International Journal of Applied and Universal Research E-ISSN No: 2395-0269
Volume IV, Issue III, May-June. 2017 Available online at: www.ijaur.com

STUDIES ON THE WILD ECORACE OF *ANTHERAEA MYLITTA* DRURY OF TASER SILK WORM OF NORTH CHHATTISGARH

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ABSTRACT: - The word "Sericulture" has been derived from the word "Su" (Si) which means silk. Sericulture, the art and science of growing silkworm, food plants, rearing silkworms and production of silk is basically an agro-industry. Tasar silk is produced from the tasar silkworms (Insecta: Lepidoptera: Saturniidae) which has many ecoraces principally controlled by prevailing environmental conditions. The tasar silkworms are cultivated ex-situ in natural forests, however, some attempts have been made for its semi- domestication. Tasar culture is a traditional livelihood for lakhs of tribal population in our country. The present study depicts the variation in the different stages of tasar silkworm *Antheraea mylitta* Drury which is distributed in the form of ecoraces in varied geographical areas. From the studies it is observed that rich biological diversity of *Antheraea mylitta* Drury mainly is due to its wide range of distribution, climatic factors, and food plants etc., which have led to variations in their ethology and physiology.

KEYWORDS: Antheraea mylitta Drury, environmental conditions, geographic distribution, variation, diversity, climatic factors.

INTRODUCTION:

Silk is Nature's gift to mankind and a commercial fiber of animal origin other than wool. Being an eco-friendly, biodegradable and self-sustaining material; silk has assumed special relevance in present age. Promotion of sericulture can help in ecosystem development as well as high economic returns. Sericulture is practiced in India and India is the 5th largest producer of silk in the World. It has been identified as employment oriented industry. All the sections of sericulture industry, viz. mulberry cultivation, silkworm seed production, silkworm rearing, reeling and weaving of silk and collection of byproducts and its processing provide a large scale employment, thereby a source of livelihood for the rural and tribal people. Sericulture industry is rated as the second largest employer in India.

Owing to this peculiar nature, the Indian planners have identified sericulture as one of the best-suited occupations for ideal growth and development of rural India. Mulberry sericulture has been traditional occupation in Karnataka, Tamil Nadu, A.P. and Kashmir; Tasar one, in M.P., Chota Nagpur Division and Orissa; Muga one, in Assam, Nagaland, Tripura and Eri one in Assam and West Bengal. North-eastern part of India is the only region in the world where all four varieties of silk are produced.

Central and State level Government Silk Departments are actively engaged in addressing the objective of promotion of sericulture in traditional as well as non-traditional regions. With the launching of massive developmental schemes, it is expected to gain an accelerated tempo of sericulture activities in the country, paving way for doubling the employment opportunities in phased manner, and thereby, it may set to bring a soothing touch to the burning problem of acute unemployment in rural India and thus can check the rural migration to urban areas to a certain extent.

Sericulture is an agro-based cottage industry involving interdependent rural, semi-urban and urban-based activities in which estimated participation of women is about 60%. Thus, in contrast to any other agro-based profession the role of women in sericulture industry is dominating which will be helpful for improving the status of women in family enterprises. In the light of women welfare through Sericulture industry, the Central Silk Board, a statutory organization, under the Ministry of Textiles, Government of India has established a special component of assistance to Women and NGO's' into the National Sericulture Project.

The performance of parental ecoraces and their hybrids clearly indicate the role of their origin and genetic diversity, Moghaddam et.al., (2005), Tutaja et.al., (2006) and Ojha et. al. (2009) on commercial out-put. The higher number of fertilized eggs, highest silk yield in Daba race proves its commercial superiority and economic viability in spite of lower shell weight. The species of *Antheraea mylitta* Drury with wide distribution, encounter diverse biological niche and on adaptation forms in to ecoraces (Nayak et.al. 2000 and Rao et. al. 2000). Most of the phenotypic variations are highly influenced by temperature, relative humidity and rainfall Srivastava et. al. (2000).

Sericulture and its components:

Commercial rearing of silk producing silkworm is called sericulture. It is an agro-based industry comprising three main components:

i) Cultivation of food plants of the worms rearing of silk worms.

ii) Reeling and spinning of silk.

The first two are agricultural and the last one is an industrial component. There are four varieties of silkworms in India; accordingly sericulture is classified into **Mulberry Culture, Tasar Culture, Muga Culture** and **Eri Culture.**

Rearing Equipment's

i) **Rearing house:** The rearing house should meet certain specification, as the silk worms are very sensitive to weather conditions like humidity and temperature. The rearing room should have proper ventilation optimum temperature and proper humidity. It should be ensured that dampness, stagnation of air, exposure to bright sunlight and strong wind should be avoided.

ii) **Rearing stand:** Rearing stands are made up of wood or bamboo and are portable. These are the frames at which rearing trays are kept. A rearing stand should be 2.5 m high, 1.5 m long and 1.0 m wide and should have 10 shelves with a space of 20 cm between the shelves. The trays are arranged on the shelves, and each stand can accommodate 10 rearing trays.

iii) **Ant well:** Ant wells are provided to stop ants from crawling on to trays, as ants are serious menace to silk worms. They are made of concrete or stone blocks 20 cm square and 7.5 cm high with a deep groove of 2.5 cm running all round the top. The legs of the rearing stands rest on the centre of well filled with water.

iv) **Rearing tray:** These are made of bamboo or wood so that they are light and easy to handle. These are either round or rectangular.

v) **Paraffin paper:** This is a thick craft paper coated with paraffin wax with a melting point of 55^{o} C. It is used for rearing early stages of silk worms and prevents withering of the chopped leaves and also help to maintain proper humidity in the rearing bed.

vi) **Foam rubber strips:** Long foam rubber strips 2.5 cm wide and 2.5 cm thick dipped in water are kept around the silkworm rearing bed during first two instar stages to maintain optimum humidity. Newspaper strips may also be used as a substitute.

vii) **Chopsticks:** These are tapering bamboo rods (1cm in diameter) and meant for picking younger stages of larvae to ensure the hygienic handling.

viii) **Feathers:** Bird feathers preferably white and large are important items of silkworm rearing room. These are used for brushing newly hatched worms to prevent injuries.

ix) **Chopping board and Knife:** The chopping board is made up of soft wood it is used as a base for cutting leaves with knife to the suitable size required for feeding the worms in different instar stages.

x) **Leaf chambers:** These are used for storing harvested leaves. The sidewalls and bottom are made of wooden strips. The chamber is covered on all sides with a wet gunny cloth.

xi) **Cleaning net:** These are cotton or nylon nets of different mesh size to suit the size variations of different instars of the silk worm. These are used for cleaning the rearing beds, and at least two nets are required for each rearing tray.

xii) **Mountages:** These are used to support silkworm for spinning cocoons. These are made up of bamboo, usually 1.8 m long and 1.2 m wide. Over a mat base, tapes (woven out of bamboo and 5-6 cm wide) are fixed in the form of spirals leaving a gap of 5-6 cm. They are also called chandrikes. Other types of mountage such as centipede rope mountage, straw cocooning frames etc. are also used.

xiii) **Hygrometers and Thermometers:** These are used to record humidity and temperature of the rearing room.

xiv) **Feeding stands:** These are small wooden stands (0.9 m height) used for holding the trays during feeding and bed cleaning. Other equipment's like feeding basins, sprayer, and leaf baskets may also be required.

Cares:

Silkworms must be reared with utmost care since they are susceptible to diseases. Therefore, to prevent diseases, good sanitation methods and hygienic rearing techniques must be followed. The appliances and the rearing room should be thoroughly cleaned and disinfected with 2-4% formaldehyde solution. Room temperature should be maintained around 25^{0} C.

MATERIAL AND METHODS:

For the present study, the natural habitats of the seven ecoraces of Tasar Silkworm, Antheraea mylitta Drury, were explored in their natural habitats and the geographical parameters were recorded. The ecological aspects of the seven ecoraces of tasar silkworm, Antheraea mylitta Drury were observed in their natural habitats and recorded (Suryanarayana et. al., 2005). In the present study, the genetic capabilities of tasar silkworm in north C.G. (Sarguja, Balrampur, Udaypur, Surajpur) have been explored through conventional breeding methods to demonstrate the implication of

introgression of wild and semi-domestic genotypes and its influence on different characters of tasar silkworm. The reciprocal crosses of two wild populations such as Daba (wild) and Laria were prepared by combining with semi-domestic Daba ecorace. The optimum temperature and relative humidity for the tasar silkworm rearing are 25-30 °C and 60-70% respectively. Such observations were made during first, second and third crops and the behaviour during feeding, moulting, ecdysis, defecation and cocoon spinning, emergence pattern, etc., have been recorded.

RESULT:

Taxonomy of silkworm:

Silk producing insects are commonly referred to as serigenous insects. Silkworm is a common name for the silk-producing caterpillar larvae of silk moths. Silk moths belong to Phylum - Artropoda, Class - Insecta, Order - Lepidoptera, Super family - Bombycoidea. Bombycoidea comprises eight families of which only Bombycidae and Saturnidae are the two important families the members of which produce natural silk. There are several species of silkworm that are used in commercial silk production.

(i)Tasar silk worm

- *Antheraea mylitta (Saturnidae)*
- *Antheraea pernyi (Saturnidae)*
- *Antheraea yamamai (Saturnidae)*
- *Antheraea paphia (Saturnidae)*
- *Antheraea royeli(Saturnidae)*

Rearing of Tasar Silkworm

Cultivation of food plants is generally avoided, as tasar silkworms are wild in nature and need to be reared outdoors. However, modern sericulturists prefer to cultivate the food plants for better supervision. Cultivation is done with seeds or saplings being raised in nurseries. Saplings are transplanted to fields 20-25 feet apart. Agronomic practices are carried on regularly. Pruning is done regularly to maintain better foliage growth.

It is the bi-voltine variety of tasar worm that is used for commercial purpose. The cocoons of bi-voltine variety harvested in November/December go into diapause at pupal stage and moths generally emerge in May/June of following year. The rearing of worms from eggs produced in May/June is completed by June/July. This is the summer crop. These cocoons do not undergo diapause. The moths emerge in 15-20 days, and the layings prepared out of this crop are used for rearing the second crop during September/October. The summer crop is seed crop for second crop which is commercial crop. The rearers usually keep the necessary quantity of seed cocoons from the previous year crop for preparation of egg laying. Emergence is usually in the evening. The males are active and copulate with the females soon after emergence. After copulation the females are decoupled and kept in bamboo baskets for about 48 hours to lay eggs. A single female lays about 150-200 eggs in 2 days. The eggs are oval and dorso-ventrally flattened. Eggs are soaked in 2% formalin, washed with water, dried and allowed to hatch. Life cycle of tasar worm consists of adult, egg, larva and pupal stages.

The larvae hatch out in ten days. The hatching larvae are kept in cups made up of leaves and the cups are uniformly distributed over the host trees. These larvae crawl in search of food. The larval period lasts for 30-35 days in summer, which may prolong in winter. The larvae pass through four moults and 5 instar stages. The hatched 1st instar larvae are brown and change to green colour at second instar. There are a number of tubercles on the body, which carry the setae. The final instars are green in colour with violet tubercles distributed over the body. A prominent brown and yellowish lateral line is visible on either side of the body. The tubercles are violet. The dorsal tubercle carries brick red dorsal spots, and lateral tubercles carry mirror like shining lateral spots.

The larvae feed voraciously on leaves and defoliate trees. In Antheraea, cocoon formation takes about in two days. It follows gut purging, initiated by ecdysone production in which larva expels gut contents by a series of waves of contraction passing along the abdomen from front to back. Subsequently, the larva enters an active wandering phase, which ends when it finds a suitable site in which to pupate. The first phase of cocoon formation is the construction of a scaffold of silk threads between leaves of food plant and the production of stalk or peduncle which attaches the cocoon to the leaf petiole /tree twig. Subsequent behavior consists of a series of cycles in which the larva weaves loops of silk by figure-of-eight movements of the head to construct one end of the cocoon and then turns through 180^{o} to form the other end. After a period of about 14 hours, by which time a complete layer of silk has been produced, the insect turns from one end of the cocoon to the other at much shorter intervals, and at the same time, it coats the inside of cocoon with a liquid from the anus containing crystals of Calcium Oxalate produced by the Malpighian tubules. The hydration of silk by secretion promotes cross-linking and tanning of the silk protein sericin, and the wall of cocoon becomes stiff and yellowish- brown. This period of impregnation lasts for an hour. After this more silk is added to the inside of the cocoon. The rearers then harvest the cocoons. In addition to systemic rearing, the

cocoons are collected in forests by the tribes and forest men, as the tasar worms thrive naturally in wild.

Post Cocoon Processing

Cocoon are first soaked in 5% Soda (Na_2CO_3) solutions for 18 hours and then subjected to steam cooking in pressure chambers for 2½ hours to bring about the stifling of cocoon. After 24 hours, the stifled cocoons are washed in 0.5% formalin for 15-20 minutes followed by washing with water. Water is then squeezed out, and cocoons are reeled on reeling machine.

The waste outer layer, damaged cocoons and peduncles are teased, and then silk thread is spun on earthen mutka. The spun silk is commonly known as katia matka.

Table No.1. Origin and Characteristics of Tasar Silkworm, *Antheraea mylitta* Drury.

Sr. No.	Ecorace	Site of Collection	Food plant	Cocoon availability	Level of adaptability
1.	Ambikapur Local	Surguja	*Terminalia arjuna* and *T. tomentosa*	Forest collection	Wild
2.	Daba Duri	Balrampur	*Terminalia arjuna* and *T. tomentosa*	Forest collection	Wider adaptability
3.	Duri Lariya	Surajpur	*Terminalia arjuna* and *T. tomentosa*	Silkworm rearing	Wild
4.	Duri Raili	Koriya	Shorea robusta	Silkworm rearing	Wider adaptability
5.	Duri Bogai	Rajpur	*Terminalia arjuna* and *T. tomentosa*	Forest collection	Wider adaptability

Table 2: Natural habitat and ecological parameters of the ecoraces of Tasar Silkworm *Antheraea mylitta* Drury

Ecorace	Area of Habitat Collection	Geographical ordinates		Forest type	Soil type	Avg. Max Tem. (^{0}C)	Avg. Min. Tem. (^{0}C)	Annual Preci. (mm)
Ambikapur Local	Surguja	*23°12′N*	83°2′E	Tropical moist deciduous	Black Clay	30.16	20.80	1450.00
Daba Duri	Balrampur	23.605°N	83.617°E	Tropical dry Deciduous	Black Clay	29.10	18.50	1250.00
Duri Lariya	Surajpur	*23.22°N*	82.85°E	Tropical moist deciduous	Black Clay	31.50	19.85	1239.50
Duri Raili	Koriya	22°56′N	81°56′ E	Tropical Humid Deciduous	Black Clay	32.40	20.60	1210.21
Duri Bogai	Rajpur	23.335°N	83.413°E	Tropical moist deciduous	Red Loamy	31.40	18.50	1195.20

Table 3: The Larval characteristics of Tasar Silkworm, *Antheraea mylitta* Drury.

Ecorace	**Diapause period (months)**	**Voltinism**	**Average fecundity**	**Predominant female moth colour**	**Avg. larval weight (g)**	**Avg. Larval span (days)**
Ambikapur Local	4	Trivoltine	175	Brown	24	42
Daba Duri	6-7	Bi/ Trivoltine	250	Yellow	40	31
Duri Lariya	6-7	*Trivoltine*	240	Brown	30	35
Duri Raily	4-10	Uni /Bi/Trivoltine	285	Grey	44	32
Duri Bogai	5-6	Trivoltine	170	Yellow/Grey	40	35

The diapause period of the tasar silkworm, *Antheraea mylitta* Drury, was ranging from 4-5, 5-7 and 10 months for bivoltine, trivoltine and univoltine respectively, in the seven ecoraces studied. The moth colour was also observed to be brown, yellow or grey predominantly. The average Fecundity of tasar silkworm, *Antheraea mylitta* Drury, Ambikapur local, Daba, Raily ecoraces. The average larval weight (g) of tasar silkworm, *Antheraea mylitta Drury*, Ambikapur local, Daba, Raily ecoraces were respectively. The average Larval spanoftasar silkworm, *Antheraea mylitta*, Ambikapur local, Daba, Bhandara, Modal, Raily ecoraces were, respectively (Table3).

DISCUSSION:

Tropical tasar silkworm, Antheraea mylitta Drury is a commercial variety, which exists in various forms as 44 ecological populations or ecoraces in different geographical niches of our country depend on food plants and environmental conditions. In the present study out of the seven ecoraces studied, except Amibikapur local and Surajpur C.G., which are predominantly found in dry tropical forest area, all other ecoraces grow in moist deciduous forest areas of red loamy and black clayey regions within maximum temperature range of 30-34 °C and a minimum of 18-21 °C, the annual precipitation ranging from 925-939 mm in dry deciduous and 1000-1275mm in moist tropical deciduous forest areas (Suryanarayana 2005). The voltinism (uni/bi/tri) in *Antheraea mylitta* Drury is regulated by environmental factors like temperature, relative humidity, day length and rainfall. Some have reported that voltinism pattern is found to be stable for a particular zone can change in different environmental conditions (Kar, 2000). Humidity also plays an important role in growth of the larvae, triggering the moth emergence and preventing pupal desiccation. The present study depicts the variation in the different stages of tasar silkworm Antheraea mylitta Drury which is distributed in the form of ecoraces in varied geographical areas. From the studies it is observed that rich biological diversity of Antheraea mylitta is mainly due to its wide range of distribution, climatic factors, and food plants etc., which have led to variations in their ethology, physiology and commercial traits. The area occupied by the Tasar silkworm, Antheraea mylitta is highly diversified geographically as such the population from diverse sources has not evolved uniformly. The range of distribution is also so large that this had an opportunity for geographic variation. Inter – and intra – populational variability is very much prominently seen. *Antheraea mylitta* Drury, a lepidopteran insect of the Saturniidae family produces tasar silk of commercial importance. This species is endemic and distributed in different geographical regions of India in the form of ecological races (Table 2). They show variation in their phenotypic traits such as fecundity, voltinism, cocoon weight, silk ratio and also in their host plant preference (Sinha 1994). To understand the genetic closeness and also for the identification of the wild silkworm Antheraea mylitta Drury ecoraces, usage of RFLP markers was reported by Mahendran et al., in 2006. The subsequent phylogenetic analysis revealed that their relationships were found to be consistent with a neighbourhood structure of randomly mating population and the geographically closely situated populations tend to be genetically more similar. As is evident from the present investigation (Table 2), the tasar silkworm, *Antheraea mylitta* is found to be distributed in a diverse geographic areas of varied eco-climatic conditions like temperature, humidity, photoperiod, rainfall; edaphic factors like soil, texture; geographic coordinates like latitude and longitude and forest resources of food plants etc., leading to changes in phenotypic, physiological, ethological, adaptational, economic traits and ultimately genetic variations in populations. The rich biological diversity of Antherea mylitta is largely due to its wide range of distribution and foraging of silkworm on a variety of food plants. Its wide range of distribution the species has encountered diverse geo climatic conditions like annual Precipitation, temperature, day length, plant succession. The factors like latitude, longitudes etc., of distinct areas lead to marked differences expressing wide variations in phenotypic, physiological, behavioural, commercial and technological traits. Various populations thus, isolated geographically over centuries have adapted to a particular ecological niche and referred to as ecological races.

CONCLUSION:

From the present experimental study it can be concluded that the rearing of tasar silkworm, *Antheraea mylitta*, which is not included under primary food plant group till date, is as per the profitable rearing on *T. tomentosa*, and *T. arjuna*, the primary food plants. From the studies on biodiversity of Tasar silkworm it is abundantly clear that rich biological diversity of *Antheraea mylitta* Drury is mainly due to its wide range of distribution, climatic factors, and food plants etc., which lead to variations in their ethology, physiology and commercial traits. The area occupied by the Tasar silkworm, *Antheraea mylitta* is highly diversified geographically as such the population from diverse sources has not evolved uniformly. Earlier reports have revealed that decreasing genetic diversity increases the extinction risk of populations due to a decline in fitness of individuals. Genetic diversity is inversely proportional to isolation and that it is directly correlated with population size. The genetic diversity of populations responds to environmental heterogeneity *via* alterations in the

relative strengths of the four opposing genetic forces: mutation, migration, selection, and genetic drift. The balance and cumulative history of these forces determines actual levels of genetic diversity at any one time. The main reasons for extinction of Ambikapur local ecorace may be its dwindling population size, which is consequential to physiological attributes and environmental adaptation.

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