Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.7538

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **7 (3):** 544-552 (2019)

Research Article

International Journal of Pure & Applied Bioscience

Rearing Performance of the Eri Silkworm, *Samia cynthia ricini* Biosduval in Response to Diversified Castor Ecotypes in Few Regions of the Western Ghats of Karnataka, India

K. G. Manjunath[1], B. Sannappa[2*] and M. Raju[3]

[1]Department of Sericulture, Yuvaraja's College, University of Mysore, Mysuru, India

[2]Department of Studies in Sericulture Science, University of Mysore, Mysuru, India

[3]Department of Sericulture, College of Agriculture UAS (B), V.C. Farm, Mandya, India

*Corresponding Author E-mail: drbsannappa@gmail.com

Received: 2.05.2019 | Revised: 5.06.2019 | Accepted: 12.06.2019

ABSTRACT

Eri silkworm is multivoltine, polyphagous in habit feeding mainly on castor (Ricinus communis L.) for its growth and development towards successful cocoon production. In this regard, an attempt has been made to explore different ecotypes of castor available in wild form (perennial) in the Western Ghats region of Karnataka for rearing of eri silkworm. Altogether, 10 castor ecotypes were identified in five locations (Heggada Devana Kote, Madikeri, Sakaleshpur, Shimoga and Sirsi) of Western Ghats of Karnataka and two from Mysore location (for comparison) through molecular characterization (DNA sequencing) and accession numbers were obtained from the National Centre for Biotechnological Information (NCBI). The identified castor ecotypes were grown and leaves were utilized to assess the rearing performance using three strains of eri silkworm (Yellow-Plain, Blue-Plain and Blue-Zebra).

The results of the investigation revealed that, the Yellow-Plain strain of eri silkworm fed on leaves of the castor ecotype bearing accession No. KJ000406 recoded significantly superior matured larval weight, total larval duration, cocoon weight, shell weight, cocoon yield, shell yield, shell ratio, silk productivity, fibroin and sericin. Further, the castor ecotypes possessing accession numbers KJ000404, KJ130043, KJ130045, KJ000402, KJ300047, KJ000407, KJ000405, KJ130044, KJ130046 and KJ000403 were found next best in respect of all the rearing parameters. However, Blue-Zebra strain of eri silkworms fed on the leaves of castor ecotype possessing accession No. KJ130048 recorded least rearing parameters.

Key words: *Eri silkworm, Samia cynthia ricini, castor, Ricinus communis, Western Ghats.*

INTRODUCTION

Apart from the marvelous mulberry silk, which is quite popular the world over, there are few other varieties that are equally attractive. They are collectively termed as '*Vanya Silks*' comprises of Tasar, Eri and Muga silks.

Cite this article: Manjunath, K.G., Sannappa, B. and Raju, M., Rearing Performance of the Eri Silkworm, *Samia cynthia ricini* Biosduval in Response to Diversified Castor Ecotypes in Few Regions of the Western Ghats of Karnataka, India, *Int. J. Pure App. Biosci.* **7(3):** 544-552 (2019). doi: http://dx.doi.org/10.18782/2320-7051.7538

Also known as non-mulberry or wild silks, they in fact represent finest facets of India's richest culture and tradition. Brahmaputra valley and its adjoining foot hills in the sub Himalayan belt are believed to be the native of domesticated vanya silkworm, *Philosamia ricini* Hutt. Which is possibly the parent species and hence it is identified as Assam silk. Eri silk is also called as poor man's silk. Unlike other varieties, eri cocoons do not have continuous filament and hence they are spun.

Ericulture is recognized as important from the point of view of generating income and employment, using the silk and byproducts for various purposes and larvae and pupae as food and feed. This would be a valuable subsidiary farm enterprise to small and marginal farmers and landless labourers, particularly women, as 12.7 - 47.2% of the people are living below poverty line in different states[6]. Although, eri silkworm is known to feed on more than 30 host plants[2], only on few host plants developmental biology and other related aspects have been studied. Among the commercially exploited non-mulberry silkworm species for the silk of commerce, eri silkworm, *Samia cynthia ricini* Boisduval is the only species domesticated completely and adopted to indoor rearing all through the year. The history of ericulture is obscure, but it is believed to have originated in India.

The Western Ghats of India are rich in culture and ecology. The biodiversity contained in this mosaic of tropical forest types, from wet evergreen forest to mangrove swamp, is considered worthy of global protection efforts. These also contain potentially valuable genetic material for agriculture in the form of wild relatives of widely cultivated plants. Growth, development and survival rate of worms, secretion of silk, reproductive ability of moths, etc. are largely determined by the type of host or genotype provided for the silkworm. Keeping this in view, an attempt has been made to explore the castor flora available in wild form (perennial) in the Western Ghats region of Karnataka for rearing of the domesticated multi voltine eri silkworm as the leaves are available all through the year for eri cocoon production. Besides increasing eri cocoon production, it helps in effective utilization and conservation of natural resources, apart from generating additional farm income, thus contributing to sustenance of rural industries as well as farming community.

MATERIAL AND METHODS

Cultivation of castor

An attempt has been made to explore the genetic variability exists in castor under natural habitat in five selected regions [Heggada Devana Kote, Madikeri, Sakaleshpur, Shimoga, Sirsi and Mysore (control for comparison)] of the Western Ghats of Karnataka to identify the best ecotype (s) for rearing of eri silkworm. In each of the selected region, identified castor ecotypes were authenticated from the National Centre for Biotechnology Information (NCBI) by obtaining accession numbers. For this purpose, the seeds of identified castor accessions were collected from the selected regions of the Western Ghats of Karnataka. The castor crop was raised in a field at Immavu village, Nanjangud taluk, Mysore District, keeping two local varieties as control. The seeds of these castor accessions were sown at 90 x 60 cm in a plots of 5.0 x 4.0 m and the crop was raised as per the recommended package of practices under irrigated condition[1]. The leaves were used to record the bio-assay performance of eri silkworm.

Eri silkworm rearing

Disinfection of silkworm rearing house was done with 2% per cent formalin solution @ 2.0 l/m^2. Disease free layings of eri silkworm (Blue-Plain, Blue-Zebra and Yellow-Plain) was procured from Central Sericultural Germplasm Resources Centre, Hosur and incubated at a temperature of 25±1^{o}C and relative humidity of 75±5%. The hatched larvae were offered tender leaves of respective castor ecotypes. Eri silkworm rearing operations was conducted from day of brushing to spinning as per the procedure of Dayashankar[4]. The average temperature of 26.04^{o}C and relative humidity of 75.06% were recorded during rearing. One hundred larvae were used for the experimentation and were replicated thrice and the experiment was laid out as completely randomized design. The commercial characters of eri silkworm *viz*., matured larval weight (g), total larval duration (days), cocoon weight (g), shell weight (g), cocoon yield (kg/100 layings), shell yield (kg/100 layings), shell ratio (%), silk productivity (cg/day), fibroin (%) and sericin (%) were recorded.

Statistical analysis of data

The data obtained in the current investigation was subjected to two way analysis of variance and significant differences between means were determined by multivariate test at $p \leq 0.05$ and $p \leq 0.01$ through SPSS for Windows version 20.0.

RESULTS

Rearing parameters

Matured larval weight

Matured larval weight varied significantly during different instars when eri worms fed on the leaves of castor ecotypes. Higher matured larval weight was recorded in KJ000406 accession (8.812 g) followed by KJ000404 (8.126 g), KJ130043 (7.788 g), KJ130045 (7.286 g), KJ000402 (7.187 g) and KJ130047 (C-1) (6.965 g). However, it was lower in KJ130048 (C-2) accession (6.373 g). Among the eri silkworm strains, matured larval weight was significantly more in Yellow-Plain (7.544 g) when compared to Blue-Plain (7.454 g) and Blue-Zebra (6.575 g).

The interaction between castor accessions and eri silkworm strains did not exhibit significant variation with respect to matured larval weight in different instars. However, weight was highest (9.138 g) in the interaction of KJ000406 x Yellow-Plain followed by KJ000406 x Blue-Plain (8.864 g), KJ000406 x Blue-Zebra (8.435 g), KJ000404 x Yellow-Plain (8.370 g), KJ000404 x Blue-Plain (8.060 g) and KJ00404 x Blue-Zebra (7.947 g) and it was lowest in KJ130048 (C-2) x Blue-Zebra (5.684 g) (Tables 1).

Total larval duration

Eri silkworms fed on the leaves of different castor ecotypes showed marked influence on total larval duration. Total larval duration ranged between 18.96 (KJ000406) and 21.68 days (KJ130048) (C-2). Among the eri silkworm strains, total larval duration was shorter in Yellow-Plain (20.19 days) over Blue-Plain (20.50 days) and Blue-Zebra (20.96 days).

The interaction between castor accessions and eri silkworm strains did not show significant difference in total larval duration. Larval duration was lowest in KJ000406 x Yellow-Plain (18.73 days) when compared to KJ000404 x Blue-Plain (18.90 days). However, larvae of Blue-Zebra strain fed on the leaves of KJ130048 accession (C-2) recorded highest duration of 21.92 days (Table 1).

Cocoon parameters

Cocoon weight

Eri cocoons formed from the worms fed on the leaves of different castor ecotypes exerted notable variations with respect to cocoon weight with higher being in KJ000406 accession (3.162 g) followed by KJ000404 (2.934 g), KJ130045 (2.815 g), KJ130043 (2.741 g), KJ000402 (2.721 g), KJ130047 (2.682 g), KJ000407 (2.649 g), KJ000405 (2.631 g), KJ130044 (2.607 g), KJ130046 (2.586 g) and KJ000403 (2.563 g). However, it was lower in KJ130048 accession (C-2) (2.530 g). Cocoon weight varied significantly among the eri silkworm strains with highest being in Yellow-Plain (2.791 g) when compared to Blue-Plain (2.757 g) and Blue-Zebra (2.606 g). The interaction between castor accessions and eri silkworm strains showed non-significant variation for cocoon weight. However, cocoon weight was more in KJ000406 x Yellow-Plain (3.321 g) followed by KJ000406 x Blue-Plain (3.106 g), KJ000406 x Blue-Zebra (3.058 g), KJ000404 x Yellow-Plain (3.019 g), KJ000404 x Blue-Plain (2.920 g) and KJ00404 x Blue-Zebra (2.864 g). But, it was less in KJ130048 (C-2) x Blue-Zebra (2.398 g) (Table 2).

Shell weight

Significant variations were evident in shell weight among the castor ecotypes with higher being in KJ000406 accession (0.488 g), followed by KJ000404 (0.436 g), KJ130045 (0.392 g), KJ130043 (0.372 g), KJ000402

(0.353 g), KJ130047 (C-1) (0.341 g), KJ000407 (0.334 g), KJ000405 (0.323 g), KJ130044 (0.317 g), KJ130046 (0.312 g) and KJ000403 (0.306 g). However, it was lower in KJ130048 accession (C-2) (0.299 g). Among the eri silkworm strains, shell weight was significantly higher in Yellow-Plain (0.381 g) over Blue-Plain (0.372 g) and Blue-Zebra (0.315 g).

The interaction between castor accessions and eri silkworm strains had seldom influence on shell weight. More weight was recorded in KJ000406 x Yellow-Plain (0.527 g) followed by KJ000406 x Blue-Plain (0.474 g) and KJ000406 x Blue-Zebra (0.463 g). However, shell weight was less in KJ130048 (C-2) x Blue-Zebra (0.266 g) (Table 2).

Cocoon yield

Cocoon yield i.e., final indicator of the produce of eri worms did vary significantly among the batches of eri worms fed on the leaves of different castor ecotypes with highest being in KJ000406 accession (81.79 kg/100 layings) followed by KJ000404 (80.35 kg), KJ130045 (79.41 kg), KJ000402 (76.59 kg), KJ130043 (75.82 kg), KJ130047 (C-1) (75.15 kg), KJ000407 (74.18 kg), KJ000405 (73.04 kg), KJ130044 (72.35 kg), KJ130046 (71.76 kg) and KJ000403 (71.01 kg). However, it was lowest in KJ130048 accession (C-2) (70.73 kg). Among the eri silkworm strains, cocoon yield was significantly more in Yellow-Plain (77.17 kg/100 layings) when compared to Blue-Plain (75.84 kg) and Blue-Zebra (72.54 kg).

In the interaction between castor accessions and eri silkworm strains, cocoon yield was higher in KJ000406 x Yellow-Plain (83.43 kg/100 layings), while KJ000404 x Yellow-Plain (81.84 kg), KJ000406 x Blue-Plain (81.77 kg), KJ130045 x Blue–Zebra (80.25 kg), KJ000406 x Blue-Zebra (80.18 kg), KJ000404 x Blue-Plain (80.10 kg) and KJ130045 x Yellow-Plain (79.79 kg) were found next best. Cocoon yield was lower (67.68 kg) in KJ130048 (C-2) x Blue-Zebra (Table 3).

Shell yield

Shell yield is the better indicator of produce of eri worms, as the cocoons are of open type and are marketed in the form of shells. Shell yield was significantly more in KJ000406 accession (12.15 kg/100 layings) when compared to KJ000404 (11.38 kg), KJ130045 (10.91 kg), KJ130043 (10.11 kg), KJ000402 (9.718 kg), KJ130047 (C-1) (9.423 kg), KJ000407 (9.227 kg), KJ000405 (8.780 kg), KJ130044 (8.584 kg), KJ130046 (8.459 kg) and KJ000403 (8.283 kg). However, it was less in KJ130048 accession (C-2) (8.135 kg). Among the eri silkworm strains, shell yield was significantly highest in Yellow-Plain (10.28 kg/100 layings) over Blue-Plain (9.935 kg) and Blue-Zebra (8.573 kg).

The interaction between castor accessions and eri silkworm strains did not show significant variation in respect of shell yield with higher being in KJ000406 x Yellow-Plain (12.98 kg/100 layings) followed by KJ000406 x Blue-Plain (11.80 kg), KJ000404 x Yellow-Plain (11.79 kg), KJ00406 x Blue –Zebra (11.67 kg), KJ130045 x Yellow-Plain (11.29 kg), KJ000404 x Blue-Plain (11.20 kg). Shell yield was lower in KJ130048 (C-2) x Blue-Zebra (7.209 kg) (Table 3).

Shell ratio

Shell ratio showed significant variation among the castor ecotypes, highest shell ratio was noticed in KJ000406 accession (15.46 %), followed by KJ000404 (14.88 %), KJ130045 (14.36 %), KJ130043 (13.25 %), KJ000402 (12.97 %), KJ130047 (C-1) (12.72 %), KJ000407 (12.64 %), KJ000405 (12.26 %), KJ130044 (12.13 %), KJ130046 (12.05 %) and KJ000403 (11.89 %). However, it was lowest in KJ130048 accession (C-2) (11.77 %). Among the eri silkworm strains, shell ratio was significantly higher in Yellow-Plain (13.60 %) followed by Blue-Plain (13.43 %) and same was lower in Blue-Zebra (12.06 %).

When different strains of eri silkworms nourished on the leaves of castor ecotypes did not show significant difference in shell ratio. It was more in KJ000406 x Yellow-Plain (15.87 %) followed by KJ000406 x Blue-Plain (15.28 %) and KJ000406 x Blue-Zebra (15.21 %), KJ000404 x Yellow-Plain (15.05 %), KJ000404 x Blue-Plain (14.81 %) and

KJ000404 x Blue-Zebra (14.78 %). The shell ratio was less in KJ130048 (C-2) x Blue-Zebra (11.04 %) (Table4).

Silk productivity

Silk productivity i.e., shell weight to fifth instar larval duration showed significant variation among the castor ecotypes. Silk productivity was significantly highest in KJ000404 accession (7.320 cg/day) followed by KJ000406 (7.199 cg), KJ130043 (6.177 cg), KJ130045 (5.345 cg), KJ130047 (C-1) (5.242 cg), KJ000402 (5.126 cg), KJ000407 (4.995 cg), KJ000405 (4.794 cg), KJ130044 (4.646 cg), KJ130046 (4.537 cg) and KJ000403 (4.412 cg). However, it was lowest in KJ130048 accession (C-2) (4.259 cg). Silk productivity too varied significantly among the eri silkworm strains with higher being in Yellow-Plain (5.730 cg/day) followed by Blue-Plain (5.521 cg) and same was lower in Blue-Zebra (4.762 cg).

When different strains of eri silkworms nourished on the leaves of castor ecotypes did not show significant difference in silk productivity. It was more in KJ000406 x Yellow-Plain (8.508 cg) followed by KJ000404 x Blue-Plain (7.706 cg) and KJ000404 x Blue-Zebra (7.210 cg), KJ000404 x Yellow-Plain (7.045 cg), KJ000406 x Blue-Plain (6.670 cg), KJ000406 x Blue-Zebra (6.418 cg), KJ130043 x Yellow-Plain (6.246 cg) and KJ130043 x Blue-Plain (6.166 cg). The silk productivity was less in KJ130048 (C-2) x Blue-Zebra (3.814 cg) (Table 4).

Fibroin

Significantly higher fibroin content was obtained in the batches of cocoons when eri worms fed on the leaves of KJ000406 castor accession (92.17 %) followed by KJ130043 (91.68 %), KJ000404 (90.90 %), KJ130045 (89.64 %), KJ000402 (89.50 %), KJ130047 (C-1) (88.96 %), KJ000407 (88.14 %), KJ000405 (88.09 %), KJ130044 (87.92 %), KJ000046 (87.61%) and KJ130403 (87.33 %). However, it was lower in KJ130048 accession (C-2) (86.75 %). Eri silkworms also showed variation with respect to fibroin content among the strains with highest being in Yellow-Plain (89.84 %) when compared to Blue-Plain (89.56 %) and Blue-Zebra (87.77 %).

The interaction between castor accessions and eri silkworm strains showed non-significant difference for fibroin content. However, the interaction of KJ000406 x Yellow-Plain recorded higher fibroin (92.51 %) followed by KJ000406 x Blue-Plain (92.23 %), KJ130043 x Yellow-Plain (91.93 %), KJ000406 x Blue-Zebra (91.77 %), KJ130043 x Blue-Plain (91.74 %), KJ130043 x Blue-Zebra (91.37 %) and KJ000404 x Yellow-Plain (91.16 %) and it was lower in KJ130048 (C-2) x Blue-Zebra (85.39 %) (Table5).

Sericin

The sericin i.e., gluey substance coated with fibroin did vary significantly among the group of worms that were fed on the leaves of different castor ecotypes. Notably, it was less in KJ000406 accession (7.830 %) and KJ130043 (8.319 %), KJ000404 (9.096 %), KJ130045 (10.37 %), KJ000402 (10.50 %), KJ130047 (C-1) (11.06 %), KJ000407 (11.86 %), KJ000405 (11.91 %), KJ130044 (12.08 %), KJ000046 (12.39 %) and KJ130403 (12.67 %). However, it was higher in KJ130048 accession (C-2) (13.28 %). Sericin content varied markedly among the eri silkworm strains with lowest being in Yellow-Plain (10.17 %) over Blue-Plain (10.44 %) and Blue-Zebra (12.23 %).

The interaction between castor accessions and eri silkworm strains did not influence on sericin content. The interaction of KJ000406 x Yellow-Plain recorded lower (7.488 %) sericin content and KJ000406 x Blue-Plain (7.775 %), KJ130043 x Yellow-Plain (8.072 %), KJ000406 x Blue-Zebra (8.227 %), KJ130043 x Blue-Plain (8.256 %), KJ130043 x Blue-Zebra (8.631 %) and KJ000404 x Yellow-Plain (8.840 %) were found next best and it was higher in KJ130048 (C-2) x Blue-Zebra (14.61 %) (Table5).

DISCUSSION

Eri silkworms fed on the leaves of different castor ecotypes showed marked variations in larval parameters *viz.*, matured larval weight and total larval duration among Yellow-Plain, Blue-Plain and Blue-Zebra strains. The castor accession, KJ000406 excelled superior with all the three strains of eri silkworm followed by

KJ000404, KJ130043, KJ130045 and KJ000402 accessions and these parameters were inferior with KJ130048 accession. Eri worms fed on Aruna and RC-8 castor genotypes recorded higher larval weight and were lower in PCS-121 castor genotype[7]. According to Sarmah *et al.*[10], Local red (non-powdery) castor variety was found best among 10 selected castor genotypes with respect to larval weight and effective rate of rearing as revealed by bio-assay with eri silkworm. Eri worms fed on the leaves of Local green (non-powdery) variety of castor recorded least larval duration and was more with DCH-32 hybrid[5]. The larval weight showed marked difference among eri silkworm strains, highest being in Yellow-Zebra and least in Green-Blue Spotted[12]. Similarly, Sharma and Kalita[11] also recorded higher larval weight in Yellow-Zebra and lower in Yellow-Plain during spring and autumn seasons, respectively.

Eri silkworms fed on leaves of different castor ecotypes exerted variations in different strains on cocoon parameters *viz*., cocoon weight, shell weight, shell ratio, silk productivity, fibroin, sericin, cocoon yield and shell yield. The cocoon parameters were higher in KJ000406 castor accession with Yellow-Plain, Blue-Plain and Blue-Zebra strains followed by KJ000404, KJ130045 and KJ130043 accessions and these parameters were lower in KJ130048 accession. According to Sarmah *et al.*[10], Local red (non-powdery) castor variety recorded higher shell weight and silk ratio as revealed by bio-assay with eri silkworm. Teotia *et al.*[13] recorded shell yield of 8-9 kg/100 DFLs among commercial farmers in the North – Eastern states of Assam, Nagaland and Meghalaya.

According to Mahobia *et al.*[8], cocoon yield in eri ranged from 47.79 to 63.45 kg with an average of 56.02 kg/100DFLs which is significantly high and the study pointed out towards potentiality of eri silkworm rearing in Chhattisgarh. Sannappa *et al*.[9] recorded higher cocoon and shell weights when eri larvae fed on RC-8 genotype, while the shell ratio was higher in cocoons formed by the larvae fed on Aruna genotype. As per Singh *et al*.[12], eco-races of eri silkworm did not show significant influence on cocoon and shell weights. However, significant difference in shell ratio was observed among different eco-races with higher being in Kokrajhar and least in Mendipathar. Further, shell ratio was higher in Yellow-Zebra and least in Green Blue Spotted strain. Eri worms nourished on the leaves of DCH-85 recorded higher cocoon weight, cocoon yield, shell weight, shell yield, shell ratio, silk productivity, fibroin and sericin, while these were lower in GCH-4[3].

Table 1: Matured larval weight and total larval duration in three strains of eri silkworm reared on castor ecotypes

Castor ecotype (Accession No.)	Matured larval weight (g)				Total larval duration (days)			
	Blue-Plain	Blue-Zebra	Yellow-Plain	Mean	Blue-Plain	Blue-Zebra	Yellow-Plain	Mean
KJ000402	7.605 ± 0.53	6.514 ± 0.36	7.442 ± 0.25	**7.187**	20.85 ± 0.47	21.92 ± 0.18	20.67 ± 0.31	**21.15**
KJ000403	6.891 ± 0.07	5.757 ± 0.09	6.954 ± 0.22	**6.534**	20.85 ± 0.18	21.56 ± 0.18	20.49 ± 0.18	**20.97**
KJ000404	8.060 ± 0.32	7.947 ± 0.31	8.370 ± 0.23	**8.126**	18.90 ± 0.18	19.08 ± 0.00	19.08 ± 0.31	**19.02**
KJ000405	7.205 ± 0.53	6.066 ± 0.19	7.253 ± 0.16	**6.841**	20.67 ± 0.00	21.56 ± 0.18	20.49 ± 0.18	**20.91**
KJ000406	8.864 ± 0.35	8.435 ± 0.53	9.138 ± 0.11	**8.812**	19.08 ± 0.00	19.08 ± 0.00	18.73 ± 0.18	**18.96**
KJ000407	7.312 ± 0.25	6.091 ± 0.18	7.354 ± 0.18	**6.919**	20.32 ± 0.35	21.21 ± 0.31	19.79 ± 0.18	**20.44**
KJ130043	7.773 ± 0.23	7.701 ± 0.44	7.889 ± 0.27	**7.788**	19.96 ± 0.18	19.96 ± 0.18	19.79 ± 0.18	**19.90**
KJ130044	7.133 ± 0.22	6.045 ± 0.07	7.171 ± 0.42	**6.783**	21.03 ± 0.47	21.56 ± 0.18	20.49 ± 0.18	**21.03**
KJ130045	7.610 ± 0.38	6.582 ± 0.21	7.665 ± 0.12	**7.286**	20.32 ± 0.18	21.03 ± 0.18	19.96 ± 0.18	**20.44**
KJ130046	7.059 ± 0.14	5.909 ± 0.28	7.067 ± 0.30	**6.679**	21.21 ± 0.31	21.39 ± 0.18	20.67 ± 0.00	**21.09**
KJ130047 (C-1)	7.345 ± 0.17	6.168 ± 0.14	7.380 ± 0.18	**6.965**	21.03 ± 0.36	21.21 ± 0.00	20.67 ± 0.31	**20.97**
KJ130048 (C-2)	6.589 ± 0.15	5.684 ± 0.07	6.846 ± 0.21	**6.373**	21.74 ± 0.00	21.92 ± 0.18	21.38 ± 0.47	**21.68**
Mean	**7.454**	**6.575**	**7.544**		**20.50**	**20.96**	**20.19**	
F-value	3.656*	11.16*	7.685*		9.274*	35.58**	9.266**	
Two way ANOVA (F-value)	Accession No.: 20.05** Strain: 44.81** Accession No. x Strain: 0.690 [NS]				Accession No.: 39.21** Strain: 32.76**, Accession No. x Strain:1.181[NS]			

C-1: Control-1; C-2: Control-2; ±: Standard error; *: Significant ($p \leq 0.05$); **: Highly significant ($p \leq 0.01$); NS: Non-significant

Table 2: Cocoon and shell weights in three strains of eri silkworm reared on castor ecotypes

Castor ecotype (Accession No.)	Cocoon weight (g)				Shell weight (g)			
	Blue-Plain	Blue-Zebra	Yellow-Plain	Mean	Blue-Plain	Blue-Zebra	Yellow-Plain	Mean
KJ000402	2.795 ± 0.03	2.560 ± 0.04	2.806 ± 0.01	**2.721**	0.381± 0.00	0.289 ± 0.00	0.387 ± 0.00	**0.353**
KJ000403	2.614 ± 0.05	2.453 ± 0.05	2.621 ± 0.04	**2.563**	0.322 ± 0.02	0.271 ± 0.00	0.325 ± 0.02	**0.306**
KJ000404	2.920 ± 0.11	2.864 ± 0.08	3.019 ± 0.06	**2.934**	0.430 ± 0.01	0.424 ± 0.01	0.455 ± 0.01	**0.436**
KJ000405	2.681 ± 0.11	2.523 ± 0.07	2.689 ± 0.03	**2.631**	0.342 ± 0.01	0.281 ± 0.00	0.347 ± 0.01	**0.323**
KJ000406	3.106 ± 0.08	3.058 ± 0.07	3.321 ± 0.07	**3.162**	0.474 ± 0.01	0.463 ± 0.01	0.527 ± 0.00	**0.488**
KJ000407	2.705 ± 0.05	2.526 ± 0.01	2.717 ± 0.07	**2.649**	0.360 ± 0.01	0.282 ± 0.01	0.361 ± 0.00	**0.334**
KJ130043	2.812 ± 0.04	2.586 ± 0.12	2.825 ± 0.04	**2.741**	0.397 ± 0.02	0.314 ± 0.01	0.407 ± 0.00	**0.372**
KJ130044	2.650 ± 0.05	2.517 ± 0.10	2.653 ± 0.02	**2.607**	0.334 ± 0.02	0.281 ± 0.02	0.335 ± 0.02	**0.317**
KJ130045	2.832 ± 0.15	2.769 ± 0.03	2.845 ± 0.07	**2.815**	0.410 ± 0.02	0.353 ± 0.01	0.412 ± 0.05	**0.392**
KJ130046	2.629 ± 0.05	2.488 ± 0.05	2.639 ± 0.07	**2.586**	0.329 ± 0.03	0.275 ± 0.01	0.331 ± 0.01	**0.312**
KJ130047 (C-1)	2.753 ± 0.08	2.533 ± 0.07	2.760 ± 0.07	**2.682**	0.367 ± 0.02	0.285 ± 0.00	0.372 ± 0.02	**0.341**
KJ130048 (C-2)	2.591 ± 0.09	2.398 ± 0.05	2.602 ± 0.05	**2.530**	0.314 ± 0.02	0.266 ± 0.03	0.318 ± 0.04	**0.299**
Mean	**2.757**	**2.606**	**2.791**		**0.372**	**0.315**	**0.381**	
F-value	3.38*	8.21**	13.95**		8.55**	25.4**	8.40**	
Two way ANOVA (F-value)	Accession No.: 20.78** Strain: 24.90** Accession No. x Strain: 0.397^{NS}				Accession No.:33.24** Strain: 51.11** Accession No. x Strain: 0.738^{NS}			

C-1: Control-1; C-2: Control-2; ±: Standard error; *: Significant ($p \leq 0.05$); **: Highly significant ($p \leq 0.01$); NS: Non-significant

Table 3: Cocoon and shell yields in three strains of eri silkworm reared on castor ecotypes

Castor ecotype (Accession No.)	Cocoon yield (kg/100 layings)				Shell yield (kg/100 layings)			
	Blue-Plain	Blue-Zebra	Yellow-Plain	Mean	Blue-Plain	Blue-Zebra	Yellow-Plain	Mean
KJ000402	77.21 ± 0.64	73.85 ± 1.43	78.69 ± 1.20	**76.59**	10.29 ±0.12	8.255 ±0.30	10.61 ±0.64	**9.718**
KJ000403	72.25 ± 1.07	67.30 ± 2.10	73.46 ± 0.08	**71.01**	8.693 ±0.42	7.258 ±0.14	8.897 ±0.40	**8.283**
KJ000404	80.10 ± 2.75	79.11 ± 2.00	81.84 ± 1.80	**80.35**	11.20 ±0.60	11.14 ±0.38	11.79 ±0.29	**11.38**
KJ000405	74.11 ± 3.20	69.64 ± 1.15	75.36 ± 1.38	**73.04**	9.238 ±0.35	7.603 ±0.26	9.501 ±0.06	**8.780**
KJ000406	81.77 ± 1.92	80.18 ± 1.04	83.43 ± 1.40	**81.79**	11.80 ±0.56	11.67 ±0.41	12.98 ±0.09	**12.15**
KJ000407	75.27 ± 1.29	71.09 ± 1.27	76.19 ± 2.95	**74.18**	9.828 ±0.31	7.909 ±0.46	9.946 ±0.23	**9.227**
KJ130043	77.68 ± 0.94	71.18 ± 3.17	78.61 ± 1.04	**75.82**	10.75 ±0.43	8.447 ±0.28	11.140 ±0.36	**10.11**
KJ130044	73.23 ± 1.57	69.45 ± 1.52	74.36 ± 0.67	**72.35**	9.009 ±0.41	7.574 ±0.37	9.168 ±1.21	**8.584**
KJ130045	78.19 ± 3.67	80.25 ± 0.89	79.79 ± 2.42	**79.41**	11.09 ±0.64	10.35 ±0.26	11.29 ±0.18	**10.91**
KJ130046	72.63 ± 0.93	68.72 ± 0.46	73.93 ± 1.23	**71.76**	8.883 ±0.66	7.419 ±0.35	9.074 ±0.50	**8.459**
KJ130047 (C-1)	76.04 ± 1.78	72.00 ± 1.72	77.41 ± 2.97	**75.15**	9.952 ±0.63	8.038 ±0.14	10.28 ±1.14	**9.423**
KJ130048 (C-2)	71.55 ± 2.16	67.68 ± 1.14	72.97 ± 2.29	**70.73**	8.477 ±0.48	7.209 ±0.86	8.720 ±0.64	**8.135**
Mean	**75.84**	**72.54**	**77.17**		**9.935**	**8.573**	**10.28**	
F-value	2.521*	8.512**	3.427**		5.020**	15.77**	5.357**	
Two way ANOVA (F-value)	Accession No.:12.29** Strain: 20.03** Accession No. x Strain: 0.440^{NS}				Accession No.: 21.17** Strain: 40.63** Accession No. x Strain: 0.651^{NS}			

C-1: Control-1; C-2: Control-2; ±: Standard error; *: Significant ($p \leq 0.05$); **: Highly significant ($p \leq 0.01$); NS: Non-significant

Table 4: Shell ratio and silk productivity in three strains of eri silkworm reared on castor ecotypes

Castor ecotype (Accession No.)	Shell ratio (%)				Silk productivity (cg/day)			
	Blue-Plain	Blue-Zebra	Yellow-Plain	Mean	Blue-Plain	Blue-Zebra	Yellow-Plain	Mean
KJ000402	13.71 ± 0.25	11.37 ± 0.31	13.83 ± 0.13	**12.97**	5.543 ±0.28	4.270 ±0.34	5.563 ±0.50	**5.126**
KJ000403	12.24 ± 0.59	11.05 ± 0.32	12.37 ± 0.89	**11.89**	4.598 ±0.40	3.888 ±0.16	4.748 ±0.67	**4.412**
KJ000404	14.81 ± 0.56	14.78 ± 0.22	15.05 ± 0.30	**14.88**	7.706 ±0.48	7.210 ±1.14	7.045 ±0.12	**7.320**
KJ000405	12.66 ± 0.31	11.24 ± 0.49	12.87 ± 0.25	**12.26**	4.873 ±0.44	4.188 ±0.35	5.322 ±0.18	**4.794**
KJ000406	15.28 ± 0.03	15.21 ± 0.25	15.87 ± 0.33	**15.46**	6.670 ±0.56	6.418 ±0.27	8.508 ±0.88	**7.199**
KJ000407	13.30 ± 0.46	11.29 ± 0.52	13.32 ± 0.48	**12.64**	5.240 ±0.05	4.253 ±0.32	5.493 ±0.19	**4.995**
KJ130043	14.01 ± 0.28	11.45 ± 0.24	14.29 ± 0.41	**13.25**	6.166 ±0.27	6.118 ±0.46	6.246 ±0.45	**6.177**
KJ130044	12.59 ± 0.51	11.16 ± 0.37	12.63 ± 0.60	**12.13**	4.840 ±0.29	4.201 ±0.53	4.897 ±0.19	**4.646**
KJ130045	14.62 ± 0.76	13.70 ± 0.29	14.76 ± 1.86	**14.36**	5.752 ±0.24	4.399 ±0.34	5.885 ±0.05	**5.345**
KJ130046	12.50 ± 0.92	11.09 ± 0.49	12.56 ± 0.39	**12.05**	4.730 ±1.68	4.080 ±0.34	4.802 ±0.17	**4.537**
KJ130047 (C-1)	13.36 ± 0.98	11.32 ± 0.33	13.49 ± 0.64	**12.72**	5.702 ±0.74	4.307 ±0.35	5.718 ±0.57	**5.242**
KJ130048 (C-2)	12.09 ± 0.34	11.04 ± 1.15	12.16 ± 1.34	**11.77**	4.432 ±0.26	3.814 ±0.47	4.531 ±0.72	**4.259**
Mean	**13.43**	**12.06**	**13.60**		**5.521**	**4.762**	**5.730**	
F-value	3.55*	10.49**	2.20^{NS}		2.41*	5.50**	5.70**	
Two way ANOVA (F-value)	Accession No.:11.48** Strain: F-value: 21.69** Accession No. x Strain: F-value- 0.512^{NS}				Accession No.:11.37** Strain: 11.09** Accession No. x Strain: 0.524^{NS}			

C-1: Control-1; C-2: Control-2; ±: Standard error; *: Significant ($p \leq 0.05$); **: Highly significant ($p \leq 0.01$); NS: Non-significant

Table 5: Fibroin and sericin contents in three strains of eri silkworm reared on castor ecotypes

Castor ecotype (Accession No.)	Fibroin (%)				Sericin (%)			
	Blue-Plain	Blue-Zebra	Yellow-Plain	Mean	Blue-Plain	Blue-Zebra	Yellow-Plain	Mean
KJ000402	90.26 ±1.44	87.43 ±0.93	90.83 ±0.09	**89.50**	9.739 ±0.84	12.57 ±0.66	9.174 ±0.09	**10.50**
KJ000403	88.14 ±1.01	86.18 ±0.44	87.66 ±0.80	**87.33**	11.86 ±1.01	13.82 ±0.44	12.34 ±0.80	**12.67**
KJ000404	91.12 ±0.35	90.43 ±1.15	91.16 ±0.81	**90.90**	8.879 ±0.35	9.568 ±0.72	8.840 ±0.81	**9.096**
KJ000405	89.58 ±0.30	86.10 ±0.94	88.58 ±0.37	**88.09**	10.42 ±0.30	13.90 ±0.94	11.42 ±0.37	**11.91**
KJ000406	92.23 ±0.45	91.77 ±1.02	92.51 ±0.70	**92.17**	7.775 ±0.45	8.227 ±1.02	7.488 ±0.70	**7.830**
KJ000407	88.68 ±1.36	86.79 ±1.29	88.94 ±1.17	**88.14**	11.32 ±0.28	13.21 ±0.49	11.06 ±0.45	**11.86**
KJ130043	91.74 ±0.46	91.37 ±0.29	91.93 ±0.30	**91.68**	8.256 ±0.46	8.631 ±0.29	8.072 ±0.30	**8.319**
KJ130044	88.63 ±0.61	86.37 ±1.21	88.76 ±0.59	**87.92**	11.37 ±0.61	13.63 ±1.20	11.24 ±0.59	**12.08**
KJ130045	90.75 ±0.40	87.17 ±1.29	90.99 ±0.56	**89.64**	9.255 ±0.40	12.83 ±0.92	9.008 ±0.56	**10.37**
KJ130046	86.05 ±4.10	87.09 ±0.59	89.68 ±0.18	**87.61**	13.95 ±0.82	12.91 ±0.59	10.32 ±0.18	**12.39**
KJ130047 (C-1)	89.86 ±0.91	87.12 ±0.87	89.90 ±1.22	**88.96**	10.14 ±0.62	12.88 ±0.73	10.15 ±0.74	**11.06**
KJ130048 (C-2)	87.71 ±1.92	85.39 ±2.20	87.15 ±2.24	**86.75**	12.29 ±0.58	14.61 ±2.20	12.94 ±0.31	**13.28**
Mean	**89.56**	**87.77**	**89.84**		**10.44**	**12.23**	**10.17**	
F-value	1.422^{NS}	3.704*	3.205*		8.933**	4.902*	9.637**	
Two way ANOVA (F-value)	Accession No.: 6.288** Strain: 10.28** Accession No. x Strain: 0.495^{NS}				Accession No: 17.33** Strain: 28.03** Accession No. x Strain: 1.364^{NS}			

C-1: Control-1; C-2: Control-2; ±: Standard error; **: Highly significant ($p \leq 0.01$); NS: Non-significant

CONCLUSION

The results of the investigation on the bio-assay of identified castor (perennial) ecotypes of the Western Ghats region of Karnataka using three strains (Yellow - Plain, Blue - Plain and Blue – Zebra) of eri silkworm revealed that KJ000406 castor accession with Yellow-Plain strain excelled superiority with respect to rearing performance of eri silkworm and thus can be exploited for rearing of eri silkworm all through the year for maximizing eri cocoon production.

Acknowledgments

The authors are thankful to the Coordinator, Institution of Excellence, University of Mysore, Mysuru, for providing financial assistance and the Chairman, Department of Studies in Sericulture Science, University of Mysore, Mysore, for providing facilities to carry out the current investigation.

REFERENCES

1. Anonymous, *Castor – Package of Practices for Increasing Production*. (Eds. Hegde, D. M. and Patil, D.,) Directorate of Oilseeds Research, Hyderabad, p. 20 (2000).
2. Arora, G. S. and Gupta, L. J., Taxonomic studies on some of the Indian non-mulberry silk moths (Lepidoptera: Saturniidae). *Mem. Zool. Survey India*, **16:** 49-54 (1979).
3. Chandrashekhar, S., Sannappa, B., Manjunath, K. G. and. Govindan, R., Efficacy of castor genotypes on bio-assay, cocoon and grainage traits of the domesticated vanya silkworm, *Samia cynthia ricini* Boisduval. *J. Pharmacy Res.*, **5(3):** 1346-1349 (2012).
4. Dayashankar, K. N., Performance of eri silkworm, *Samia cynthia ricini* Boisduval on different host plants and economics of rearing on castor under Dharwad conditions. *M.Sc. (Agri.) Thesis*, UAS, Bangalore, p. 86 (1982).
5. Govindan, R., Sannappa, B., Bharathi, V. P., Singh, M. P. and Hegde, D. M., Influence of feeding leaves of some castor varieties on rearing performance of eri silkworm, *Samia cynthia ricini* Boisduval. *Indian J. Environ. Ecoplan*, **6:** 485-488 (2002).
6. Jayaraj, S., Ericulture for employment and income generation in South India. *Proceedings of the Workshop on Prospects for Development of Ericulture in Karnataka*, UAS, Dharwad, p. 9 (2004).
7. Jayaramaiah, M. and Sannappa, B., Influence of castor genotypes on rearing performance of different eri silkworm breeds. *Int. J. Wild Silkmoth & Silk*, **5:** 29-31 (2000).
8. Mahobia, G. P., Shankar Rao, K. V., Verma, R. S., Roy, G. C. and Suryanarayana, N., Potential of eri silkworm rearing in Chhatisgarh. *Indian Silk*, **44(4):** 12-14 (2005).
9. Sannappa, B., Naika, R., Govindan, R. and Subramanya, G., Influence of some castor

genotypes on larval, cocoon and grainage traits of eri silkworm (*Samia cynthia ricini* Boisduval). *Int. J. Agric. Sci.*, **3:** 139-141 (2007).

10. Sarmah, M. C., Datta, R. N., Das, P. K. and Benchamin, K. V., Evaluation of certain castor genotypes for improving ericulture. *Indian J. Seric*., **41:** 62-63 (2002).
11. Sharma, P. and Kalita, J. C., A comparative study on six strains of eri silk worm (*Samia ricini* Donovan) based on morphological traits, *Global J. Biosci. Biotech*, **2(4):** 506-511 (2013).
12. Singh, B. K., Tiken, N., Baruah, P. K., Dutta, K., Mishra, S. N., Mahanta, J. C. and Jayaprakash, P., Studies on rearing performance and economic traits of eri silkworm (*Samia ricini* Donovan) on castor and kesseru: Prospects for sustainable utilization of by products. *The Ecoscan*, **1:** 305-308 (2012).
13. Teotia, R. S., Sathyanarayana, K., Rajashekar, K., Goel, R. K. and Krishna Rao, J. V., UNDP assistance in development of ericulture. *Indian Silk*, **41(14):** 13-18 (2003).