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COMPARATIVE REARING PERFORMANCE OF BORDUAR AND TITABAR ECORACES OF ERI SILKWORM (*SAMIA RICINI)* IN DIFFERENT CROPS

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ABSTRACT

Eri silkworm *Samia ricini* is a domestic Vanya silkworm, multivoltine, polyphagous in nature producing silk. Eri silkworm has several morphotypes having distinct morphological differences and is cultured in different north eastern states particularly in Assam. Twenty six different ecorace of eri silkworm were identified. Out of which two ecoraces viz., Borduar and Titabar were collected from Germplasm Bank of CMER&TI, Lahdoigarh. Borduar ecorace has four strains categorised based on larval body colour and marking pattern i.e. Yellow Plain (YP), Greenish Blue Plain (GBP), Greenish Blue Zebra (GBZ), Yellow Zebra (YZ), similarly, Titabar ecorace is having Yellow Plain (YP), Greenish Blue Plain (GBP) Greenish Blue Spotted (GBS), Yellow Spotted (YS). All these eight strains were isolated and reared separately for six crops (July-August, September-October, November-December, January–February, March-April, May–June) with comparative studies on economical parameters such as fecundity, hatching percentage, larval duration, Effective rate of rearing (%) & shell ratio. Significant difference ($P<0.05$) in all the parameters among different strains of Borduar and Titabar ecoraces was observed. Seasonal variations have significant effect on larval duration of different strains showing significant negative correlation with mean temperature and significant positive correlation with mean relative humidity, indicating longest larval duration in Jan- Feb crop (C4) and shortest in July-August crop (C1). Among these strains, YP of Borduar showed highest average fecundity 359 nos. & shell ratio 13.77% in six different crops while GBS of Titabar showed lowest fecundity 347nos. and shell ratio13.07%. The study revealed that YP strain of Borduar is superior in terms of rearing performance as compared to other strains in different crops. March-April and September –October crops are favourable for rearing of eri silkworm for all the strains of Borduar and Titabar.

***Keywords*:** Eri silkworm, strains, seasonal crops, relative humidity, temperature.

Introduction

The Eri silkworm, *Samia ricini* is a species of Saturniidae family produce silk called eri silk. It is non mulberry, polyphagus, completely domesticated and reared 5-6 crop throughout the year. Eri silkworm mostly found in north eastern state especially in Assam and Meghalaya because of easy rearing process and availability of food plant (Brahma *et al.,* 2015). In the north east, 26 ecoraces of Eri silkworm are found with six different morphotype till date. Based on body colour and marking pattern they have been identified as a strain namely yellow plain(YP), greenish blue plain (GBP), yellow zebra (YZ), greenish blue zebra (GBZ), yellow spotted(YS)and greenish blue zebra (GBZ) (Debraj *et al.,* 2001). Castor (*Ricinus communis* L) is the primary food plant of eri silkworm which is highly nutritious for silkworms and secondary food plant is Kesseru (*Heteropanax fragrans*). According to the annual report of Central Silk Board (2018-19), Assam state produced highest production of eri silk in India. A total of 8.11 lakh kg was produced in the year 2010-11 and 25.55lakh kg of eri silk produced in the year 2015-16 by Assam. Now a day's approximately more than 2.40 lakh family are engaged in this field and benefited (Anonymous, 2019a).

In eri-culture, temperature and humidity are the main factors for the production of eri silk. For the production of quality cocoon, a good temperature, relative humidity, ventilation, knowledge about the maintaining of hygiene are important during the rearing period (Kumarsen and Geetha Devi, 2009). Less spinning and high mortality of larva and pupae due to increase of temperature above 35^0C and less amount of ingestion of larva, drying of leaves due to increase or decrease of humidity (Sugai and Takashashi, 1981; Sahu *et al.,* 2006; Sharma *et al.,* 2003). Eri silkworms are very sensitive to the environmental factors. Rapidly increasing and decreasing of temperature and humidity negatively impact on the natural tolerance of the silkworms and gives poor results in silk production (Kremky *et al.,* 1984; Singh *et al.,* 2009). The internal relation between two variables are measured by calculating correlation value may be positive or negative. Positive correlation means one variable is increases and another variable also increases but negative correlation means one variable is increases and another variable decreases (Mahesha *et al.,* 2013; Singh *et al.,* 2011; Umeshankara and Subramanya 2002). Now a day's many researchers have been found to identify best suitable strain in different seasons in different region. Hazarika *et al.,* 2003 experimented on larval duration in different seasons**.** High production of eri and income, farmers are mainly depending on rearing performance with suitable environmental condition.

The main objective of present experiment have to select superior strains with economic parameters on favourable crops for producing high yield that will help to farmer for rearing a particular strains in suitable crop and analyse correlation between temperature and humidity with larval duration of eri silkworm.

Materials and Method

The study was conducted at CMER&TI Lahdoigarh Jorhat, Assam during the year 2020-2021. Two ecoraces of Eri silkworm *Samia ricini* namely viz., Borduar and Titabar were collected from Germplasm bank of CMER & TI, Lahdoigarh, Jorhat, Assam for the experiment to evaluate the rearing performance of eri silkworm strains in different crops. Each ecorace have four strains categorised based on larval body colour and marking pattern i.e. Borduar have Yellow Plain (YP), Greenish Blue Plain (GBP), Greenish Blue Zebra (GBZ), Yellow Zebra (YZ), and Titabar ecorace have Yellow Plain (YP), Greenish Blue Plain (GBP) Greenish Blue Spotted (GBS), Yellow Spotted (YS) respectively, which were reared in six different periods during 2020-2021 as July-August (C1), September-October(C2), November –December (C3), January-February (C4), March- April (C5), May-June(C6) (Table-1). During Eri eggs incubation, temperatures were maintained at 24±1^{0}C and relative humidity at 80±5%. The rearing room and the entire appliance were cleaned and disinfected by using standard protocols (Krishnaswami, 1978). After 3rd moult out, 300 worms in each replication were replicated into three and maintained separately. After maturing, larvae were transferred to spinning plastic mountages for cocooning. Cocoons were harvested after 7th day of spinning and preserved under normal room temperature for moth emergence to produce seeds for next crops. Meteorological data of the rearing room were recorded three times (9 am, 12 pm and 4pm) daily .The rearing parameter were recorded for fecundity, hatching, larval weight, larval duration, ERR, cocoon weight, shell weight, shell ratio. The recorded data were analysed using technique of analysis of variance (ANOVA) and critical difference (CD) calculated at 5% for interpretation.

Table 1: Meteorological data recorded at different crops.

Crop name	Periods	Grainage		Rearing	
		Temperature (^{0}C)	Relative Humidity (%)	Temperature (^{0}C)	Relative Humidity (%)
C1	July- August	28.41	70.39	29.53	70.5
C2	September – October	25.43	76.19	27.15	79.36
C3	November- December	24.52	79.5	22.52	80.26
C4	January—February	22.6	82.05	22.03	86.6
C5	March-April	22.67	76.08	24.76	79.91
C6	May- June	26.62	74.72	26.81	75

Results and Discussion

The rearing performance of eight strains isolated from two ecoraces namely, Borduar and Titabar were carried out at different six crops (C1 to C6) showed significant variation in different crops. During grainages, the fecundity among the eight strains of eri silkworm, B YP showed highest fecundity in C5 crop (366) followed by C2 crop (363). Chakravorty (2006) also reported earlier almost similar result with highest fecundity in YP. It positively support the present finding and YP can be used as superior strain to get highest yielding of seed. It revealed that C5 crop and C2 crop recorded higher fecundity while other crops showed almost lower fecundity in all eight strains. The statistical analysis showed that there was significant variation in fecundity among different strains. The result on seasonal variation of fecundity of eight strains reared in six crops found to be significantly different (Table-2).

Table 2 : Mean value of rearing performance for six different crops (C1 –C6)

Strains	Crops	Fecundity (nos)	Hatching %	Larval Duration (d)	Larval Weight(g)	ERR%	SR%
BYP	**C1**	346.80±3.99	85.28±1.08	17±0.48	7.74±0.13	81.38±0.35	13.27±0.21
	C2	363.60±5.26	88.08±2.87	20±0.44	8.07±0.13	87.46±0.29	14.34±0.36
	C3	359.00±3.40	92.50±1.31	22±0.48	7.76±0.11	91.28±1.08	13.83±0.54
	C4	343.40±5.36	87.59±2.04	26±0.44	7.07±0.07	80.02±0.23	12.86±0.28
	C5	366.60±4.19	92.89±1.51	24±0.58	7.43±0.20	92.23±2.39	14.55±0.41
	C6	356.40±1.88	94.01±1.19	22±0.50	7.61±0.12	89.72±0.20	13.49±0.19
	Mean	**359.63**	**90.06**	**22**	**7.61**	**87.02**	**13.77**
	CD	**12.72**	**5.67**	**1.57**	**0.41**	**3.25**	**1.11**
	CV	**2.7**	**4.74**	**5.17**	**4.01**	**2.81**	**6.13**
B GBP	**C1**	335.00±7.48	85.74±1.36	18±0.63	7.32±0.05	80.79±0.53	13.04±0.22
	C2	357.40±6.87	91.96±1.01	21±0.48	7.57±0.10	87.81±0.24	14.48±0.40
	C3	358.00±3.74	87.97±1.62	23±0.63	7.23±0.08	85.68±0.35	12.78±0.15
	C4	351.00±3.13	84.48±3.37	27±0.48	7.00±0.04	79.62±0.90	13.4±0.29
	C5	364.20±5.32	92.56±1.45	25±0.54	7.54±0.15	89.31±0.70	13.82±0.18
	C6	359.06±3.95	92.20±1.62	24±0.86	7.37±0.10	88.82±1.02	13.55±0.30
	Mean	**355.87**	**89.15**	**23**	**7.34**	**85.34**	**13.47**
	CD	**14.72**	**5.61**	**1.54**	**0.29**	**1.89**	**0.81**
	CV	**3.11**	**4.74**	**5.13**	**2.97**	**1.67**	**4.47**

B YZ	**C1**	334.20±5.97	86.81±2.66	18±0.58	7.62±0.14	80.98±0.39	13.43±0.21
	C2	356.80±4.88	89.39±2.43	21±0.37	7.68±0.13	87.42±0.26	14.53±0.36
	C3	358.20±2.63	92.83±2.17	25±0.36	7.46±0.15	91.12±0.81	14.10±0.33
	C4	348.20±4.63	82.36±0.46	27±0.58	7.09±0.08	79.06±0.32	12.58±0.38
	C5	348.00±1.51	91.84±3.69	25±0.44	7.22±0.12	91.12±1.26	13.59±0.71
	C6	351.80±2.13	92.78±0.92	23±0.66	7.28±0.08	89.21±1.04	12.96±0.29
	Mean	**349.53**	**89.33**	**23**	**7.39**	**85.34**	**13.47**
	CD	**12.33**	**6.59**	**1.6**	**0.36**	**1.89**	**0.81**
	CV	**2.65**	**5.55**	**5.23**	**3.69**	**1.67**	**4.47**
B GBZ	**C1**	338.20±4.21	84.97±2.06	19±0.37	7.59±0.25	80.81±0.42	12.9±0.28
	C2	359.60±4.66	83.25±2.87	22±0.66	7.77±0.16	86.57±0.49	13.91±0.44
	C3	362.80±4.59	81.00±3.55	24±0.24	7.67±0.15	89.33±0.41	12.31±0.71
	C4	343.80±4.07	90.22±1.30	28±0.50	7.09±0.05	80.64±0.17	13.35±0.52
	C5	358.20±3.73	92.09±1.78	25±0.37	7.03±0.12	92.17±2.41	13.88±0.53
	C6	352.60±5.87	90.28±1.87	23±0.44	7.34±0.16	87.48±3.87	13.00±0.08
	Mean	**352.53**	**86.97**	**23**	**7.42**	**86.17**	**13.55**
	CD	**12.03**	**6.95**	**1.34**	**0.52**	**5.28**	**1.37**
	CV	**2.56**	**6.08**	**4.33**	**5.33**	**4.61**	**7.44**
T YP	**C1**	341.80±9.81	84.42±2.14	18±0.37	7.17±0.11	81.20±3.88	13.23±0.18
	C2	351.80±3.73	91.04±0.98	21±0.66	7.38±0.07	87.68±2.11	14.43±0.20
	C3	357.00±2.75	86.10±2.55	23±0.24	7.31±0.08	86.43±2.80	13.92±0.18
	C4	348.80±3.73	80.69±3.50	27±0.50	6.98±0.07	75.47±3.33	12.96±0.34
	C5	355.40±3.04	89.29±1.37	24±0.37	6.99±0.11	88.47±2.35	14.27±0.13
	C6	357.00±3.16	90.78±1.83	22±0.44	7.12±0.05	86.34±1.67	14.16±0.53
	Mean	**350.77**	**87.05**	**22**	**7.16**	**84.27**	**13.76**
	CD	**11.25**	**7.19**	**1.44**	**0.27**	**8.38**	**0.92**
	CV	**2.63**	**6.22**	**4.53**	**2.93**	**7.49**	**5.02**
T GBP	**C1**	337.80±4.73	84.97±1.93	19±0.40	7.54±0.89	80.77±0.62	13.21±0.27
	C2	356.20±8.05	89.77±1.39	21±0.58	7.76±0.13	87.45±0.35	14.47±0.36
	C3	349.40±4.55	88.95±1.94	23±0.44	7.34±0.10	86.31±1.26	13.65±0.46
	C4	334.60±4.43	81.84±3.70	28±0.50	6.89±0.09	77.92±0.85	12.94±0.19
	C5	353.00±6.67	91.23±0.82	26±0.31	7.30±0.11	89.87±0.98	14.78±0.12
	C6	355.60±4.29	90.03±1.53	23±0.37	7.59±0.12	90.64±2.77	13.71±0.60
	Mean	**349.53**	**87.8**	**23**	**7.41**	**85.49**	**13.6**
	CD	**17.32**	**6.35**	**1.15**	**0.33**	**3.96**	**1.17**
	CV	**3.74**	**5.44**	**3.76**	**3.4**	**3.44**	**6.41**
T YS	**C1**	341.80±9.81	83.59±2.21	19±0.37	7.45±0.14	80.97±0.91	13.06±0.13
	C2	361.00±4.90	87.13±1.51	22±0.50	7.48±0.12	86.60±0.82	14.12±0.21
	C3	357.00±2.75	92.42±1.60	25±0.51	7.31±0.07	84.59±2.42	13.95±0.24
	C4	334.00±3.01	85.22±2.54	28±0.63	6.98±0.08	79.61±0.45	13.09±0.35
	C5	356.40±3.54	90.48±1.42	27±0.40	6.99±0.11	89.99±2.99	14.22±0.45
	C6	354.00±4.37	82.96±2.70	23±0.51	7.12±0.05	89.74±0.28	13.45±0.25
	Mean	**353.97**	**86.97**	**24**	**7.22**	**86.35**	**13.53**
	CD	**15.99**	**6.56**	**1.53**	**0.31**	**4.99**	**0.86**
	CV	**3.43**	**5.68**	**4.83**	**3.23**	**4.35**	**4.78**
T GBS	**C1**	347.20±3.65	79.50±3.19	20±0.24	7.39±0.85	79.92±0.92	13.32±0.14
	C2	355.80±8.05	85.60±2.15	23±0.51	7.59±0.18	86.82±0.30	13.62±0.37
	C3	348.60±6.35	90.84±0.77	26±0.63	7.23±0.06	88.68±2.26	12.20±0.52
	C4	344.40±2.06	86.46±2.52	29±0.74	6.89±0.09	79.79±0.52	12.74±0.40
	C5	333.00±2.38	86.91±2.66	25±0.37	7.30±0.11	92.22±1.53	13.36±0.47
	C6	355.40±2.37	90.69±2.40	24±0.50	7.54±0.12	89.99±2.25	13.23±0.31
	Mean	**347.4**	**86.67**	**24**	**7.33**	**86.24**	**13.07**
	CD	**14.24**	**7.31**	**1.57**	**0.33**	**5.68**	**1.21**
	CV	**3.08**	**6.35**	**4.88**	**3.43**	**4.96**	**6.67**

The statistical analysis of eggs hatching reveals that significant variation among the strains and crops. In C6 and C5 crop, BYP showed highest hatching (94.01%, 92.89%) followed by BGBP. It clearly revealed that better crop for highest hatching percentage of eight strains in C6 and C5 except other crops. However, there was no significant difference in the larval duration among eight strains but significant variation among the different crops. The result showed that different crops significantly effect on the larval duration among the eight strains of the particular crop. The larval duration recorded highest in C4 and lowest in C1 crop and followed by C5 crop irrespective of the strain (Figure-1). Longest larval duration was recorded in TGBS (29 days) in C4 crop while shortest recorded in BYP (17 days) in C1 crop.

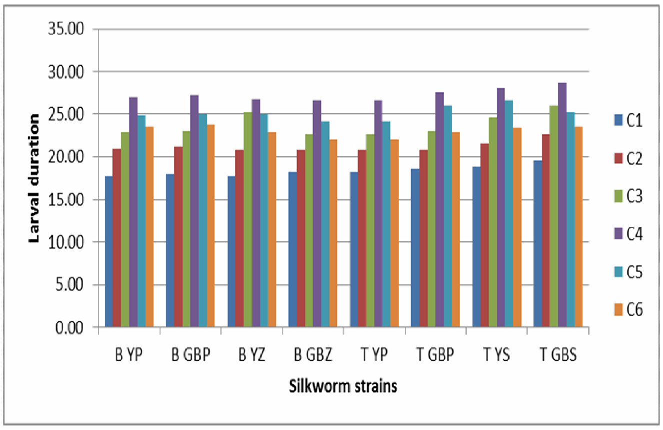


Fig. 1: Average larval duration of eight strains of Eri silkworm in six different crops

The result effect of different crop on the larval weight of Eri silkworm was found to be significant. Significant variation is observed in the larval weight among the strains. In C2 and C3 crop, BYP showed highest larval weight (8.07g & 7.76g) followed by BGBZ (7.77g). It revealed that larval weight in C3, C2 and C1 crop is higher than other three crops for all the strains (Figure-2).

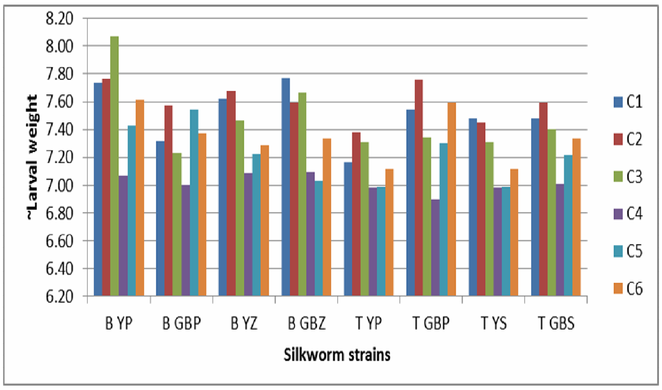


Fig. 2: Average larval weight of eight strains of Eri silkworm in six different crops

The effective rate of rearing among the strains, showed BYP highest ERR% (92.23%) in C5 crop. It was followed by TGBS (92.22%), BGBZ (92.17%). The results revealed that significant difference was observed in ERR in different crops. But there is no significant differences in ERR% among the eight strains. C5 crop can be considered better in terms of ERR than other crops (Figure-3).

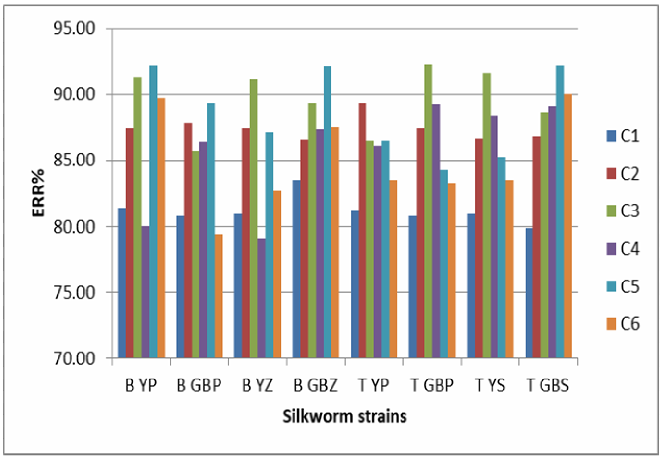


Fig. 3: Average ERR% of 8 strains of eri silkworm in 6 different crop

There was significant difference in the shell ratio among the eight strains of Eri silk worms in different crops and BYP recorded the highest shell ratio followed by BYZ. The BYP reported to have highest shell ratio in C5 crop (14.55%) (Figure-4).

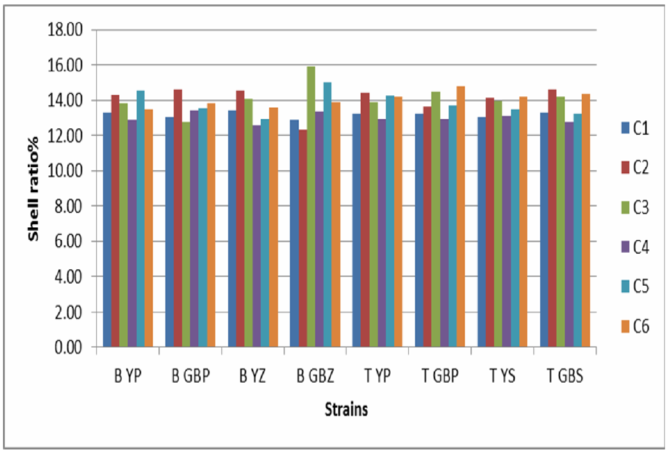


Fig. 4: Shell ratio of eight strains Eri silkworm in six different crop

Coefficient of correlation between temperature & relative humidity with larval duration of eight strains were calculated and found strong negative correlation with temperature and positive correlation with relative humidity presented in Table-3. It revealed that an average temperature 29.53^{0}C and relative humidity 70.5% during C1 crop showing short larval duration of eri silkworm helps in maturing larvae in short period of time.

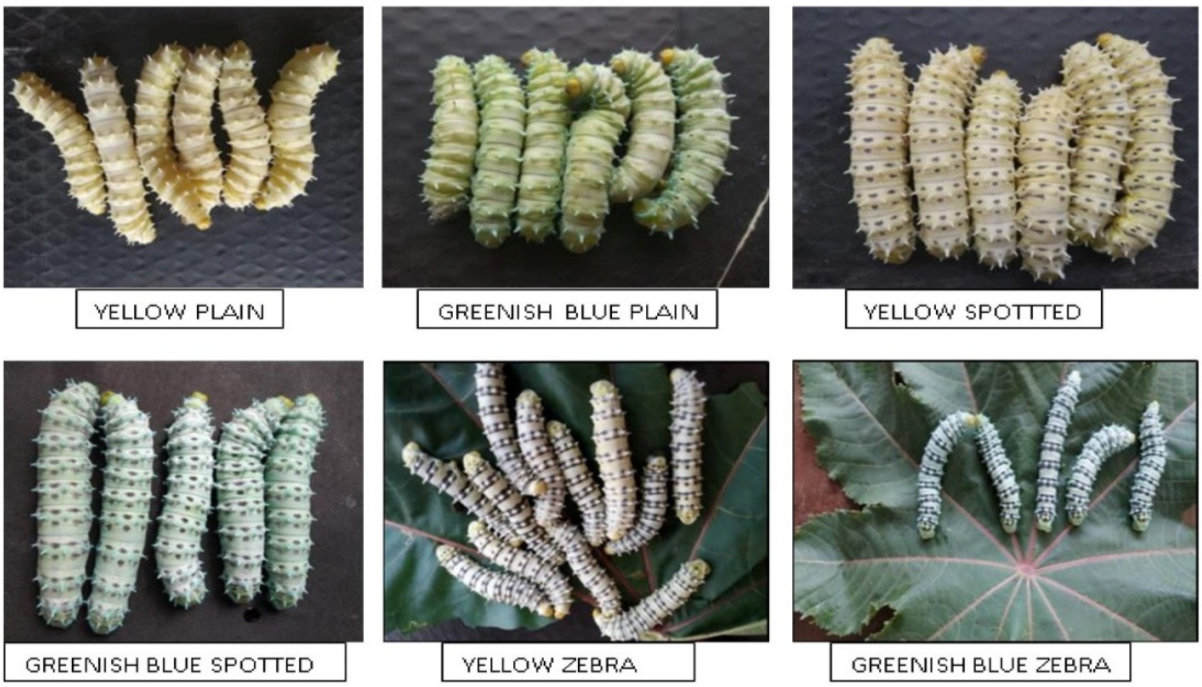
Table 3 : Coefficient of correlation between temperature & relative humidity with larval duration of Eri silkworm during 6 crops rearing

Correlation between	Larval duration	
Strains	**Temperature (^{0}C)**	**Relative Humidity (%)**
B YP	-0.826*	0.839*
B GBP	-0.826*	0.839*
B YZ	-0.955**	0.862*
B GBZ	-0.877*	0.904*
T YP	-0.877*	0.904*
T GBP	-0.832*	0.842*
T YS	-0.891*	0.867*
T GBS	-0.967**	0.926**

*= Significant at 5% **= Significant at 1%
NS= Non significant

It can be concluded that significant variation are present in six economic parameters for eight strains of eri silkworm in different crops. Also present work revealed that C2 crop and C5 crop were suitable crop for all the eight strains, which showed short larval duration with more fecundity and larval weight with highest ERR in these two crops. Shell ratio (%) was also reported high in these two crops. Significant differences was observed in ERR in different crops but no significant difference was among the strains. This present study showed highest ERR% in BYP (92.23%) in C5 crop and lowest in C4 crop (TGBP, 77.92%). Highest fecundity was observed in B YP (366nos) in C5 and lowest in C4crop (T GBS 330 nos). Swathiga *et al.,* 2019; Kumar and Elangoovan 2010 proved that performance of Borduar ecorace in terms of economic traits compared to other ecorace. Among the eight strains reared in 6 different crops, it deduced that BYP is a superior in all the characters and suitable for six crop through-out the year. Hatching percent is also an important parameter for production of eri silk. Earlier finding of Wankhede *et al.* (2014) reported YP recorded highest hatching percent and similar finding with the present work, hatching percentage was found highest in BYP(94.00%) in C6 crop followed by (92.89%) in C5 crop. Sharma and Kalita, (2017) reported earlier that shell ratio was highest in YS (16.03%) in autumn and spring seasons. Lowest shell ratio was found in GBP in summer season. Among the strains, the lowest shell ratio was found in winter and summer. In this present work found highest shell ratio in C5 crop for all the strains.

Genes are not only responsible for controlling the expression of characters but also abiotic factors i.e. Temperature, humidity, photoperiodic cycle etc. are responsible (Jaiswal and Kumar, 2005). Temperature and relative humidity also has a significant effect on larval duration indicated that slightly decreasing of temperature will increases the larval duration of silkworm. The present study also showed that longest larval duration of all the strains were observed in C4 crop. Verk *et al.,* 2009 also reported that longest larval duration occurred in winter season and shortest larval duration is observed in summer season. Dutta (2000) also revealed that ERR of eri silkworm were found longest during spring season which is similar with this work. From the present findings it can be concluded that there was significant differences in the rearing performances among eight strains of *Samia ricini,* Donovan. The seasonal variation also has a significant impact on these parameters. In the present work, it was observed that negative correlation between temperature and larval duration among eight strains of eri silkworm based on this work can proved to be beneficial for evaluating superior crop in terms of rearing performances and used to producing large scale in different crops within a shorter period of time.



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