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A COMPARATIVE PERFORMANCE OF TASAR SILKWORM (*ANTHERAEA MYLITTA* D.) DABA ECORACE AND BDR-10- AN ONLY AUTHORIZED RACE

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ABSTRACT

In India about 44 eco-races of Tasar exist and distributed over different tasar producing states. Among all the eco-races, Daba is the most commercially exploited in tropical tasar states. Daba is the most amenable eco-race largely cultivated in tropical India. The Daba races are bivoltine and trivoltine in nature. A new bivoltine strain of DABA silkworms, known as BDR-10, has been created through recurrent selection breeding of yellow larvae at the Basic Seed Multiplication and Training Center, Boirdadar, Chhattisgarh. BDR-10 is currently being promoted and adopted in various Tasar silk-producing regions. The silkworms of the BDR10 race are yellow in color, which serves as a reflective mechanism to lower their body temperature and help them to survive in extremely hot climates. The two primary Tasar silkworm ecoraces of interest in this study are the "Daba Ecorace" and the "BDR-10 Authorized Race." Different ecoraces exhibit variations in multiple biological traits, such as fecundity, larval weight, and key commercial attributes like cocoon weight and shell weight. Preliminary investigations reveal notable variations in cocoon weight, not only among different ecoraces but also within a single ecorace. This comparative analysis aims to provide valuable insights into the performance of these two Tasar silkworm ecoraces. By assessing key parameters such as silk quality, cocoon yield, growth rates, and disease resistance, this study seeks to shed light on the strengths and weaknesses of each ecorace. Additionally, it aims to identify any specific factors that may influence their performance, such as regional variations, environmental factors, or breeding practices.

Keywords: Tasar, Eco-race, Daba, BDR-10, Rearing.

Introduction

Among the diverse range of silk-producing insects, the Tasar silkworm (*Antheraea mylitta* D.) stands out as a valuable contributor to the sericulture sector. Known for its exquisite golden silk, Tasar silkworms have been cultivated for generations, supporting livelihoods and preserving traditional silk-weaving practices in India and several other countries.

Tasar silk is highly regarded for its lustrous texture and natural appeal. The unique characteristics of Tasar silk have positioned it as a prized commodity both in domestic and international markets. This economic importance has driven continuous research and development efforts to enhance the productivity and quality of Tasar silk.

The Tropical Tasar is produced in Jharkhand, Chhattisgarh, Madhya Pradesh, Orissa and Bihar and to a small extent in Maharashtra, West Bengal, Andhra Pradesh, Telangana and Uttar Pradesh. In India about 44 ecoraces of Tasar exist and distributed over different Tasar producing states. Among all the ecoraces, Daba is the most commercially exploited in tropical Tasar states (Singh and Srivastava, 1997 *and* Srivastava *et al., 2002*). Daba is the most amenable eco-race largely cultivated in tropical India. The Daba races are bivoltine and trivoltine in nature.

The highest number of ecoraces is found in Jharkhand, closely followed by Chhattisgarh. Additionally, Odisha is home to six recognized ecoraces. India has about 44 ecoraces of *A. mylitta* (Suryanarayan and Srivastava*, 2005)* out of which only a few are commercially exploited in Odisha. Different ecoraces exhibit variations in multiple biological traits, such as fecundity, larval weight, and key commercial attributes like cocoon weight and shell weight. Preliminary investigations reveal notable variations in cocoon weight, not only among different ecoraces but also within a single ecorace.

A new bivoltine strain of DABA silkworms, known as BDR-10, has been created through recurrent selection breeding of yellow larvae at the Basic Seed Multiplication and Training Center, Boirdadar, Chhattisgarh. BDR-10 is currently being promoted and adopted in various Tasar silk-producing regions. The silkworms of the BDR10 race are yellow in color, which serves as a reflective mechanism to lower their body temperature and help them to survive in extremely hot climates. It is less susceptible to pebrine and virosis than Daba eco-races (Chandrasekhar *et al.* 2018*).*

One of the key factors contributing to the success of Tasar silk production is the choice of silkworm races or ecoraces. Silkworm ecoraces are distinct populations adapted to specific geographical regions and environmental conditions, exhibiting varying characteristics in terms of silk quality, yield, and resistance to diseases. These ecoraces are crucial in determining the overall performance and success of Tasar silk production.

The two primary Tasar silkworm ecoraces of interest in this study are the "Daba Ecorace" and the "BDR-10 Authorized Race." Both of these ecoraces have their unique attributes and have been widely cultivated in different regions of India. Understanding their comparative performance is vital for the silk industry's sustainable growth, as it can inform decisions regarding race selection, breeding programs, and resource allocation.

This comparative analysis aims to provide valuable insights into the performance of these two Tasar silkworm ecoraces. By assessing key parameters such as silk quality, cocoon yield, growth rates, and disease resistance, this study seeks to shed light on the strengths and weaknesses of each ecorace. Additionally, it aims to identify any specific factors that may influence their performance, such as regional variations, environmental factors, or breeding practices.

Material and Methods

This presents a detailed account of the materials, methodologies, and procedures employed during the study

Location

This study was conducted at Basic Seed Multiplication & Training Centre, Basic Tasar Silkworm Seed Organization (BTSSO), Central Silk Board, Ministry of Textiles, Govt. of India, Sundargarh, Odisha (22.12° N, 84.03° E, above mean sea level 243m).

DFL Collection

Freshly laid eggs were collected from healthy adult Daba Ecorace and BDR-10 Tasar silk moths. During the month of June and July a total of 25 DFLs each of Daba Bivoltine (DBV) and Daba Trivoltine TV (DTV) and BDR-10 were collected from BSMTC, Sundargarh, Odisha.

Incubation

Eggs/DFLs were carefully incubated under controlled temperature (25-28°C) and humidity conditions (80-85%) until hatching.

Selection of rearing field, rearing and maintenance

Tasar silkworm rearing field selected for the study was cleaned by removing all the weeds and well maintained before taking up the silkworm rearing. Disinfection was done by lime and bleaching powder (9:1) in the rearing site by removing all weeds and shrubs in a radius of 2ft around each plant. Rearing was conducted at elevated places of Arjun (*Terminalia arjuna*) as well as *Terminalia tomentosa* plantation with quality leaves. The Newly hatched larvae were brushed on host plants *Terminalia arjuna* and *Terminalia tomentosa* and reared under chawki nylon net until the third instar. Larvae were transferred from one plant to other as and when the leaves got exhausted and fed fresh host plant leaves and monitored throughout the all-larval stages carefully. The silkworms selected were examined based on their uniformity in age, weight, disease incidence, larval duration and cocoon yield etc.

Parameters assessed

Larval parameters & Growth Rates:

Larval growth rates, instar wise larval length, weight and including larval duration were monitored and recorded.

Cocoon yield

The number and weight of cocoons produced by each eco-race were recorded. Cocoon yield data were recorded for each eco-race separately.

Diseases

Susceptibility to common silkworm diseases, such as virus, pebrine and bacteria, was assessed.

Cocoon parameters

The Daba Bivoltine (DBV), Daba Trivoltine (DTV) and BDR-10 cocoons were brought to lab and a visual inspection was made. Various morphometric parameters *viz.,* length, breadth and weight were recorded. The length was measured using measuring scale, breadth using vernier calliper and weight by electronic weighing balance. And also, the peduncle was cut off from the cocoons and the length of peduncle was also recorded. The cocoon shell weight of all three races was weighed and recorded separately.

Data Collection

Data on the parameters mentioned above were collected meticulously using appropriate instruments and methodologies.

Ethical Considerations

All experiments involving silkworms were conducted in accordance with ethical guidelines and regulations.

Results and Discussion

The results and discussion of the study are presented in this chapter under different subheadings as follows.

Tasar Silkworm Larval parameters

Assessment of Larval parameters

The data on larval parameters *viz.,* length, weight, colour, size, shape, larval duration, larval life span and larval mortality was recorded by the selection of larvae at the beginning of each instar. 20 no. healthy worms were selected randomly from the rearing lot of Daba BV, Daba TV and BDR-10 Tasar Silkworm, *Antheraea mylitta* D. eco-races rearing on *Terminalia arjuna* and *Terminalia tomentosa* plantation of Sarsara, Sundargarh District, Odisha, India.

These parameters are taken just after hatching for the first instar and just before moulting for second instar and daily for fourth and fifth instar. Larval weights were measured in an electronic balance of Citizen. The weights were measured for first instar to fifth instar, the length of the larvae were measured in cm by using a graph paper. The larval lifespan was also recorded. The larval mortality was calculated by counting the number of worms lost due to various reasons during each instar. The colour and shape of the cocoons whether they were yellow, gray or white or the oval / elliptical shape also recorded.

Among three eco-races instar wise average larval length (cm) was found to be highest in DBV silkworm larvae (1.53±0.27) followed by BDR-10 silkworm larvae (1.49±0.32) and DTV (1.41±0.27) whereas the larval length was found to be highest in DBV followed by BDR-10 and DTV Silkworms till fourth Instar. However, in fifth instar average larval length was found to be highest in BDR-10 (10.60±0.49) followed by DBV (10.40±0.49) and DTV (9.94±0.36 respectively (Table 1).

Among three eco-races instar wise average larval weight (g) was found to be highest in DBV silkworm larvae (1.10±0.48) followed by BDR-10 silkworm larvae (1.07±0.47) and DTV (0.25±0.06) whereas the larval length was found to be highest in BDR-10 followed by DBV- and DTV Silkworms till fourth Instar. However, average larval weight was found to be highest in DBV (40.60±0.05) followed by BDR-10 (40.50±1.63) and DTV (32.20±4.69) respectively (Table 1) (Plate 1A & 1B).

Table 1: Length and Weight of Daba BV, Daba TV and BDR-10 Tasar Silkworm Eco-races

Instar	Larval length (in cm) (Mean± SEm)			Larval weight (g) (Mean±SEm)		
	Daba BV	**Daba TV**	**BDR-10**	**Daba BV**	**Daba TV**	**BDR-10**
I instar	1.53±0.27	1.41±0.27	1.49±0.32	1.10±0.48	0.25±0.06	1.07±0.47
II instar	2.81±0.51	2.06±0.23	2.76±0.52	2.49±0.47	2.28±0.32	2.54±0.46
III instar	5.35±0.20	5.16±0.50	5.25±0.163	4.5±0.50	3.64±0.37	4.9±0.943
IV instar	8.65±0.63	7.84±0.33	8.62±0.49	25.30±1.62	19.75±2.11	25.30±1.21
V instar	10.40±0.49	9.94±0.36	10.60±0.49	40.60±0.05	32.20±4.69	40.50±1.63

Plate 1A: BDR-10 Tasar Silkworm Larva

Plate 1B: Daba BV Tasar Silkworm Larva

Rearing performance of Daba BV, Daba TV and BDR-10 Tasar Silkworm Eco-races

A total of 25 DFLs of each ecorace was brushed to assess the rearing performance of ecoraces. Among three eco-races the highest hatching of 90 % was recorded in BDR-10 ecorace followed by Daba BV (88 %) and Daba TV (83 %) and a total of 5625 worms were hatched in case of BDR-10 followed by DBV &DTV. Whereas, the highest larval duration of 39 days was found in Daba BV followed by BDR-10 (34 Days) and Daba TV (32 Days). However, highest cocoon yield of 52 No. per DFL was recorded in BDR-10 followed by Daba BV (47 No. per DFL) and Daba TV (38 No. per DFL) (Table 2). Also, the diseases *viz.,* virosis, Pebrine and mixed infections were observed during the rearing period. However, the virosis was more prevalent during the rearing (Plate 2). Barsagade *et al*., (2012) reported that The Daba and Sukinda eco-races of *A. mylitta* silk-producing worms in vidarbha are experiencing higher larval mortality due to environmental factors and diseases compared to the Bhandara eco-race. The vidarbha forest has suffered from significant loss of plant species due to deforestation, and the uncontrolled gathering of wild *A. mylitta* silk cocoons is putting this particular eco-race at risk of disappearing. To utilize this eco-race, for commercial purpose, it is necessary to save it from extinction and multiply its population under semi domesticated conditions.

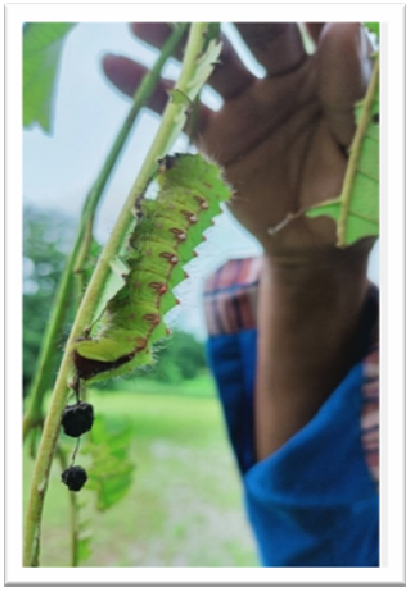

Plate 2: Tasar Silkworm Larvae infected with Diseases (Bacterial, viral & mixed)

Table 2: Rearing performance of Daba BV, Daba TV and BDR-10 Tasar Silkworm Eco-races

Eco-race	No. of DFLs brushed/ reared	Hatching %	No. of Worms Brushed Or hatched	Larval Duration (Days)	Cocoon yield
Daba BV	25	88	5500	39	47
Daba TV	25	83	5188	32	38
BDR-10	25	90	5625	34	52

Assessment of cocoon parameters of Daba BV, Daba TV and BDR-10 Tasar Silkworm Eco-races

Among three eco-races length of cocoons with peduncle was found to be highest in BDR-10 female cocoons (9.32±0.855) followed by DBV (8.66±0.359) and DTV (8.36±0.727) where cocoon length without peduncle was found to be highest in DBV (5.46±0.148) followed by BDR-10. However, peduncle length was found to be highest in BDR-10 (4.46±1.173) followed by DTV (4.02±0.827) respectively. In case of male cocoons, the length of cocoons with peduncle was found to be highest in BDR-10 (8.38±1.273) followed by DBV (8.22±1.142) and DTV (8.2±0.963). Whereas, the length of the cocoon without peduncle was found to be highest in DBV (4.5±0.322) followed by BDR-10 and DTV. However, peduncle length was highest in BDR-10 (4.12±1.00) followed by DBV and DTV (Fig. 1.).

The present study revealed that the length of female cocoons was found to be highest compared to the male cocoons in all the three eco-races**.** Chandrasekhar *et al*., (2019) reported the multi-location trials of BDR-10 conducted in India indicated the average larval weights as well as cocoon yield were negatively correlated with the altitude (AMSL). Besides, analysis of larval performance in terms of hatching percentage, larval period and weight of matured larva of BDR-10 were better than the Daba BV. Chandrashekhar *et al*.,(2020) suggested that the BDR-10 was moderately resistance to viral infection and the overall mortality of silkworm larvae due to different diseases was significantly less when compared to DBV. Sreenivas and Shamitha (2017) reported that during ex-situ rearing of Tasar silkworm, (Sukinda ecorace), though larval life period was increased and larval weight and cocoon parameters like cocoon weight, and shell width were observed lesser than the worms grown under natural habitats. The low cocoon yield of 48 for the 200 worms hatched (i.e., 24%), also suggests poor adaptability in ex-situ conditions. Significant difference in cocoon characteristics was observed for the Tasar Silkworms reared on different food plant species. The author suggested about the low cocoon yield due to poor adaptability in ex-situ conditions. Kamaraj *et al*., (2017) reported that the Chawki rearing of Tasar silkworms proved to be more beneficial as compared to the direct brushing method. In terms of faster development of silkworms, lower mortality rate of silkworms, and improved silkworms' weight and cocoon characteristics such as cocoon weight, shell weight, and shell ratio. Overcrowding of tropical Tasar silkworm in the host plant during spinning stage declines the cocoon weight and shell weight; this also results in occurrence of double cocoons.

The cocoon breadth/width was found to be highest in BDR-10 female cocoons (3.40 ±0.27) followed by DBV (3.30 ±0.10) and DTV (2.80±0.17) female cocoons. Whereas in male cocoons the highest breadth in BDR-10 cocoons (2.86 ±0.103) followed by DBV (2.79 ±0.056) and DTV (2.39 ±0.056) (Table).A comparison was made between male and female cocoons where female cocoons of all three races DBV, DTV and BDR-10 were found to have the highest breadth (Fig. 1). Shivkumar & Shamita (2013) reported that parameters (cocoon weight, shell weight, length of the shell, shell thickness, peduncle thickness, peduncle length & weight, denier and shell ratio cocoon weight, shell weight, length of the shell, shell thickness, peduncle thickness, peduncle length & weight, denier and shell ratio) of outdoor reared tropical Tasar cocoons are distinctly superior than indoor reared cocoons except reelability and ERR (by weight) which were observed significantly higher in indoor reared cocoons

The cocoon weight was found to be highest in BDR-10 female cocoons (12.00±1.55), followed by DBV (10.89±0.703) and DTV (8.59±0.546). Whereas, in male cocoons the highest weight was noticed in BDR-10 (8.22±0.333), followed by DBV (8.1±0.486) and DTV (7.79± 0.656) (Fig.2).

Among all the three races DBV, DTV and BDR-10 female cocoons weighed more compared to male cocoons. In case of female cocoons, among three eco-races, the highest shell weight was observed in BDR-10 (2.21±0.275), followed by DBV (1.72±0.267) and DTV (1.24± 0.087). Whereas in male cocoons same pattern was observed (Fig. 2).

A comparison was made between male and female cocoons where female cocoons of all three eco-races contained highest shell weight. Peduncle weight was found to highest in BDR-10 female cocoons (0.23± 0.028), followed by DTV (0.2±0.054) and DBV (0.15±0.046).Whereas in male cocoons highest peduncle weight was found in DTV (0.23±0.184), followed by BDR-10 (0.16±0.059) and DBV (0.11± 0.008) (Fig. 2). Yellow and Almond hybrid combinations was found superior in shell weight. Diallel analysis with four mutant lines of Daba were carried out by Jolly et al. (1969) based on larval body color of Green, Yellow, Blue and Almond. Yellow and Almond hybrid combinations was found superior in shell weight. Renuka and Shamitha (2015) focused on studying the ecological aspects and post-cocoon characteristics of ecoraces selected from different regions of the country to explore genetic diversity. They found that the extensive biological diversity of *A. mylitta* is primarily a result of its wide distribution, climatic conditions, and the variety of food plants available. These factors have contributed to differences in the behavior, physiology, and commercial characteristics of the silkworms.

In the present study it was found that female Tasar silkworm pupae were bigger than the male silkworm pupae in all three races i.e, Daba Bivoltine (DBV), Daba Trivoltine (DTV) and BDR-10 cocoons. The weight of female pupa was found to be highest in BDR-10 (10.89±1.98), followed by DBV (8.81±0.26) and DTV (7.43±0.83). Whereas, in male pupa highest weight was found in DTV (6.69±0.63), followed by BDR-10 (6.67±1.20) and DBV (5.71±0.25). Aratibala Sahu *et al.*, (2022) reported that wide range of variation was observed in both male and female cocoon quantitative traits for all the places for Modal. The best option is to conserve the ecorace in its natural habitat is to save the population and for its sustainable utilization, conservation works are undertaken every year where wild cocoons are collected, eggs are produced and subsequently released on Sal trees in forest for natural proliferation. Sinha and Prasad (2011) reported that there is a tremendous phenotypic as well as genetic variability among the ecoraces of tropical Tasar silkworm *A. mylitta* D. On the study of biochemical parameter of A. mylitta indicates that the ecoraces Raily and Daba differ from each other. The ecoraces Bhandara, Sarihan and Andhra local differ from Daba in biochemical constituent. This comprises the extent and degree of natural variation in tropical Tasar silkworm *A. mylitta* D. Chandrasekhar *et al.*,(2021) reported that the cocoon yield and other commercial characters in the BDR-10 have highly convincing compared to DBV in the areas. The performance of BDR-10 was quite promising in the states like Jharkhand, Odisha and West Bengal. Considering the importance of BDR10 over the DABA eco-race in terms of economic characters like higher cocoon yield, disease resistance and acceptance of the rearers in the states like Odisha, Jharkhand and Chhattisgarh. Therefore, it is the need of the hour to further intensify and popularize the BDR-10 among the stockholders in all the states to improve the cocoon productivity.

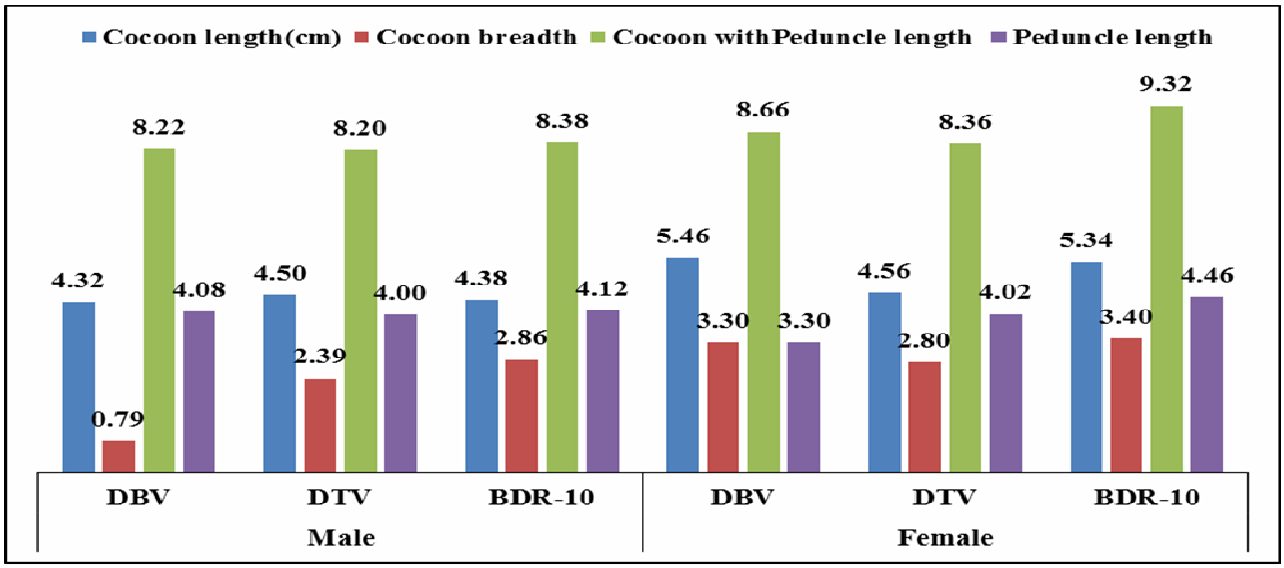

Fig. 1 : Comparison between male & female cocoon parameters (Length & Breadth in cm) of Daba BV, Daba TV and BDR-10 Tasar Silkworm Eco-races

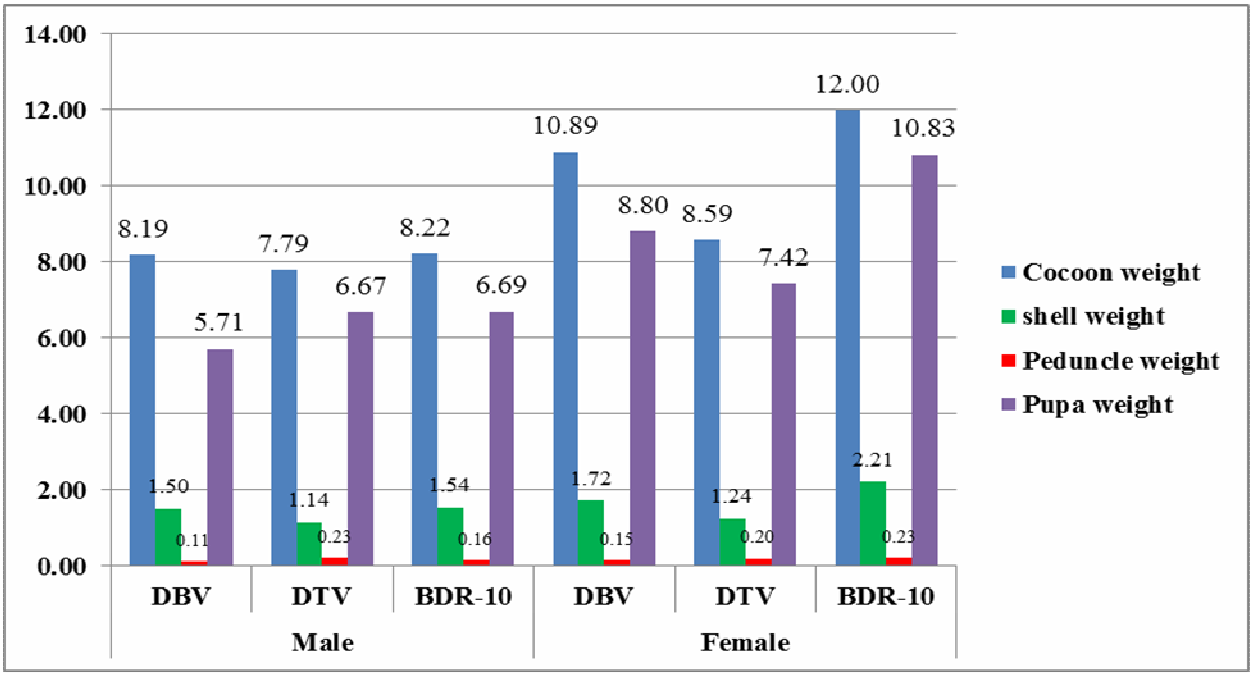

Fig. 2 : Comparison between male & female cocoon weight, shell weight and pupal weight (in grams) of Daba BV, Daba TV and BDR-10 Tasar Silkworm Eco-races

Conclusion

One of the key factors contributing to the success of Tasar silk production is the choice of silkworm races or ecoraces. Silkworm ecoraces are distinct populations adapted to specific geographical regions and environmental conditions, exhibiting varying characteristics in terms of silk quality, yield, and resistance to diseases. These ecoraces are crucial in determining the overall performance and success of Tasar silk production. The two primary Tasar silkworm ecoraces of interest in this study are the "Daba Ecorace" and the "BDR-10 Authorized Race." Both of these ecoraces have their unique attributes and have been widely cultivated in different regions of India. Understanding their comparative performance is vital for the silk industry's sustainable growth, as it can inform decisions regarding race selection, breeding programs, and resource allocation. Different ecoraces exhibit variations in multiple biological traits, such as fecundity, larval weight, and key commercial attributes like cocoon weight and shell weight. Preliminary investigations reveal notable variations in cocoon weight, not only among different ecoraces but also within a single ecorace. The Daba Ecorace, known for its resilient nature and adaptability to various ecological conditions, has been a favored choice for Tasar silk production in certain regions. It has demonstrated commendable performance in terms of silk yield, cocoon quality, and disease resistance, making it a valuable asset for sericulturists. The silkworms of the BDR10 race are yellow in color, which serves as a reflective mechanism to lower their body temperature and help them to survive in extremely hot climates. By shedding light on the strengths and weaknesses of these two Tasar silkworm races, this study intends to contribute to the advancement of sericulture practices, the improvement of silk quality, and the enhancement of livelihoods for those engaged in the Tasar silk industry. Additionally, it is hoped that the findings of this research will promote the conservation of Tasar silkworm genetic resources and contribute to the overall development of the sericulture sector

Ultimately, the findings of this study will contribute to the knowledge base of Tasar silk production, enabling silk farmers, researchers, and policymakers to make informed decisions about race selection and breeding strategies. Moreover, it will help ensure the sustainability and prosperity of the Tasar silk industry, benefiting not only the economy but also the livelihoods of countless individuals involved in sericulture.

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