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Performance of BDR-10: A newly authorized race of *Antheraea mylitta* D. in different agro climatic zones in India

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Abstract

Tasar sericulture is dominated by the DABA eco-race as a commercial crop and to some extent wild ecoraces such as Sukinda, Sarihan, Laria, Modal, Simlipal, Raily, Bhandara, and Andhra local. Majority of these ecoraces are of green larval type, as a cryptic association with the ecological niche. Recently, a new bivoltine race of DABA called BDR-10 has been developed through recurrent selection of yellow larvae at Basic Seed Multiplication and Training Center, Boirdadar, Chhattisgarh and is presently under popularization at different tasar producing state. Multi-location trials conducted at different parts of India indicated that the average larval weight as well as cocoon yield was negatively correlated with altitude (Above Mean Sea Level-AMSL). The average cocoon yield per dfl was 61.10 ± 37.10 (Mean \pm SD) and highest cocoon yield was recorded at CTSSS, Kargi Kota, Deoghar, Dudhi, Madhupur, Pali and Bhagalpur. The cocoon, pupal and shell weight ranged from 14.00 g to 9.59 g, 9.60 g to 12.28 g and 1.95 g to 1.50 g, respectively. Correlation analysis also revealed that cocoon weight, pupal weight, shell weight and S.R.% were negatively influenced by the AMSL. But, positive correlation was recorded between cocoon & pupal weight, cocoon & shell weight and pupal & shell weight.

Keywords: BDR-10, Ecoraces, Bivoltine, AMSL, Boirdadar, Multiplication trial

Introduction

The tropical tasar, *Antheraea mylitta* D. (Lepidoptera: Saturniidae) is a wild silk moth endemic to India. The habitat, climate and geographical differences have led to the divergence of *A. mylitta* to eco-races as a parapatric population and nearly 44 eco-races have been reported in *A. mylitta* (Endler, 1977; Sinha and Srivastava, 1997) [2, 8]. Among the eco-races, Daba (Singhbhum) bi-voltine (BV) and tri-voltine are only semi-domesticated and are used for commercial rearing throughout India. Similarly, sukinda (Sundhargarh) is also a semi domesticated eco-race, but its utility is less popular in India due to their performance restricted to specific area. The eco-races like Sarihan (Santhal Pargana), Laria (Peterbar & Hazaribagh), Modal (Keonjhar), Simlipal (Simlipal), Raily (Bastar), Bhandara (Bhandara) and Andhra local (Adilabad & Karimnagar) are also economically important wild eco-races of *A. mylitta*. The tasar cocoons of wild eco-races are been harvested by the tribal people as non-timber forest produce of plant origin and marketed in the local markets. The major host plants being used for rearing of silkworm are *Terminalia tomentosa* (Roxb. (ex DC) Wight. & Arn.), *T. arjuna* (Roxb. (ex DC) Wight. & Arn.) and *Shorea robusta* Gaertn f. About, 3 lakh tribal families in different states mainly in Jharkhand, Orissa, Chhattisgarh, Madhya Pradesh, Andhra Pradesh, Telangana, West Bengal, Maharashtra and Bihar are involved in tasar culture. It has high potential for rural employment and remunerative income to the farmers.

The DABA race has been used for rearing in a semi-domesticated way since several years. But, recently a new race *i.e.* BDR-10 has been developed through recurrent selection of DABA bivoltine population at Basic Seed Multiplication and Training Center, Boirdadar (Alok Sahay, 2018). The BDR-10 larvae is yellow in color and it has 21% more productivity than the traditional Daba breed in selected conventional areas. Farmers can get up to an average of 52 kg cocoons per 100 disease free layings (dfls) (Press Information Bureau (MoT-GOI), 2018). The larval color polymorphism, polyphagy and voltinism are specific features of *A. mylitta*. Among the four prominent color in larvae of *A. mylitta* (Green, Blue, Yellow and Almond), green is wild and blue, yellow and almond are mutants (Sinha and Prasad, 2011) [9]. DABA bi-voltine and tri-voltine with green type of larvae and gray cocoons are popular in India. The occurrence of color polymorphism in nature have been explained in various studies on different insects like Nymphalidae, Noctuidae, Papilionoidea, Lycaenidae, Pieridae, Psychidae, Pieridae *etc.* (Ford, 1965; Lopes-Da-Silva M and Casagrande MM, 2003; Yamasaki *et al.*, 2009) [12, 11, 10]. But, in *A. mylitta*, larval coloration may serve as camouflage

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in avoiding predation by visual hunters. Since BDR-10 race has the characteristic of 215-230 eggs/female fecundity, grey-cocoon color, 10.5-15.0 g cocoon weight, 1.5-1.9 g cocoon shell weight, 900-1100 m filament length, 9-10 denier, 50-60% reelability and 60-65% silk recovery (CRT&TI, 2016). For effective multiplication and popularization, multilocation trial has been conducted prior to introduction to new areas. The present study was intended to assess the performance of BDR-10 at different agro-climatic zones in India under replenishment programme of Basic Tasar Silkworm Seed Organization (BTSSO).

Materials and Methods

The study was conducted at CTSSS, Kota, (22°4'43.1112" N, 82°9'8.3808" E 264 AMSL), Pali (22.3753° N, 82.3262° E 331 m AMSL), Bastar (19.1071° N, 81.9535° E 564 m AMSL), Kathikund (24.3613° N, 87.4195° E 146 m AMSL), Deoghar (24.4763° N, 86.6913° E 248 m AMSL), Madhupur (24.2654° N, 86.6480° E 228 m AMSL), Dudhi (24.2154° N, 83.2386° E 249 m AMSL), Bhagalpur (25.3478° N, 86.9824° E 52 m AMSL), Baripada (21.9322° N, 86.7517° E 52 m AMSL), RC Varam (17.4367° N, 81.7760° E 183 m AMSL), Narsapur (17.7394° N, 78.2846° E 560 m AMSL) and Balaghat (21.8603° N, 80.3659° E 315 m AMSL). A total of 8950 dfls (disease free layings) were supplied from BTSSO-Central Tasar Silkworm Seed Station, Kargi Kota to all the selected units. Nearly 1000 dfls for each unit except Deoghar (550 dfls), Madhupur (500 dfls), RC Varam (400 dfls) and Balaghat (500 dfls) were supplied for rearing. The nucleus dfls with biological fecundity of 253.33±21.53 (Mean±SD) and hatching percentage of 82% to 91% were supplied. The dfls were prepared as per the BTSSO standard norms with zero percent pebrine infestation. DFLs were washed with 5% Depuratex, dried for surface moisture and packed with muslin cloth labelled with red color code, having the information like date of coupling, date of hatching, number of dfls and name

of unit *etc.*

The units conducted the rearing as per the package of practices (Alok Sahay *et al.*, 2018) and finally the cocoons harvested were preserved in their respective units for further maintenance, multiplication and popularization in their location. The information like weight of mature larva, duration from hatching to spinning, total duration from hatching to cocoon harvesting, Yield per DFL, Good cocoons, flimsy cocoon, cocoon weight, pupal weight and shell weight. Finally, Shell ratio (SR%) was recorded [(shell weight/cocoon weight)*100].

Results and Discussion

Total larval duration from hatching to spinning was 45.33±1.37 and up to harvesting was 53.50±1.04 (Mean±SD). The larval duration in all most all the places was similar to CTSSS, Kota. The average weight of mature larvae (5th instar) was 40.17±3.74. But, larval weight varied across the locations and maximum was recorded in Dudhi (48 g), Deoghar (44 g), Bhagalpur (43.80 g) and Madhupur (42 g) and lowest was recorded in Narsapur (35 g), Pali (36 g), Bastar (36 g) and Balaghat (36.80 g). At CTSSS Kota, the average larval weight (g) was 39.55±4.34. The correlation studies indicated that the average larval weight ($R^2 = -0.558$) as well as cocoon yield ($R^2 = -0.454$) was negatively associated with the Above Mean Sea Level (AMSL), in which rearing was conducted at different places in India.

The overall average cocoon yield per dfl was 61.10±37.10. Out of total cocoons, nearly 90.11% and 9.89% of cocoons were good and flimsy, respectively. Highest cocoon yield of more than 75 cocoons per dfl was recorded at CTSSS, Kota, Deoghar, Dudhi, Madhupur, Pali and Bhagalpur. Units like Baripada, in Balaghat also obtained more than 60 cocoons per dfl. The cocoon yield per dfls was not up to the standard norms in the units like Kathikund, R.C. Varam, Narsapur, and Bastar (Fig. 1).

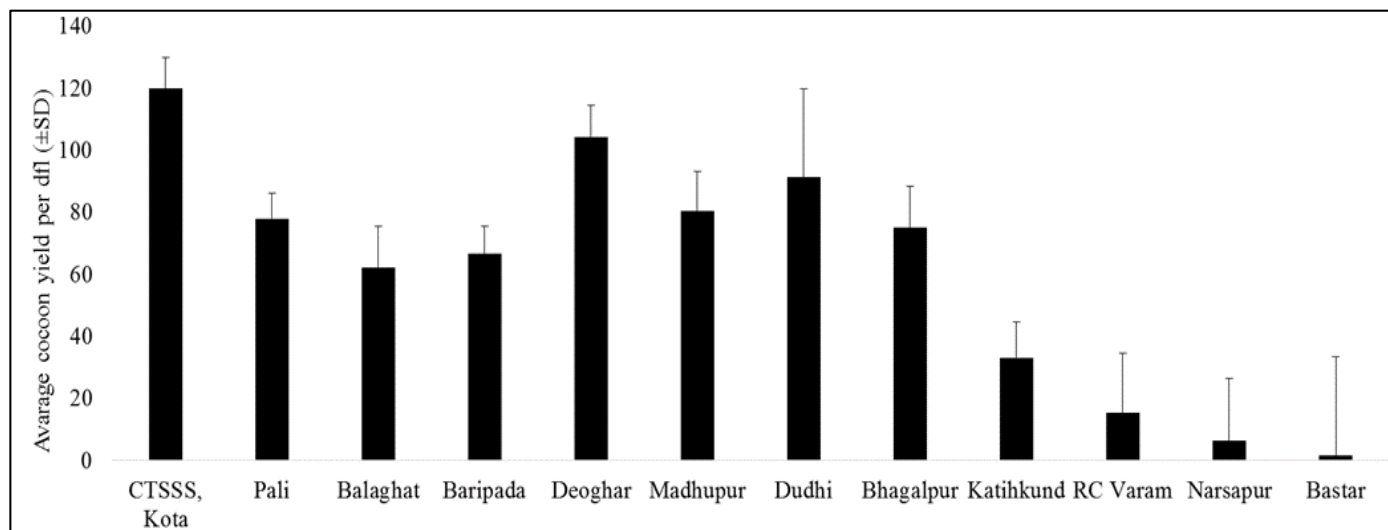


Fig 1: Performance of BDR-10 in terms of cocoon yield per dfl obtained at different locations across India

The cocoon, pupal and shell weight ranged from 14.00 g to 9.59 g, 9.60 g to 12.28 g and 1.95 g to 1.50 g, respectively. Strong correlation was recorded between cocoon weight and pupal weight ($R^2=0.9597$) and weak correlation between cocoon weight and shell weight ($R^2=0.728$) as well as pupal weight and shell weight ($R^2=0.571$). The highest SR (%) was recorded CTSSS, Kota (16.30), Pali, Deoghar, Kathikund Madhupur. Correlation analysis revealed that cocoon weight

($R^2=-0.234$), pupal weight ($R^2=-0.273$), shell weight ($R^2=-0.338$), and S.R.% ($R^2=-0.218$) were negatively influenced by the AMSL. But, positive correlation was recorded between cocoon weight and pupal weight ($R^2=0.959$), cocoon weight and shell weight ($R^2=0.728$) and pupal weight and shell weight ($R^2=0.571$). The S.R.% was positively linked with shell weight ($R^2=0.636$) and negatively linked with cocoon weight ($R^2=-0.06$) and pupal weight (0.0242).

Table 1: Performance of cocoon parameters and S.R.% of BDR-10 at different location in India

Unit	Cocoon Wt. (g)	Pupal Wt. (g)	Shell Wt. (g)	S.R. (%)
CTSSS, Kota	11.47	9.60	1.87	16.30
Pali	11.48	9.66	1.82	15.85
Kathikund	12.85	10.90	1.95	15.18
Deoghar	11.48	9.72	1.76	15.33
Madhupur	12.77	10.85	1.92	15.04
Dudhi	9.59	8.35	1.24	12.93
Bhagalpur	13.05	12.28	1.72	13.18
Baripada	12.75	10.95	1.80	14.12
RC Varam	10.40	8.90	1.50	14.42
Balaghat	14.00	12.18	1.82	13.00
Narsapur	11.50	9.90	1.60	13.91
Bastar	116.50	10.20	1.45	12.45

Existence of color morphs within an interbreeding population has a great impact on their fitness. Similarly, in the tasar



Fig 2: Different stage of BDR-10 larvae during rearing at Pendari campus, BTSSO, Bilaspur. A-Neonate larvae; B- third instar larvae and C- fifth instar larva

On an average fecundity of 253.33 ± 21.53 (Mean \pm SD) with an average hatching percentage of 84.42% was recorded in the BDR10 at CTSSS, Kota during nucleus crop grain age 2017-18. Gupta *et al.*, (2016) reported that the fecundity of BDR-10 and DABA BV ranged from 215-230 and 200 – 220, respectively. The stock maintained at CTSSS, Kota showed high vigor and fecundity to directional selection and multiplication of higher fecund individual. Cocoon weight ranged from 11.00 g to 16.37 g during second crop, respectively. But, cocoon weight as reported earlier ranged from 10.5 to 15.0 g in BDR-10 and 12.00 g – 15.00 g in DABA BV (Gupta *et al.*, 2016). Similarly, the average shell weight recorded at CTSSS, Kota was 1.87 g. Gupta *et al.*, (2016) reported the shell weight 1.5 g - 2.0 g in DABA BV and 1.5 g - 1.9 g in BDR-10. From the foregoing observations, it was revealed that the present stock of BDR-10 at CTSSS, Kota has more vigor with higher economical characters.

The rural as well as tribal community in the vicinity of forest in the central India practice tasar sericulture as cash crop. The youth migration and poverty upliftment mainly depends on profitability of crop. Use of high yielding breed, new technologies and improved package of practices are essential for improvement of profitability. The traditional practices have low impact on improving yield. The cocoon yield per dfl under replenishment programme of DABA BV during 2015-16 and 2016-17 at different agro-climatic zones was 57 and 47, respectively (BTSSO, 2016-17 & 2017-18). But, in the present study the average cocoon yield was 61.10, but the yield obtained was to an extent of 119.75 dfls at CTSSS, Kota. Multi-locational trials of newly developed Daba BV

silkworm it may also be due to avoiding vulnerability to predation. Among the different color type, the fittest one maintained at higher frequencies under natural conditions. But, their prevalence and perpetuation is still enigmatic as per ecological and evolutionary perspective. Phenotypic variation, with respect to color pattern inclined to have complex inheritance mechanisms with continuous or discrete variation in a random mating system (McKinnon and Pierotti, 2010) [13]. The BDR-10 has been developed through continuous selection of yellow color larvae for about 26 generations. The stability in the larval color has been achieved through directional selection. The existence of larval color morphs would be due to counter evolutionary process of herbivore as a cryptic coloration against various backgrounds (Schaefer and Rolshausen, 2005) [14]. This characteristic feature might be favorable for silkworm for tolerance to virus infection under rearing conditions during humid and sunny days.

race BDR-10 was conducted at RTRS Warangal; RECs Kapistha, Hatgamaria, Bangriposi, Kathghora and Nasik respectively. The data indicated that hatching percentage, larval period and weight of matured larva of BDR-10 were better than the ruling variety i.e., Daba BV. Average cocoon productivity of BDR-10 was 48.91/dfl against 43.43/dfl in Daba BV (Nagesh Prabhu, 2015) [5]. Hence, from the above discussion it can be inferred that BDR-10 perform better in Jharkhand, Bihar, Odisha, Chhattisgarh compared to Telangana, Andhra Pradesh and Madhya Pradesh.

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