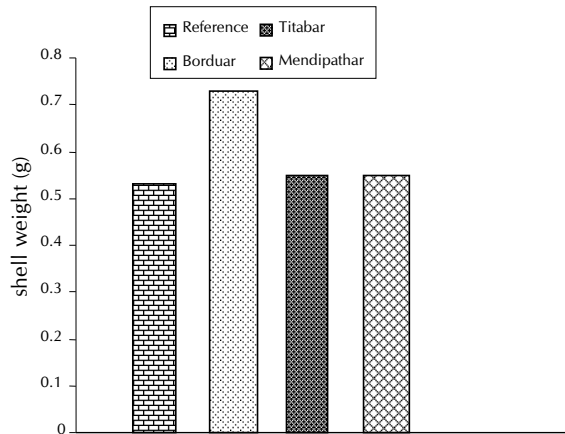


Figure 5: Histogram of shell weight (g)

ranged from 3.4g to 3.8g (Table 1). This is much better than the present race which ranges from 3.33g. Similarly the single shell weight of all the three ecoraces ranged 0.55g to 0.70g (Table 1) as compared to 0.53g in present condition. The

most important part of commercial silkworm rearing is shell ratio percentage. In all the three ecoraces the SR% is between 16.7% -18.42% (Table 1). The result is higher than the value obtained from that of mixed variety of 16.20%. The compactness of the cocoons of the eco races and cocoon

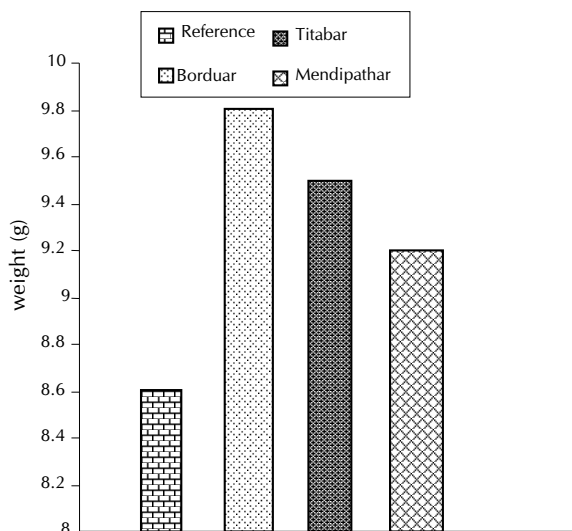


Figure 3: Histogram of larval weight (g)

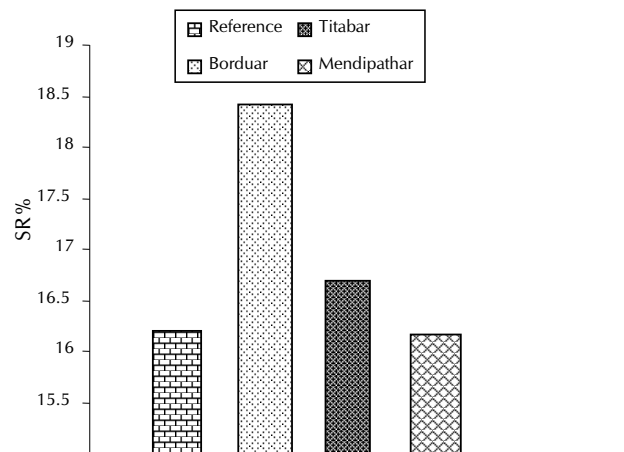


Figure 6: Histogram of silk ratio percentage (SR%)

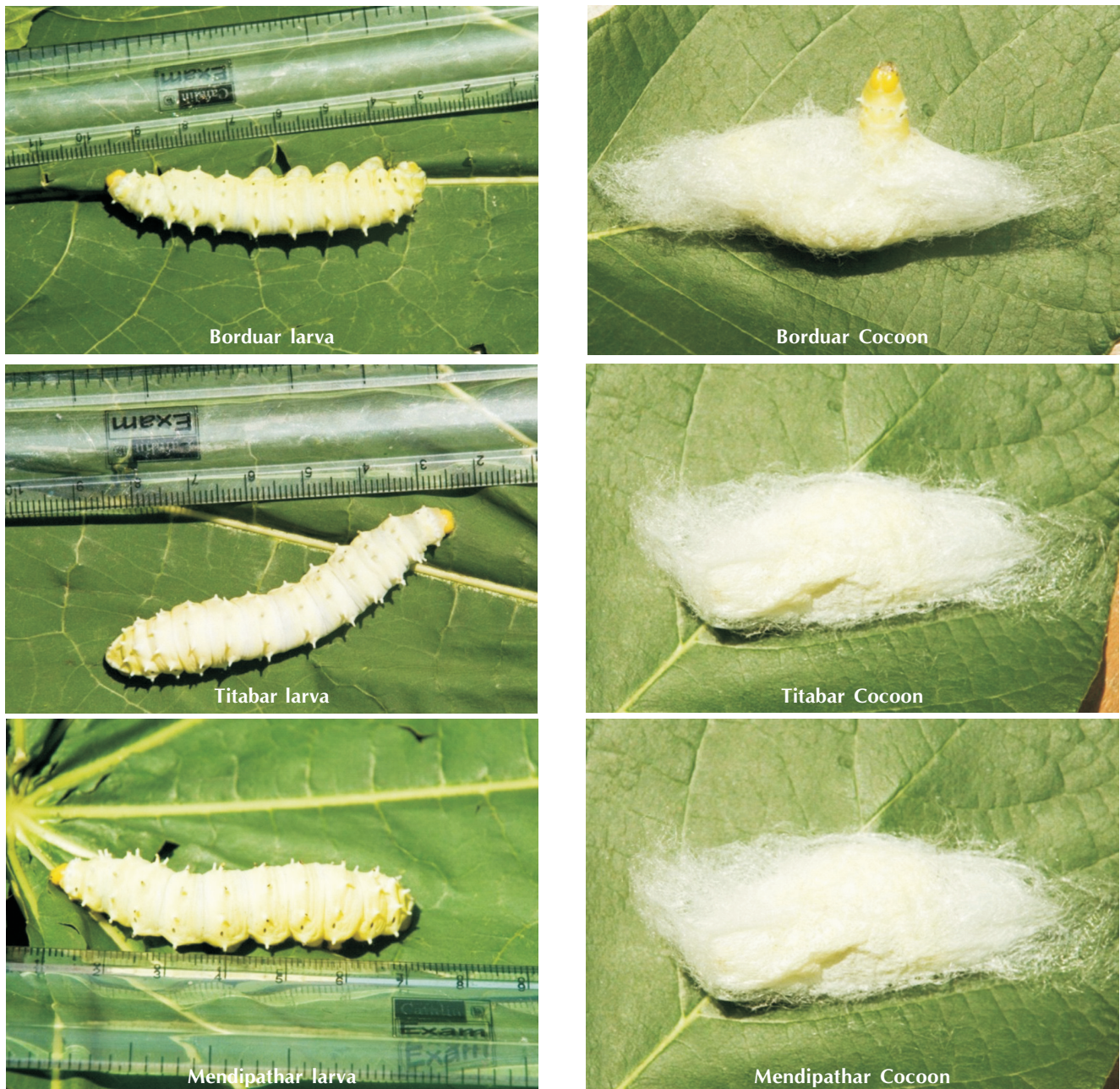


Figure 8: Larvae and cocoons of different ecoraces

Table 2(b): Rearing of eri ecoraces at field level at Sundergarh district (mean of 5 crops); eri cocoon characteristics of the ecoraces Borduar, Titabar and Mendipathar

| | | |
|---|-----------------------------------|-------------------------------------|
| 1 | Average single cocoon wt. | 3g |
| 2 | Average shell wt. | 0.4g |
| 3 | Average wt. of a male pupa | 1.48g |
| 4 | Average wt. of a female pupa | 2.06g |
| 5 | Shell ratio percentage | 13.33% |
| 6 | No. of cocoon per Kg | 347 |
| 7 | Double cocoon percentage in a lot | > 1% |
| 8 | Defective cocoon percentage | 8.88% |
| 9 | Color and shape of the cocoon | creamy white, compact and elongated |

colour reflects the high silk contents of the cocoons of all the three eco races. The morphological data of the ecoraces was tested for significance by one-way ANOVA. From the analysis of variance it was observed that (Table 1) except for hatching percentage all other features are significantly different from that of reference. ($p < 0.5$).

As per the grainage performance and fecundity, the exotic races show above 90% stability in western Odisha condition (Table 2a, b, and c). The fecundity and the life cycle of all the three ecoraces were better than the existing races (Table 1) and also comparable to Assam conditions (Kar, 2004). The duration of the life cycle was similar to Assam condition of 50-

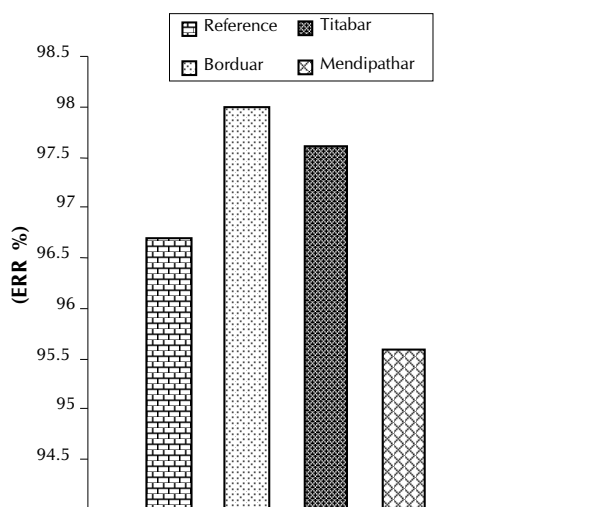


Figure 7: Histogram of effective rate of rearing (ERR %)

Table 2(c): Rearing of eri ecoraces at field level at Sundergarh district (mean of 5 crops); grainage performance details of the ecoraces Borduar, Titabar and Mendipathar

| | | |
|----|---|----------------------------------|
| 1 | Total no. of cocoons preserved for grainage | 72640 |
| 2 | Moth emergence percentage | 98% |
| 3 | Average male percentage | 32688(46%) |
| 4 | Average female percentage | 39952(54%) |
| 5 | Percentage early male moths emergence | 1-2% |
| 6 | Percentage of erratic emergence | nil |
| 7 | Percentage of cocoon remain unemerged | 2% |
| 8 | Period of emergence (total days/hrs) | 6days |
| 9 | Percentage of deformed moth (if any) | only one moth with cramped wings |
| 10 | Coupling duration (in hrs) | 8hrs |
| 11 | Average fecundity | 240 nos. |
| 12 | Average egg laying duration(in hrs) | 32hrs |
| 13 | Total no. of unfertilized eggs per DFLs | > 1% |
| 14 | Average hatching percentage | 98% |

Table 2(d): Rearing of eri ecoraces at field level at Sundergarh district (mean of 5 crops); meteorological data of the study area Sundergarh

| | | |
|---|---|-------|
| 1 | Average temperature during the rearing period(22-23°C) | |
| | (a)Average maximum | 27°C |
| | (b)Average minimum | 18°C |
| 2 | Average relative humidity during the rearing period (61%) | |
| | (a) Average maximum | 66% |
| | (b) Average minimum | 56% |
| 3 | No. of rainy days during the rearing period | 3days |

68days. These results indicate that the ecoraces Borduar, Titabar and Mendipathar performed better than the present variety supplied to the farmers in Odisha. Moreover, the one-way ANOVA analysis of Silk ratio % at (pd"0.05) level indicates that the SR% of the ecoraces is significant. Thus it opens of the opportunity for the government agencies to adopt all of the three eco races or to initiate program to develop suitable hybrids using the ecoraces for the Eri farmers of the state.

CONCLUSION

The ecoraces of *Philosamia ricini* (Eri silkworm) namely Borduar, Titabar and Mendipathar of North East India perform extremely well in terms of their productivity in the geo-climatic conditions of western Odisha. The Eri industry reeling under non-profitability in terms of quality silk can take these cues to introduce them as a better alternative. With silk ratio of 18.42%, Borduar variety performs much better compared to the Mendipathar and Titabar ecoraces. Considering the silk yield the Borduar variety can be introduced to the farmers of Western Odisha for augmentation of their income.

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