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Variation in growth of terminalia silk worm of *Ecorace* daba TV in different food plant under condition of Bastar (C.G.) India

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Abstract
The tasar (or tussore or tusser or tussur or tussah) silk that contribute substantially to the national economy of a number of contribute and provided gainful occupation to lakhs genus Antheraea Huber belonging to family satuniidae of order Lepidoptera. In the present investigation an experimental rearing of *Antherara mylita D.*
Chhattisgarh state is the second largest producer of the tasar silk next to Bihar. Tasar culture is the traditional occupation of tribal who are utilizing nature grown tasar food plant which accounts for 30% of total forest in the state. The state has vast potentiality of development of tasar sericulture in the forest having nature grown tasar food plants, Raily one of the nature grown tasar ecorace of *Antheraea mylitta D* is well distributed in the belt of Bastar division of Chhattisgarh, The present investigation is carried out during the June 2018 - July 2018 at Tasar silk field Lab, Sargipal (Regional Tasar Silk Research Centre, Kalipur) district Bastar (C.G).
The present investigation also revealed that irrespective of the food plants, winter season was more ideal for tasar cocoon crop performance of *Antheraea mylitta* in comparison to rainy and autumn season at lower altitude.
Cocoon crop performance of *Antheraea mylitta* on the available limited number of primary food plants species cannot meet the increasing demand for tasar silk at the present time. So it is absolutely species of food plants to fulfill the growing requirements of tasar silk. The present experimental study revealed that the rearing of *Antheraea mylitta* on *Terminalia tomentosa* and *Shorea robusta*, which is not included under primary group of food plant till date, is as per the profitable rearing on *Terminalia alata, Shorea robusta* and *Terminalia arjuna*, the primary food plants. The vast available of this unutilized food plant in the nature forest of India can be exploited sustainably by the local tribes for successful cocoon crop performance of *Antheraea mylitta D*. However, the rate of production and quantity of leaf and gestation period of this plant need species consideration in comparison with primary host plants for the commercial feasibility.

Keywords: bastar, antheraea mylitta, ecorace, variations, growth, silkworms, food plants

Introduction
Several species of Antherace are exploited for production of wild silk known as Tasar silk. These are *Anthera mylitta D, A.yamamai, A. paphia and A. royeli. A. mylitta* and A. *paphia* are reared in central and north eastern parts of India. Many regional strains known by different local names are also found. Three types of voltinism, namely Uni-, Bi- and Multi-voltine are found in *Antheraea mylitta* and *A. paphia* these are reared on trees of *Terminalia tomentosa* (Vern. Asan), *Terminalia arjuna* (Vern. Arjun), *Shorea robusta* (Vern. Sal) and *Zizyphus jujuba* (Vern. Ber).

The tasar silkworm, *Antheraea mylitta* Drury is one the important sericigenous insect of tropical India. It is polyphagous in nature having a number of primary and secondary host plant. It is polyphagous in nature having a number of primary and secondary host plants. Extensively, it thrives on the leaves of primary tasar food plants *Terminalia tomentosa, Shorea robusta* which are widely available in the tropical belt in India. Tasar culture is practiced in six major states of India *viz*., Bihar, Orissa Chhatisgarh, Telangana, West Bengal, and Uttar Pradesh (Mahobia *et al*., 2001-02) [10].
Chhattisgarh state is the second largest producer of the tasar silk next to Bihar. Tasar culture is the traditional occupation of tribal who are utilizing nature grown tasar food plant which accounts for 30% of total forest in the state. The state has vast potentiality of development of tasar sericulture in the forest having nature grown tasar food plants, Raily one of the nature grown tasar ecorace of *Antheraea mylitta* D is well distributed in the belt of Bastar division of Chhattisgarh, presently in Chhattisgarh three types of silk *viz*.., mulberry, tasar' and 'Eri' silk are production, tasar culture is practiced on the forest plant in wild condition. In Chhattisgarh tropical tasar and mulberry are reared on commercial scale. Tasar is locally named as kosa. Sericulture is bering practiced by the tribal of traditional Districts of Baster, Raigarh, Balrampur, Bilaspur and surguja. Sericulture activities covered 43,760 acres. The total number of tasar center is 285 (12, 551, 93 Acres), tasar plantaion under CGSP is 155 sites (10,000 Acres), Tasar rearning in forest is 18, 827.9 Acres (Mahobia *et al.*, 2001-02) [10].
Chhattisgarh state is a very popular for its high quality Kosa silk production. Silk a way of life in Chhattisgarh has become an inseparable part of Indian culture and tradition should be considered for rural management and development (Dewangan *et al*., 2011) [4]. Presently in Chhattisgarh three types of silk *viz*., Mulberry, Tasar and Eri

silk are producing (Singh, 1993) [18]. Mulberry and Tasar farming is done in 6 major district such as Raigarh, Bilaspur, Korba, Champa, Bastar and Ambikapur. Chhattisgarh is the second largest producer of Tasar cocoons.

Therefore, the present investigation was carried out to knowing the growth variation of silkworm and effects of different food plants i.e. *Terminalia tomentosa* and *Shorea robusta* on local condition of Bastar (ecorace), Chhattisgarh.

Material and Methods

The present work are analyze the impact of two different food plants *Terminalia tomenatosa* and *Shorea robusta* on rearing, cocoon economic traits and grainage performance of Daba ecorace of *Antheraea mylitta*. The study has been done in plantation site at outdoor forest plantation area of Sargipal under Regional Sericulture Research Station Central Silk Board Jagdalpur, Bastar Disrict (C.G.) India. The study deals with the variations in growth of Terminalia silkworm of ecorace Daba TV in different food plant under condition of Bastar (C.G.). Sargipal village of Bastar District in Chhattisgarh is located 13 Km from District head quarters Jagdalpur. The general Elevation/Altitude is 569 meters above sea level.

The larvae of these eco-races were collected from the hatching of previously prepared disease free laying (dfl). Electronic Reading balance utilized for daily weighing of larvae weight and weighing of cocoons, shells, and pupa also. The Digital Caliper (sometimes incorrectly called the Digital Vernier) with capacity to measure 0-150 mm and resolution of 0.01 was used for taking the measurement during the study. Nylon net begs were used for egg laying by individual mother moths.

Outdoor rearing practice, on the day of hatching, the polythene sheet was spread the morning hours and tender wigs of food plant were spread on the sheet.

Then the newly hatched silkworms were released. When sufficient silkworms crawled on to the leaves, the shoots were taken out and tied on to the food plants from where they further crawled on the fresh leaves of the trees. The leftover silkworms on the polythene sheet and in the laying box were slowly transferred on to the plucked twigs with the help of a soft painting brush. Subsequently, they were transferred on to the food plants. This process continued till complete hatching of eggs. Nylon net was used for protection against the predatory birds, calotes, red ant sand rodents (plantation). The silkworms are capable of growing in temperature ranging from 15ºC to 40ºC. But from the physiological point of view the ideal temperature ranges from 20ºC to 30ºC.The rearing room temperature can be recorded using a thermometer. On the contrary, low humidity makes to prolong the length of growing period of larva. Egg period was considered as period between date of egg lying and date of egg hatching. In egg observations, the colour, (white), shape and size (round), breadth (2.72), and length (2.73), weight was recorded on electronic weighing balance. Larval period was considered from hatching of the eggs to last larval instar. Newly hatched larva was released on the tender leaves of Arjun and Sal trees with the help of soft camel hair brush. Moulting was confirmed by the presence of casted off skin of larva of subsequent instars. pre-pupal period, observations were taken every day at morning during the larval development. The duration between formations of pre pupa to formation of pupa was recorded as prepupal period. The measurement of pre-pupal stage was recorded with the help of standard ruler and weight was recorded on electronic balance.

The time interval between formations of pupae to emergence of adults was considered as pupal period. After formation of cocoon, weight of cocoon was recorded on electric balance and length and breadth of cocoon was measured with the help of Digital Vernier Caliper. The growth and development of tasar silkworm was observed by feeding on leaves of *Terminalia tomentosa and Shorea robusta* and used for further study at experiment site tasar silk lab Sargipal (C.G.) laid by the Regional Sericulture Research Station Jagdalpur.

Results and Discussion

The study on "Variation in growth of Terminalia silkworm of ecorace Daba TV in different food plants under condition of Bastar (C.G)" was carried out during the June-July 2018 at Tasar silk field lab, Sargipal developed by Regional Tasar Silk Research Centre, Kalipur, district Bastar (C.G).

The rearing of Tasar Silkworm of Daba TV ecorace on dividual plants is studied and presented in table no., 01. The data about the food plants/tree (namely *Shorea robusta* and *Terminalia tomentosa)* no. of Replication hatching (81%) and cocoon harvest etc. are recorded.

In rearing of tasar Silkworm, two food plants/tree were selected and (05) DFL replication of each food plants were layout and the no. of DFL is common for experiment/ observation and the hatching and larva period recorded. The observation shows that the maximum no of cocoon production in all (05) replication is (163) in the food plant/tree *Terminalia tomentosa* where as the maximum no of cocoon production in *Shorea robusta* is (57) only. The average hatching % is also collected from the both host plant tree. The maximum average hatching is found in *Terminalia tomentosa* (81%) which is followed by *Shorea robusta* (79%). the average larvae period was also recorded.

Growth on food plants - *Terminalia tomentosa* during 1st, 2nd 3rd, 4th and 5th Instar

The growth of tasar Silkworm during 1st 2nd 3rd, 4th and 5thInstar in *Terminalia tomentosa* on Daba TV ecorace rearing are recorded during the study. Silk worms growth, enhancement and development on *Terminalia tomentosa* is presented in table no. 02.The first instar and second instar of woms growth in different rearing date (period), is observed and in first instar, the worms growth e.i,. worms weight, length and width (mm) is recorded. The second instar data observation of woms growth. It was fount that the worms growth / enhancement on the basic of weight are higher in 2nd instar (126.15%) when is the lower (64.35%) in 1st instar the length cultivation and width enhancement is more respectively in 1st instar then the 2nd instar at experiment site.The observation of 3rd instar 4th and 5th instar are recorded and durable of worms enchantment and age of worms, rearing the (date) was collected.

The third Instar and Forth instar of worms growth in different rearing date (period), is observed. It was found that the worm growth / enhancement on the basis of weight are higher in 4th instar (296.29%) then the lower (269%) in 3rd instar the length cultivation and width enhancement is more respectively in 3rd instar then the 4th instar.The fourth instar and fifth instar of woms growth in different rearing date

(period), is observed. It was found that the worms growth / enhancement on the basic of weight are higher in 4th instar (296.29%) when is the lower (176.69%) in 5th instar the length cultivation and width enhancement is more respectively in 4th instar then the 5th instar at experiment site Sargipal. After the 11 day the spinning is start and the cocoon formation is now start within the 5-6 days the complete cocoon formation is done on maximum 05 day from the spinning start.

The Worms growth, enhancement and development on *Shorea robusta* during 1th, 2nd 3rd, 4th and 5thInstar

The newly hatched larva was dark brownish or dull yellow in colour and acquired green body after 24 hours, The data on measurement of first instar in *Shorea robusta* are presented in table no.03. The Weight (gm), length and width (mm) of the worms was measured. The growth of tasar silkworm during 1st Instar to 5th Instar in *Shorea robusta* on Daba TV ecorace rearing are recorded.

The weight of worms and their single low ranged from 0.012 gm, to 0. 040 g, length between 3.25 mm to 10.907 mm and width form 0.49 to 1.66 mm. The enhancement of worms was recorded as that is 227.86% (weight of larvae) 235.6% length and 238.77 % in width of larvae from 1st day to 4th days in the period of 1st month.

The newly moulted larva was pale greenish in colour and acquired green body after 24 hours, The Weight (gm), length and width (mm) of the worms was measured in second instar. The weight of worms and their single low ranged from 0.035 gm, to 0.077 g, length between 11.56 mm to 13.28 mm and width form 2.56 to 2.875 mm. The enhancement of worms was recorded as that is 120% (weight of larvae) 14.87% length and 2.72 % in width of larvae from 6 day to 8 day in the period of 1st month. The Weight (gm), length and width (mm) of the worms was measured.The growth of tasar silkworm during 3st Instar in *Shorea robusta* on Daba TV ecorace rearing are recorded that the weight of worms and their single low ranged from 0.244 gm, to 1.09 g, length between 20.66 mm to 30.90 mm and width form 3.86 to 7.40 mm were found. The enhancement of worms was recorded that is 346.12% (weight of larvae) 49.56% length and 91.70 % in width of larvae from 10 day to 11day in the period of 1st month. The body newly moulted larva was pale greenish in colour and acquired green body after 24 hours. The Weight (gm), length and width (mm) of the worms was measured in 4st Instar in *Shorea robusta* on Daba TV ecorace rearing.

The weight of worms and their single low ranged from 0.024 gm, to 0.11 g, length between 40.12 mm to 66.77 mm and width form 7.61 to 9.21 mm. The enhancement of worms was recorded as that is 358.33% (weight of larvae) 66.42% length and 21.02 % in width of larvae from 15 day to 18 day in the period of 1st month.

The data on measurement of Fourth instar in *Shorea robusta* are presented in table no. (03). The Weight (gm), length and width (mm) of the worms was measured. The growth of tasar silkworm during 5st Instar in *Shorea robusta* on Daba TV ecorace rearing are recorded.

The weight of worms and their single low ranged from 9.87 gm, to 25.18 g, length between 68.56 mm to 102.52 mm and width form 9.44 to 17.97 mm. The enhancement of worms was recorded as that is 155.11% (weight of larvae) 49.53% length and 90.36 % in width of larvae from 20 days to 30 days in the period of June 2018 to July 2018. After the 11 days the spinning (formation of cocoon) is start and the cocoon formation is now start within the 5-6 days. The complete cocoon formation was done on maximum 05 days from the spinning start. The performance of Tasar Silkworm and their larvae development on both food plants (*Terminalia tomentosa and Shorea robusta*) and the age of worms 1st Instar 2nd, 3rd, 4th and 5th, Instar larvae growth were observed and between the 1st instar to 4th instar larvae are the moulting periods & after the 11 days moulting period and the cocoon formation was done.

Table 1: Rearing of tasar silkworm of ecorace Daba TV on different food plants

Conditions	Race	Name of food plant	No. of Replications	No. of dfls brushed	Av. Fec.	Date of brushing	Hatching %	No. of worms brushed	Date of spinning start	Larval period	No. of cocoons harvested	Coc/dfl ratio
Outdoor	DTV	*Shorea robusta*	1	1	200	8/6/2018	79	158	9/7/2018	36	12	12.00
			2	1	200	8/6/2018	76	152	9/7/2018	35	10	10.00
			3	1	200	8/6/2018	81	162	10/7/2018	36	12	12.00
			4	1	200	8/6/2018	80	160	11/7/2018	34	11	11.00
			5	1	200	8/6/2018	78	156	10/7/2018	35	12	12.00
			Total	5	200	8/6/2018	79	788		34-36	57	11.40
Outdoor	DTV	*T. tomentosa*	1	1	200	8/6/2018	80	160	9/7/2018	30	32	32.00
			2	1	200	8/6/2018	83	166	10/7/2018	29	31	31.00
			3	1	200	8/6/2018	82	164	9/7/2018	30	33	33.00
			4	1	200	8/6/2018	81	162	11/7/2018	31	34	34.00
			5	1	200	8/6/2018	80	160	10/7/2018	32	33	33.00
			Total	5			81	812		29-32	163	32.60

Table 2: Growth Performance of tasar silkworm (ecorace Daba TV) larvae during rearing fed on *Terminalia tomentose*

D/B	Food plant	Condition	Age of worm (Day)	Instar	Day of age	Worms		
						Wt (g)	Length (mm)	Width (mm)
09/06/2018	*Terminalia tomentosa*	Outdoor	1	First	1	0.0125	4.179	0.72
10/06/2018			2		2	0.0215	8.2154	2.688
11/06/2018			3		3	0.0417	9.036	2.6948
12/06/2018			4		4	0.0756	13.1116	3.3649
13/06/2018			5	Worms are under 1st Moult				
14/06/2018			6	Second	1	0.0766	14.1174	3.584
15/06/2018			7		2	0.18972	18.9	4.81
16/06/2018			8		3	0.17554	17.1926	4.5822
17/06/2018			9	Worms are under 2nd Moult				
18/06/2018			10	Third	1	0.3639	26.2772	4.7952
19/06/2018			11		2	0.4156	27.0742	6.9182
20/06/2018			12		3	0.8175	31.9416	7.5158
21/06/2018			13		4	1.3395	34.0694	8.3432
22/06/2018			14	Worms are under 3rd Moult				
23/06/2018			15	Fourth	1	1.8905	43.6002	8.7374
24/06/2018			16		2	2.6477	53.6884	9.9594
25/06/2018			17		3	7.0823	65.695	11.739
26/06/2018			18		4	7.9481	68.3362	11.6954
27/06/2018			19	Worms are under 4th Moult				
28/06/2018			20	Fifth	1	10.3085	70.7198	11.4652
29/06/2018			21		2	12.7803	71.976	11.9664
30/06/2018			22		3	14.4691	75.5512	12.2554
01/07/2018			23		4	16.9163	79.556	12.8928
02/07/2018			24		5	18.6523	84.2578	13.3312
03/07/2018			25		6	20.2887	87.972	13.965
04/07/2018			26		7	23.5755	94.521	14.7834
05/07/2018			27		8	24.9891	100.2204	15.1354
06/07/2018			28		9	26.0428	99.0634	16.5684
07/07/2018			29		10	30.6947	97.3562	17.7648
08/07/2018			30		11	28.5068	100.0162	19.2276
09/07/2018	Spinning started							
15/07/2018	15/07/2018							

Table 3: Growth Performance of tasar silkworm (ecorace Daba TV) larvae during rearing fed on *Shorea robusta*

D/B	Food plant	Condition	Age of worm (Day)	Instar	Day of age	Worms		
						Wt (g)	Length (mm)	Width (mm)
09/06/2018		Outdoor	1	First	1	0.0122	3.2586	0.492
10/06/2018			2		2	0.0266	6.472	0.612
11/06/2018			3		3	0.025	7.543	0.392
12/06/2018			4		4	0.0402	10.907	1.66
13/06/2018			5	Worms are under 1st Moult				
14/06/2018			6	Second	1	0.035±	11.5604	2.5606
15/06/2018			7		2	0.080	12.6272	2.67
16/06/2018			8		3	0.077±	13.2808	2.875
17/06/2018			9	Worms are under 2nd Moult				
18/06/2018			10	Third	1	0.2442	20.6644	3.866
19/06/2018			11		2	0.26552	22.719	4.6922
20/06/2018			12		3	0.6772	26.8974	5.2562
21/06/2018			13		4	1.095	30.9	7.4006
22/06/2018			14	Worms are under 3rd Moult				
23/06/2018			15	Fourth	1	1.5694	40.1202	7.6176
24/06/2018			16		2	2.2571	47.1764	8.7362
25/06/2018			17		3	6.9505	63.2906	8.8566
26/06/2018			18		4	7.6803	66.7724	9.2172
27/06/2018			19	Worms are under 4th Moult				
28/06/2018			20	Fifth	1	9.8734	68.6504	9.449
29/06/2018			21		2	11.2378	70.1204	10.8818
30/06/2018			22		3	14.0158	73.24	11.1886
01/07/2018			23		4	16.3678	76.1104	11.146
02/07/2018			24		5	18.3175	82.5936	12.1645
03/07/2018			25		6	19.7281	84.9116	13.157
04/07/2018			26		7	22.1957	90.8166	13.9018
05/07/2018			27		8	25.1089	95.3512	14.231
06/07/2018			28		9	23.5958	97.3962	39
07/07/2018			29		10	26.6418	91.755	16.7694
08/07/2018			30		11	25.1856	102.528	17.972
09/07/2018	Spinning started							
15/07/2018	15/07/2018							

Conclusion

The present experimental study revealed that the rearing of silk worms *Antheraea mylitta* on *Terminalia tomentosa* and *Shorea robusta*, which is not included under primary group of food plant till date. The rearing is profitable on *Terminalia alata*, *Shorea robusta* and *Terminalia arjuna*, in this primary food plants. The vast available of this unutilized food plant in the natural forest of India can be exploited sustainably by the local tribes for successful cocoon crop performance of *Antheraea mylitta D*. However, the rate of production and quantity of leaf and gestation period of this plant need species consideration in comparison with primary host plants for the commercial feasibility.

In Chhattisgarh tropical tasar and mulberry are reared on commercial scale. Tasar is locally named as kosa. Sericulture is bering practiced by the tribal of Baster, Raigarh, Balrampur, Bilaspur and surguja. Sericulture activities covered 43, 760 acres. The total number of tasar center is 285 (12, 551, 93 Acres), tasar plantaion under CG Sericulture production in 155 sites (10,000 Acres), and Tasar rearning in forest is 18, 827.9 acres.

The economy of sericulture industry depends not only on high yield but also on quality of leaves. The quality and quantity of silk production by the silkworm depends on the leaf and the yield of the food plants. It is established fast that the performance of the silkworm is directly related to nutrient content of the food plant.

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