

## Status and Potential of *Jata*, a New Race of Indian Tropical Tasar Silkworm (*Antheraea mylitta* Drury)

N.G. Ojha, R. Manohar Reddy, G. Hansda, M.K. Sinha,  
N. Suryanarayana and N.B. Vijaya Prakash

Central Tasar Research and Training Institute, Central Silk Board, Govt. of India,  
P.O. Piska Nagri, RANCHI-835 303, [Jharkhand], India

**Abstract:** The tropical tasar silkworm, *Antheraea mylitta* Drury is distributed all along central India (12-31°N latitude and 72-96°E longitude) and feeds primarily on *Shorea robusta* (Sal), *Terminalia arjuna* (Arjun), *Terminalia tomentosa* (Asan) besides a variety of secondary and tertiary food plants. Apart existing forty four ecoraces, a new wild-race *JATA* (univoltine) with superior cocoon traits, invent under *in-situ* habitat of Thakurmunda, Simlipal biosphere, India. The extensive collection of its nature grown cocoons has depleted the race population and the imperative need is to conserve *in-situ*, stabilize *ex-situ* to save this tasar race from extinction and also to exploit its optimal commercial potential. The systematic evaluation and *ex-situ* studies under Central Tasar Research and Training Institute, Ranchi, India indicates that the race attained bivoltine status with sustainable fecundity (209 eggs) and cocoon yield (55 nos), consistent moth emergence (72.6 %) and coupling (84.1 %). The wider phenotypic and cocoon commercial trait variability vividly substantiate that *Jata* is different from Modal, Sukinda and Daba and not an off-shoot of other ecoraces of the zone. The change of voltinism, acclimatization to *ex-situ* climate, amenability for commercial rearings and seed production with feasible cocoon yields of the race *JATA*, off its niche during successive generations indicate its status and potential over in-practice Daba and Sukinda ecoraces.

**Key words:** *Antheraea mylitta* Drury • Commercial potential • *In-situ* conservation • *Ex-situ* stabilization  
• *JATA* race

### INTRODUCTION

Tropical tasar silk is produced by a wild sericigenous insect, *Antheraea mylitta* Drury; (Lepidoptera: Saturniidae) commonly known as Indian tropical tasar silkworm. The 44 ecoraces of polyphagous insect feeds majorly on nature grown food plants available over Jharkhand, Orissa, Chhattisgarh, Bihar, Madhya Pradesh Andhra Pradesh, Uttar Pradesh, West Bengal and Maharashtra states [1-5]. The species of *A. mylitta* with wide distribution, encounter diverse biological niche and on adaptation forms in to ecoraces [6-13]. Most of the phenotypic variations are highly influenced by temperature, relative humidity and rainfall [14] and for potential phenotypic expression; the breed desires suitable genotype and environment interaction [15-17]. The conservation (*in-situ* and *ex-situ*) links genetic diversity to utilization, protecting diverse gene pool, habitat or ecosystem for human socio-economic

needs [18]. The ecorace conservation is must for utilizing their valuable genes in enhancing productivity [19] and to build variation in new population through hybridization [20]. Conservation of germplasm provides potential raw material of wide genetic variation and phenotypic expression due to inbreeding [21]. The genetics of tasar silkworm in particular are yet to study for racial characters and to select right material for breeding and commercial exploitation [22]. Little deviation in any character of race under different conditions from its mean value is said to be stabilized and superior cocoon characters of *Jata* race reveal its commercial value and need for conservation as a potential genetic resource [23, 24]. The increasing global demand for Vanya (wild) silks in general and tasar silk in particular, the abundance of naturally grown tasar food plants, limited option of amenable/ productive ecoraces for commercial rearings; demand exploration of potent wild tropical tasar silkworm races. It is therefore, the present analysis has been carried out to distinguish the

status and economic potential of 'Jata' from Modal, Sukinda and Daba ecoraces for simultaneous *ex-situ* conservation and commercial exploitation.

## MATERIALS AND METHODS

The nature grown cocoons of 'Jata' race collected prior to first grainage (during April month) from Thakurmunda, Kendujuani, Mohuldiha and Kuldiha Tasar Rearers Cooperative Society (TRCS) areas of Orissa, were preserved and assessed for phenotypic, volumetric and commercial traits at Central Tasar Research and Training Institute (CTR and TI), Ranchi, India. The cocoons compared with other two ecoraces of Orissa, i.e. Modal and Sukinda and also with most commercially exploited Daba ecorace of Jharkhand. For comparison study the naturally grown cocoons of Modal, Sukinda and Daba ecoraces were obtained from their respective ecozones. Grainage competence of Jata race was recorded following integrated package of seed cocoon preservation and seed production [25]. The produced disease free layings (Dfls/seed) of Jata race were reared in three (3) replications following randomized complete block design (RCBD) on raised plantation of *Terminalia tomentosa* (W and A) successively for four generations following integrated package of tasar silkworm rearing [26]. The climatic conditions of CTR and TI, Ranchi, India with of 22-30°C; 17-28°C of temperature and 50-70%; 60-80% of relative humidity during July/August and September/November months respectively are comparable with the conditions of 19-28°C; 17-26°C of temperature and 57-75%; 60-85% of relative humidity during July/August and September/November at Thakurmunda (*in-situ* area of Jata race), India. The performance of Jata race on silkworm rearing and grainage efficiencies along with cocoon phenotypic/commercial trait variations recorded for both rearing

seasons (seed crop = July/August and commercial crop = September/November) over four successive generations (two years) were analyzed.

## RESULTS

The origin and characteristics of Jata, Modal, Sukinda and Daba races (Table 1) indicate comprehensive differentiation among races and of Jata from others. Although, Modal and Sukinda ecoraces are from same Orissa state, the rearing or natural cocoon available areas/ altitudes are different as like their voltinism and food plants. The cocoon availability, adaptability levels, color variations and cocoon rate indicates the unique characteristics of different ecoraces. The Jata race is also found different from widely cultivated Daba ecorace in many parameters. The morphometric and commercial characters of ecoraces (Table 2) indicate supremacy of Jata race over semi domesticated / commercially applied ecoraces (Daba and Sukinda) in almost all the characters except for cocoon yield and filament denier. But, Jata race has shown lower performance over wild ecorace, Modal in characters except for cocoon yield, silk recovery and denier. The rearing and grainage performances of Jata under *ex-situ* conditions, (Table 3) showed consistency throughout silkworm rearings conducted over four successive generations. The average performance of Jata race under *ex-situ* conditions recorded negative in egg and cocoon characters while the cocoon yield was improved to 55 cocoons per dfl from 17 cocoons under *in-situ* condition. However, Jata race behaved as bivoltine in spite of its univoltinism under *in-situ* habitat. The Jata race has performed better than Sukinda ecorace in shell weight and silk ratio percentage, in addition to at par in cocoon yield per dfl. The Jata race recorded an average of 72.6% of moth emergence and 84.1% of moth coupling over four successive generations of two years time.

Table 1: Origin and characteristics of Jata, Modal, Sukinda and Daba ecoraces

Particulars / Characters	Jata	Modal	Sukinda	Daba
Place of origin	Thakurmunda (Orissa)	Simlipal (Orissa)	Sukindagarh (Orissa)	Singhbhum (Jharkhand)
Altitude (AMSL)	1000'	2000'	350'	500'
Place of use / practice	Thakurmunda	Simlipal	Entire tasar producing areas	Entire tasar producing areas
Primary food plant	<i>Terminalia spp.</i>	<i>Shorea spp.</i>	<i>Terminalia spp.</i>	<i>Terminalia spp.</i>
Voltinism	Univoltine	Bivoltine	Trivoltine	Bi and Trivoltine
Cocoon availability	Silkworm rearing	Forest collection	Silkworm rearing	Silkworm rearing
Rate per cocoon	Rs.2.50	Rs.3.00	Rs.0.60	Rs.1.50
Level of adaptability	Semi adaptability	Wild	Wider adaptability	Wider adaptability
Pre dominant cocoon color	Light grey /Yellow	Blackish Grey	Yellow	Grey
(%) of cocoon color variation	Light grey - (90%) Yellow - (10%)	Blackish grey - (100%)	Yellow - (100%)	Grey - (100%)

Table 2: Comparison of morphometric and commercial characters of Jata, Modal, Sukinda and Daba ecoraces under *in-situ* conditions

Characters	Jata		Modal		Sukinda		Daba	
	Range	Ave.	Range	Ave.	Range	Ave.	Range	Ave.
Cocoon length (cm)	5.21-5.44	5.33	5.15-5.70	5.60	4.47-4.89	4.70	4.85-5.21	5.03
Cocoon width (cm)	3.25-3.32	3.28	3.35-3.60	3.50	2.81-3.21	2.90	2.95-3.17	3.06
Cocoon volume (cc)	30.88-34.40	32.64	31.85-36.17	34.21	25.01-31.21	28.45	26.70-32.24	30.47
Cocoon weight (g)	12.24-14.80	13.52	11.59-20.10	15.21	09.10-12.11	10.19	09.20-12.83	10.63
Pupal weight (g)	09.9 0-12.44	11.17	09.84-16.40	13.16	08.11-10.50	8.85	07.72-10.33	9.02
Shell weight (g)	1.60-2.34	2.35	2.25-3.50	2.70	0.99-2.00	1.30	1.25-2.36	1.80
Silk ratio (%)	15.94-18.95	17.45	17.45-19.41	19.85	11.92-13.25	12.16	16.28-14.13	15.00
Peduncle length (cm)	5.07-5.86	5.51	3.92-7.82	6.20	3.20-6.90	5.83	3.51-6.83	5.62
Fecundity (no.)	250-350	315	230-340	285	165-230	195	180-230	200
Cocoon yield / dfl (no.)	18-20	17	09-19	15	40-62	55	45-70	65
Silk yield / 1000 cocoons (g)	941-1610	1410	1314-2175	1818	575-978	845	812-1417	1170
Silk recovery (%)	45-68	61	47-70	55	57-69	63	52-71	68
Silk filament length (m)	840-1550	1184	1215-1600	1400	500-1100	870	475-1240	962
Non-breakable filament length (m)	52-635	325	65-700	347	45-365	210	79-475	230
Denier (d)	11-13	12	10-12	11	9-11	10	9-11	10

Table 3: Rearing and grainage performance of 'Jata' ecorace under *ex-situ* conditions (values are mean and  $\pm$  SE of two crops with three replications in each crop)

Parameters	Jul-Aug, 2006	Jul-Aug, 2007	Sep-Nov, 2006	Sep-Nov, 2007	Average
Fecundity (no.)	210 $\pm$ 8.45	216 $\pm$ 9.98	209 $\pm$ 8.66	201 $\pm$ 8.79	209
Egg hatching (%)	58.0 $\pm$ 2.51	47.03 $\pm$ 1.69	65.24 $\pm$ 1.99	52.83 $\pm$ 1.54	55.8
Larval Weight (g)	30.15 $\pm$ 0.16	30.5 $\pm$ 0.22	38.75 $\pm$ 0.71	39.15 $\pm$ 0.51	34.6
Larval duration (days)	29.00 $\pm$ 0.55	29.50 $\pm$ 0.67	38.60 $\pm$ 0.39	39.50 $\pm$ 0.85	34.2
Cocoon yield / dfl (no.)	63 $\pm$ 6.72	66 $\pm$ 5.89	49 $\pm$ 8.22	43 $\pm$ 6.51	55
Cocoon weight (g)	9.48 $\pm$ 0.24	9.23 $\pm$ 0.37	10.99 $\pm$ 0.56	10.45 $\pm$ 0.41	10.0
Pupal weight (g)	8.36 $\pm$ 0.22	8.06 $\pm$ 0.31	9.26 $\pm$ 0.47	8.77 $\pm$ 0.39	8.6
Shell weight (g)	1.12 $\pm$ 0.14	1.17 $\pm$ 0.12	1.62 $\pm$ 0.09	1.68 $\pm$ 0.13	1.4
Silk Ratio (%)	11.48 $\pm$ 0.29	12.67 $\pm$ 0.72	14.74 $\pm$ 0.37	16.07 $\pm$ 0.61	13.7
Moth emergence (%)	67.54 $\pm$ 8.23	69.66 $\pm$ 6.11	71.65 $\pm$ 7.09	81.55 $\pm$ 5.88	72.6
Moth coupling (%)	82.45 $\pm$ 7.89	85.71 $\pm$ 7.01	78.62 $\pm$ 6.45	89.57 $\pm$ 5.78	84.1

## DISCUSSION

Orissa state is home of Modal ecorace, which is wild, multivoltine, not amenable to human handling and available in Simlipal biosphere at an altitude of 2000'AMSL. The oversized blackish gray cocoons of this ecorace are collected by local tribes from Sal tree forests to sell them in cocoon hats at higher price. Sukinda ecorace also originates from Sukindagarh plain, Orissa at altitude of 300'AMSL is the most commercially exploited bivoltine for tasar silkworm rearings. Daba of bordering Singhbhum area, Jharkhand at altitude of 500'AMSL is another commercially exploited ecorace in the bivoltine areas of Orissa state [4, 22]. However, the unique variety 'Jata' found in Thakurmunda area (1000'AMSL) and its reared cocoons are superior over Daba and Sukinda cocoons, indicates its commercial potential [23, 24].

The dissimilar phenotypic traits of Modal, Sukinda and Daba ecoraces [6, 9, 12, 13, 27] and varied cocoon commercial characters of Jata race with semi domesticated ecoraces [23, 24] made to thought it as natural hybrid of Modal and Daba, which might be the reason to call it as 'Jatadaba' locally. The average of cocoon characters of an ecorace in one area does not differ among different morpho-variants [22] and sufficient information on *in-situ* performance potential helps assessing degree of *ex-situ* adaptation and stabilization [28]. The variation in morphometry, egg and cocoon characters of Jata from Modal, Sukinda and Daba ecoraces and the observed wider phenotypic variability among cocoons collected at different altitudes of Simlipal biosphere ruling out the possibility of Jata being the off-shoot of other ecoraces of zone.

The *in-situ* conservation and *ex-situ* stabilization links potential genetic diversity to sustainable utilization, protects diverse ecosystem in addition to meet optimal socio-economic needs with enhanced productivity through hybridization [18, 19, 20]. The Jata race behaves primarily as univoltine and rearings are restricted to Thakurmunda area during June/ July with low yield of 15-19 mixed color cocoons, despite higher fecundity of 300 eggs. But, the cocoons fetch higher rate (Rs.2.50 per cocoon) than Daba and Sukinda ecoraces and hence a small quantity of bigger cocoons (female) are retained by rearers to prepare seed using natural wild male moths, as seed support from tasar societies (TRCS) and Government of Orissa is inadequate. This clearly indicates rearing preference and commercial superiority of Jata over Modal ecorace with wild / non amenable nature and Daba and Sukinda ecoraces with inferior cocoon and lower rates. The deviation of voltinism by Jata race from uni to bi under *ex-situ* conditions with steady rearing and grainage performances over successive generations (via seed and commercial crops) indicate stabilization trend of race. However, the decline in cocoon characters (cocoon weight, shell weight and silk ratio) might be majorly due to change of voltinism and changed genotype environment interactions [12, 15-17] under *ex-situ* habitat. The wild races perform comparatively inferior while acclimatizing to new environment, but here Jata race even under such stage performed at par or even better than semi-domesticated Daba and Sukinda ecoraces in commercial characters. Although, the performance level of Jata race under *ex-situ* condition found negative in egg and cocoon characters, the average yield of 55 cocoons per Dfl could compensate the rearing economics over the yield of 17 cocoons under *in-situ* conditions. The Jata also could outdo Sukinda ecorace in shell weight (1.4g) and silk ratio (13.7%) in spite of attaining bivoltine status, gave additional tasar race option for commercial rearings. The average of 72.6% emergence and 84.1% coupling over four consecutive generations, Jata race further proves positive in seed production with amenability to human handling unlike wild ecoraces. The consistent rearing and grainage efficiencies indicate inclination of 'Jata' race towards acclimatization and stabilization to *ex-situ* climatic conditions of Tasar Research Institute, Ranchi.

### CONCLUSION

The wider phenotypic and cocoon commercial trait variability vividly substantiate that Jata is different from Modal, Sukinda and Daba and not an off-shoot

of other ecoraces of the zone. The change of voltinism, acclimatization to *ex-situ* climate, consistent rearing and grainage show indicate apparent commercial potential of Jata over in-practice Daba and Sukinda ecoraces. The additional biochemical, bio-molecular and cytological studies are needed to establish the clear identity of race.

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