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COMPARATIVE ANALYSIS ON REELING PARAMETERS OF CULTIVATED AND WILD RAILY TASAR COCOONS

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ABSTRACT

A comparative study was conducted to assess the reeling parameters of cultivated and wild tasar raily eco-race cocoons. The results of the study revealed that the cocoon and reeling parameters were superior in wild raily eco-race than cultivated. The average stifled cocoon weight, shell weight, filament length, filament weight, NBFL, Denier, reelability, raw silk recovery, yield/cocoons (g) and waste (%) in wild raily was 08.28 g, 02.22 g, 1318.50 m and 1.63 g,134.83 m, 11.07 %, 20.98 %, 52.90 %, 1237.33 g and 47.10 %, respectively. Whereas, in cultivated raily average stifled cocoon weight, shell weight, filament length, filament weight, NBFL, Denier, reelability, raw silk recovery, yield/cocoons (g) and waste (%) was 06.32 g, 01.04 g, 631.13 m, 0.60 g, 157.52 m, 08.75 %, 32.94 %, 58.30 %, 556.01 g and 41.70 %, respectively. Deterioration of cocoon and reeling parameters in cultivated raily was due to more of human handling, host plant variations and ecosystem changes. Hence, it is inferred that to produce superior quality cocoons, Raily eco-race must be maintained under natural conditions.

Keywords: Raily, ecorace, *Terminalia arjuna*, cultivated, wild.

Introduction

The tropical tasar silkworm, *Antheraea mylitta* Drury, is a significant resource for commercial silk production in our country. *A. mylitta* D. exhibits polyphagous behavior, with primary food plants including *Terminalia tomentosa*, *Terminalia arjuna* and *Shorea robusta*, while secondary food plants comprise of *Terminalia chebula*, *T. bellerica*, *T. peniculata*, *Zizyphus jujuba* and others. Various breeding techniques can be employed to develop improved varieties of these silkworms. This insect has adapted to diverse ecological conditions, forming approximately 44 eco-races (Singh and Srivastava, 1997; Srivastava, 2002; Srivastava *et al*., 2003; Mohanty, 2003), distributed across different states, based on their food plants and micro-environmental conditions. Despite centuries of free interbreeding in nature, resulting in high heterogeneity, tasar culture remains a forest-based industry, deeply rooted in the traditions of Central Indian tribes, spanning from West Bengal to Karnataka. Among these eco-races one of the important and major wild eco-race, locally known as Raily is distributed in Bastar forest. The main food plant has been found to be *Shorea robusta*. The famous kosa silk is produced from these cocoons. In nature, Raily eco-race cocoons of *A. mylitta* was recorded in various food plants namely., *Shorea robusta*, *Terminalia tomentosa*, *Anogeissus latifolia*, *Terminalia arjuna*, *Syzygium cumini Buchanania lanzan* and *Tectona grandis* in the forests of Bastar (Chhattisgarh, India) (Mahobia *et al.,* 2002). However, very few work has been done on its cultivation in economic plantation with human interference. So in this study, we explored the possibilities of raily eco-race silkworm rearing under isolated economic plantation located at Bastar, Chhattisgarh region and compared the reeling characteristics of cultivated and wild lots.

Materials and Methods

The field experiment was conducted at Basic Seed Multiplication and Training Centre, BTSSO, CSB, Bastar, Chhattisgarh during 2023. The experimental purpose, 10 raily tasar eco-race dfls were collected from Department of Sericulture, Bastar, Chhattisgarh. The newly hatched worms were brushed onto an isolated patch of 15 year old *T. arjuna* foliages. The brushing was done continuously for three days in single tree and rearing was done in same tree until the worms reached 4^{th} Instar. The fourth instar worms were transferred to another tree due complete defoliation by the worms, rearing was continued till cocoon harvest on same tree. The cultivated raily cocoons along with wild raily cocoons were sent to post cocoon section of Central Tasar Research and Training Institute, Ranchi to analyse cocoon and reeling characteristics such as cocoon weight, shell weight, filament length, filament weight, NBFL and denier.

Assessment of cocoon and shell weight

Cocoon and shell weight for wild and cultivated Raily were carried out as per standard procedure (Sonwalkar, 1993). Stifled cocoon weight was measured using precision electronic balance after removing peduncle. Shell weight was recorded after removing pupa and exuviae. 10 observations were made for wild and cultivated cocoons.

Cooking/softening of Raily tasar cocoons

Cooking/softening of Raily tasar cocoons was carried out by following newly developed non-peroxide technique using sodium carbonate and sodium bi- carbonate (Khan *et al*., 2019). 100 cocoons were softened for each variety with 3 liters water by considering material to liquor ratio of 1:30. Sodium carbonate and sodium bicarbonate of 10 g each for 1 lit of water was added with proper stirring for uniform dissolution. The cocoons were kept in nylon net cloth immersed in degumming solution which were boiled for 20 min without pressure. Then pressurized steaming for another 45-60 min keeping over same solution was done using a perforated plate in pressure cooker. After cooking, the cocoons were taken out subjected for deflossing process to find out single end, single cocoon reeling as well as reeling performance assessment.

Single cocoon reeling assessment

After softening of Raily tasar cocoons, filament was withdrawn from single cocoon under semi- moist condition by using a device "Epprouvette" and simultaneously breaks were noted. The total length of yarn from single cocoon was estimated from the number of revolutions noted from counter meter of Epprouvette multiplied by 1.125 m (circumference). Total 10 readings were taken for Wild as well as cultivated Raily cocoons. After drying in hot air dryer for 20 min at 105±3°C, yarn weight was measured using precision electronic balance and denier was estimated along with non- broken filament length (NBFL) Sonwalkar (1993) using following expressions.

Filament length (m) = Revolution in Epprouvette X 1.125 (1)

$$\text{Nonbroken filament length (NBFL) (m)} = \frac{\text{Total filament length (m)}}{\text{No. of cocoons} + \text{No. of breaks}} \quad (2)$$

$$\text{For single cocoon, NBFL (m)} = \frac{\text{Total filament length (m)}}{1 + \text{No. of breaks}} \quad (3)$$

$$\text{Yarn denier} = \frac{\text{Weight of yarn (g) x 9000}}{\text{Length of yarn (m)}} \quad (4)$$

Reeling performance assessment

Reeling performance for each experimental trials was carried out using Motorized Reeling cum Twisting Machine (MRTM). The yarn withdrawal was carried out following dry reeling technique from semi-moist cocoons after softening with reeling speed of about 30 m/min. Breakages during yarn withdrawal were noted and 90 cocoons were used for each experimental trial. Yarns as well as wastes generated during reeling were dried using hot air drier at 105±3°C. The reelability (%), raw silk recovery (%) and yield/1000 cocoons (g) were estimated by following standard method and expressions (Sonwalkar, 1993).

Reelability (%) = No. of cocoons taken for reeling X 100

No. of cocoons taken for reeling + No. of breaks during reeling

$$\text{Reelability (\%)} = \frac{\text{No. of cocoons taken for reeling X 100}}{\text{No. of cocoons taken for reeling + No. of breaks during reeling}} \quad (1)$$

$$\text{Raw silk recovery (\%)} = \frac{\text{Yarn weight (g) x 100}}{\text{Yarn weight (g) + waste weight (g)}} \quad (2)$$

$$\text{Yield/ 1000 cocoons (g)} = \frac{\text{Yarn weight (g) x 1000}}{\text{No. of cocoons reeled}} \quad (3)$$

Statistical analysis:

Statistical analysis was done to analyse significance difference between mean reeling characteristics of cultivated and wild lots by using Microsoft excel analysis tool pack. In this t-test were done to compare the mean reeling characteristics.

Results and Discussion

The results of the experiment revealed that the average stifled cocoon weight, shell weight, filament length, filament weight, NBFL, Denier, reelability, raw silk recovery, yield/cocoons (g) and waste (%) in wild raily was 08.28 g, 02.22 g, 1318.50 m and 1.63 g,134.83 m, 11.07, 20.98 %, 52.90 %, 1237.33 g and 47.10 %, respectively. Whereas, in cultivated raily average stifled cocoon weight, shell weight, filament length, filament weight, NBFL, Denier, reelability, raw silk recovery, yield/cocoons (g) and waste (%) was 06.32 g, 01.04 g, 631.13 m, 0.60 g, 157.52 m, 08.75, 32.94 %, 58.30 %, 556.01 g and 41.70 %, respectively (Table 1). The cocoon parameters such as stifled cocoon weight, shell weight and reeling parameters such as filament length, filament weight and yield/cocoons was comparatively superior in wild raily tasar eco-race than cultivated raily eco-race. But cocoon & reeling parameters such as NBFL, reelability (%), raw silk recovery (%) and waste (%) are better in cultivated raily in comparison of wild raily. The statistical analysis of cocoon and reeling parameters such as shell weight, filament length, filament weight, NBFL, waste weight showed significance difference among the observations in both cultivated and wild. Whereas, cocoon weight and denier showed non-significance difference.

Silkworm population maintained under varying environment can be expected to have greater variance and higher fitness than population that has been existing in a constant environment. The suitability of a host plant to an insect depends upon the presence of balanced nutrition in the plants for proper growth and development of the insect (Beck, 1956). It was also reported that, the meta physiological activity in the life cycle of the tasar silkworm including reproduction are influenced to a great extent by the climate and the feeding quality of leaves (Rath *et al*., 2006). Similarly, in the present case, different parameters studied in the silkworms of different groups revealed variations due to the influence of the biotic as well as abiotic factors. The present study is also concurrence with the earlier report (Srivastava *et al.,* 2003) that Sal based silkworms (Wild) showed better performance during second crop season.

The shell weight of wild Raily tropical tasar cocoons is higher as compared to other cultivated cocoons because of thicker shell (Khan *et al*., 2019). The phytochemical analysis of *T. arjuna* revealed the presence of as proteins, carbohydrates, phenols, tannins, flavonoids, saponins, glycosides, steroids, terpenoids and alkaloids (Shreya *et al*., 2013) (and also calcium, Aluminium, Magnesium, silica, zinc and copper (Dwivedi, 2007; Khan *et al.,* 2013). While that of *S. robusta* has revealed a low concentration of proteins in its plant extracts, (Murthy *et al.,* 2013). These studies reveals that phytochemical charaters of the respective trees has strong impact on the insect growth and development. Raily ecorace is reared on sal (*Shorea robusta*) tree which possesses higher foliar crude fibre content (Sinha and Jolly, 1971) as compared to arjun and asan. With combination of crude fibre, sericin along with mineral calcium oxalate and natural colouring matter tannin make the cocoon shells very tough. Since more of filament length is a function of heavier silk shells, that's why cocoons of higher shell weight will possess higher filament length & filament weight (Chattopadhyay and Khan, 2018). Also because of toughness of shells there were frequent breakages during reeling observed in case of wild Raily cocoons which resulted in deterioration of some cocoon & reeling parameters namely NBFL, reelability (%), raw silk recovery (%) and waste (%) (Khan *et al.,* 2019).

Sl. No.	Cocoon weight (g)		Shell weight (g)		Filament Length (M)		Filament Weight (g)		N.B.F.L (m)		Denier		Waste Weight (g)	
	Cultivated Raily Cocoon	Wild Raily Cocoon	Cultiv-ated Raily Cocoon	Wild Raily Cocoon	Cultiv-ated Raily	Wild Raily	Cultiva-ted Raily	Wild Raily	Cultiva-ted Raily	Wild Raily	Cultiva-ted Raily	Wild Raily	Cultiva-ted Raily	Wild Raily
1	6.25	4.86	1.14	3.28	556.88	1372.50	0.61	1.50	79.55	152.50	9.80	9.84	0.25	0.35
2	8.33	3.68	1.43	1.82	601.88	1215.00	0.53	1.76	150.47	75.94	7.94	13.00	0.42	0.61
3	5.79	13.76	0.69	2.73	877.50	1181.25	0.85	1.26	292.50	42.19	8.68	9.63	0.18	1.13
4	6.55	9.94	1.25	1.70	770.63	1327.50	0.63	2.01	192.66	147.50	7.31	13.60	0.21	0.81
5	6.60	6.33	1.34	1.71	376.88	900.00	0.39	1.02	47.11	56.25	9.39	10.16	0.45	0.44
6	5.46	8.88	1.04	2.04	742.50	1513.13	0.57	1.82	247.50	89.01	6.93	10.81	0.39	0.58
7	5.30	3.97	0.76	2.20	652.50	1395.00	0.72	1.94	163.13	99.64	9.88	12.50	0.28	0.36
8	4.86	3.96	0.66	2.28	765.00	1665.00	0.68	2.03	255.00	277.50	7.96	10.97	0.21	0.86
9	7.55	14.23	1.06	2.79	382.50	1265.63	0.50	1.42	63.75	70.31	11.74	10.10	0.27	0.84
10	6.51	13.17	0.99	1.61	585.00	1350.00	0.51	1.51	83.57	337.50	7.86	10.07	0.46	0.52
Mean	6.32	8.28	1.04	2.22	631.13	1318.50	0.60	1.63	157.52	134.83	8.75	11.07	0.31	0.65
SD	1.05	4.30	0.27	0.56	165.29	204.20	0.13	0.34	87.98	98.67	1.46	1.44	0.11	0.25
C.V. (%)	16.61	51.93	25.83	25.19	26.19	15.49	21.39	20.83	55.85	73.18	16.68	12.99	34.10	38.94
t-Value	**2.39**		**6.02**		**8.27**		**8.98**		**2.34**		**3.57**		**3.88**	
				**		**		**		*				*

Conclusion

The wild raily cocoons showed higher cocoon and reeling characters such as average cocoon weight, average shell weight, average filament length, average filament weight, as compared to the cultivated raily cocoons. The major reasons for superiority of wild raily race over cultivated raily was higher level of adaptability to the wild ecosystem, lesser human handling and host preference. So rearing of raily eco-race with human interventions, it cannot exhibit all biometrical characters effectively, as the genes were affected by the environmental variations. Though some characters such as NBFL, reelability (%), raw silk recovery (%) and waste (%) are better in cultivated raily in comparison of wild raily because of toughness of shells and frequent breakages in reeling. Hence, we can conclude that, the raily eco-race performs well under wilder ecosystem than cultivated controlled conditions.

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