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ALTITUDE VARIATION AND MUGA SILKWORM REARING

Ningthoujam Tiken Singh*, Harjeet Singh and Brajendra Choudhury*****

P3 Unit, Muga Silkworm Seed Organization, Central Silk Board, Pailapool, Assam
*Sericulture Development Department, Poonch, Jammu and Kashmir
***Muga Silkworm Seed Organization, Central Silk Board, Guwahati, Assam
*Email: ningthoujamtiken@gmail.com

ABSTRACT

Muga silk production is limited by unsuccessful summer and rainy season rearing conducted under high temperature and fluctuating environmental moisture content in Assam plains. Quality seed production and seed supply for autumn commercial rearing is interrupted by diseases. To overcome the situation, roving survey for rearing potential sites revealed the presence of wild form of *Antheraea assamensis* Helfer and distribution of its naturally grown food- 1. plants at the places located between 750-1200 metres above sea level (masl) in Manipur. 2. rearing conducted showed better performance than the lower elevations in terms of disease free layings cocoon ratio (Dfl: C) and effective rate of rearing (ERR %). Facultative diapausing pupae from the autumn rearing in higher elevated areas were a means of skipping muscardine disease prevalent period at many places of traditional zones. These places could be considered for conservation of genetic resources during summer and later part of rainy season rearing to ensure uninterrupted seed supply.

Key words: *Antheraea assamensis*, Manipur, Assam, altitudes, rearing, effective rate of rearing, disease free, diapause, summer, rainy season

Failure of muga silkworm *Antheraea assamensis* Helfer, rearing during summer and rainy seasons in the plain areas are the main limiting factors in raw silk production. The silkworm rearing is carried out at the altitudes of 30 to 650 masl where temperature shot up to 40±^{0}C with high fluctuating relative humidity in summer inviting silkworm diseases. Optimum conditions like 20-31^{o}C and 65-95% RH (Choudhury, 1981) does not exist during the summer in plains. It is also because, the region lies at a very close to the tropics and displays the character of tropical climate especially in the valley (Dikshit and Dikshit, 2013). But the hilly terrains and valley districts of Manipur have subtropical to temperate climate during the summer, a conducive environment for rearing. Manipur state provides shelter to all commercially known sericigenous insects either in the wild or cultivated form (Tiken et al., 2012). Occurrence of these silk moths herein is due to prevalence of optimum weather coupled with habitats with host plants. Hence, this region has been suggested as the centre of origin of *Antheraea* spp. (Jolly, 1981). The valley areas except bordering areas of Myanmar and Assam are at altitudes of 750 masl and above. The temperature during the summer is comparatively lower than Assam planes. The present study evaluates the effects of altitude variation on the rearing of *A. assamensis*.

MATERIALS AND METHODS

The study was carried out with roving surveys of potential muga rearing sites followed by rearing. Physical roving survey of plantation areas of muga host plants was conducted at the six districts in Manipur, with altitude observed with Google Earth application. Collection of muga host plants and wild muga silk moths encountered during survey were made. This was followed rearing done at Narankonjil and Sangaithel of Imphal West district in Manipur and at Pailapool under P3 Unit, Muga Silkworm Seed Organisation (MSSO), Pailapool, Cachar District, Assam. Altitudes at the rearing places was between 750 to 1100 masl (Manipur), and 32 masl (Assam). Muga disease free layings (dfls) were arranged by P3 Unit, MSSO, Central Silk Board, Pailapool for rearing during summer and autumn seasons of 2017. All the recommended packages of practice of rearing were followed. Meteorological data were recorded for each of the rearing places.

RESULTS AND DISCUSSION

Survey: During the survey, the presence of naturally grown *Persea bombycina* (King *ex* Hook. f.) Kosterm., syn. *Machilus bombycina* King *ex* Hook. f., Fl. (Som), *Litsea monopetala* (Roxb.) Pers., Syn. *Litsea polyantha* Juss *(Soalu*) and other host plants viz. *Litsea salicifolia*

(Roxb. *ex* Nees), *Litsea citrata* (Blume.), Syn. *Litsea cubeba*, Lour., *Litsea glutinosa* (Lour.) were recorded. Every hill slope was observed with the presence of Soalu (Tumitla-Manipuri) and in some hill slopes complete domination by Soalu in the form of patches were also recorded. Som (Nongnangkori- Manipuri) is mostly found at the river banks. However, many natural grown Som about 40 ft height with girth size of 1.5m were also found at Khunman (1200 masl) near the Khoken village (Hill) of Imphal West district.

Leaves of Som trees grown in the state have smaller size with red colour petiole. It bears more seeds. Some trees which are more than 30 years old are observed growing at Khuga river bank in Churachandpur hill district. Scattered distributions of natural Som and Soalu trees in many localities of the valley districts were also observed. Som tree being aromatic, peoples use as firewood in the villages. During the survey it has been recorded that the number of farmer's using Soalu as their muga host plantations were more than Som users in the state. Most of the farmers have their muga farms either at the foothills or hill slopes and situated in between the altitude of 750 to 1200 masl. During the survey 4 cocoons and 2 early final instar wild muga were collected from Som and Soalu trees. Small rivulet and water bodies were found near the collection sites except Sanghaithel hill. The worms collected were preserved at Sangaithel situated at an altitude of 1100 masl.

Rearing: Summer muga silkworm rearing performances were observed better at Narankonjil than Pailapool. Hatching % (H%), Dfl cocoon ratio (C: Dfl) and effective rate of rearing (ERR) recorded were 55%, 1:1.58 and 1.95% at Pailapool (Table 1). Temperature range recorded during the rearing was 27 to 40^{0}C (Fig. 1) and relative humidity (RH) recorded ranged 51 to 93% (Fig. 3) with a total rainfall of 523.019 mm (Fig 9) in 15 days. Larval duration recorded was 20 days. In Narankonjil data recorded were 82.50 %, 1:72.17 and 62.50% (Table 1). Temperature and RH range recorded were 20 to 31^{0}C, 55- 100% (Fig 2; 4) with a total rainfall of 128.744 mm (Fig 9) in 11 days. Larval period of 5 days more was recorded in case of Narankonjil than Pailapool. In autumn crop rearing performance recorded were, 75%, 1:7.81 and 12.26%

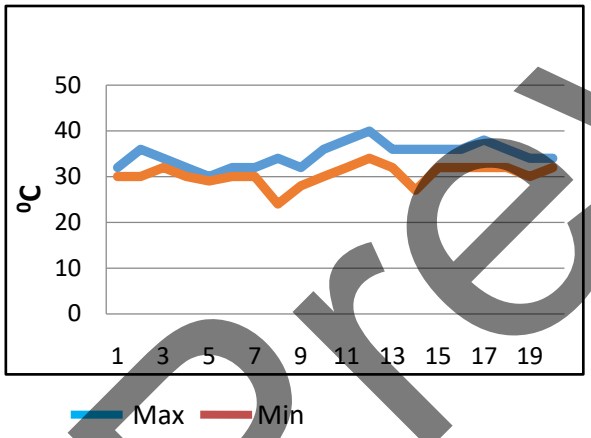

Fig. 1: Maximum and minimum temperature recorded during summer rearing at Pailapool

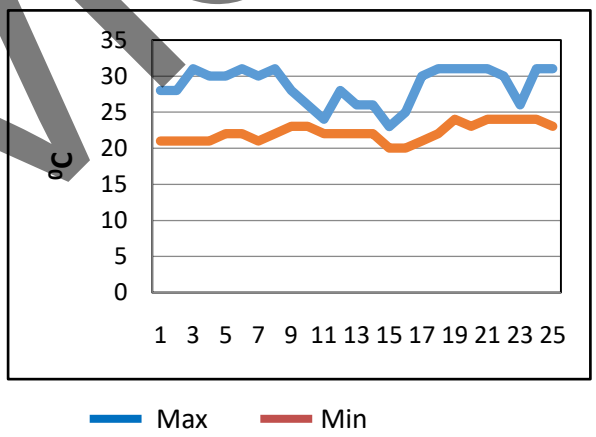

Fig. 2: Maximum and minimum temperature recorded during summer rearing at Narankonjil

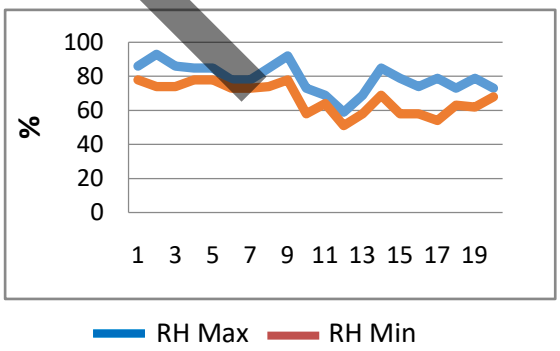

Fig. 3. Maximum and minimum relative humidity recorded during summer rearing at Pailapool

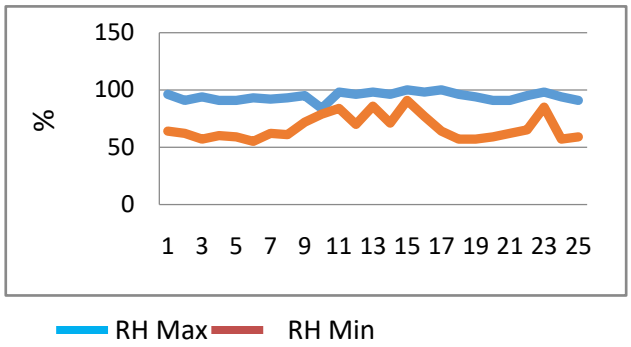

Fig. 4. Maximum and minimum relative humidity recorded during summer rearing at Narankonjil

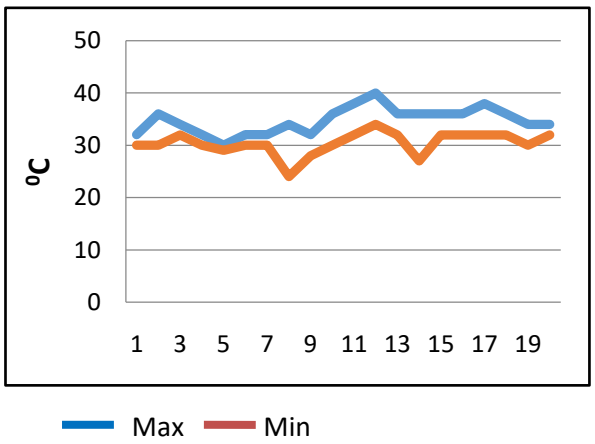

Fig. 5. Maximum and minimum temperature recorded during Autumn rearing at Pailapool

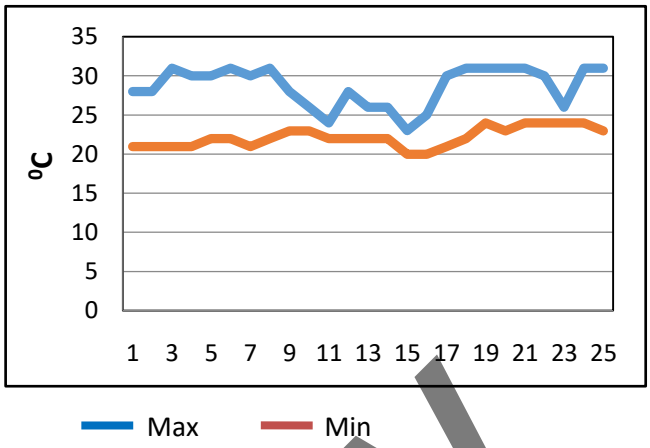

Fig. 6. Maximum and minimum temperature recorded during Autumn rearing at Sangaithel

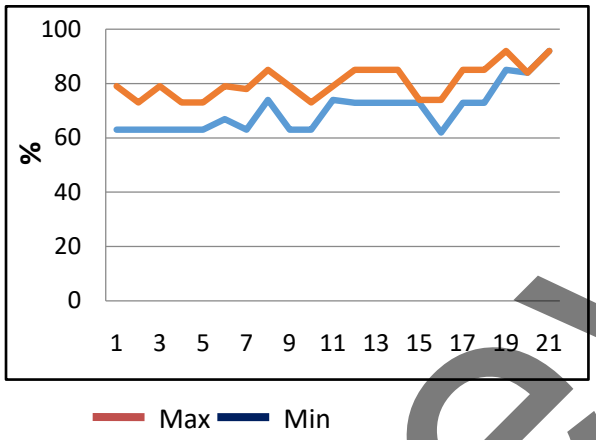

Fig. 7. Maximum and minimum relative humidity recorded during Autumn rearing at Pailapool

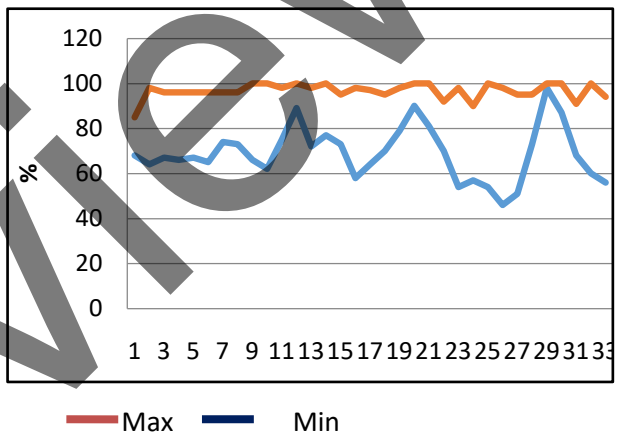

Fig. 8. Maximum and minimum relative humidity recorded during Autumn rearing at Sangaithel

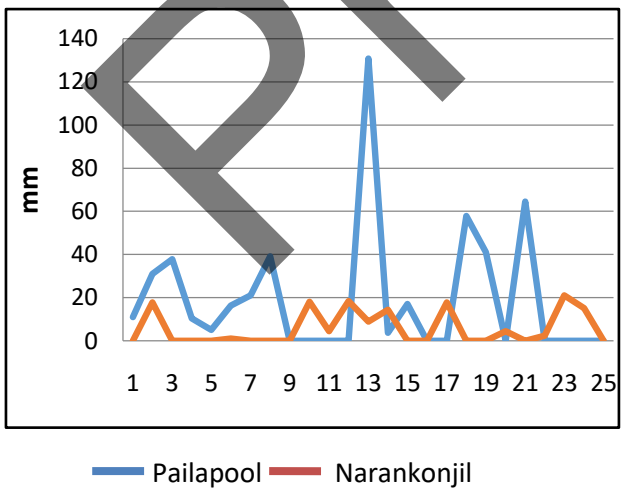

Fig. 9. Rainfall data recorded during Summer rearing at two different places

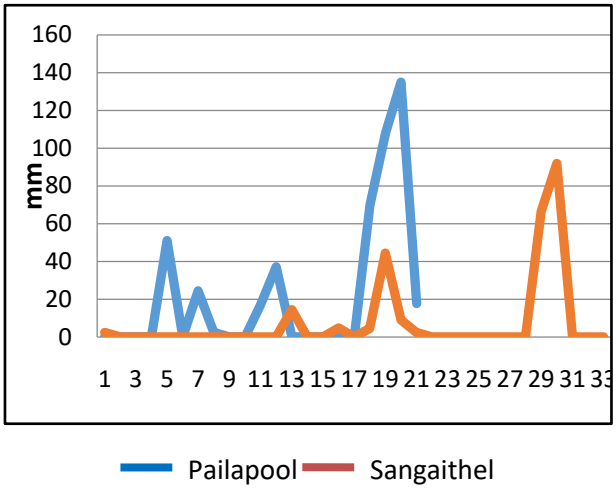

Fig. 10. Rainfall data recorded during Autumn rearing at two different places

Table 1. Silk worm rearing performances

Season	Place of rearing	H %	C. H.	Dfl: C	ERR %	Silkworm loss				
						Flacherie %	Insect pest %	Wind/ rain %	Others %	Total %
Summer	Pailapool	55	791	1:1.58	1.95	67.00	1.29	0.00	29.76	98.04
2017	Narankonjil	82	36086	1:72.17	62.50	0.00	0.94	0.50	36.07	37.51
Autumn	Pailapool	75	256	1:7.81	12.26	1.72	1.19	14.37	70.45	87.74
2017	Sangaithel	90	201	100.5	85.90	0.00	0.00	0.00	14.10	14.10

Dfls- Disease free layings; H- Hatching; C.H- Cocoon harvest; ERR-Effective rate of rearing

at Pailapool but at Sangaithel data recorded was 90%, 1:100.5 and 85.90% (Table 1). Larval duration recorded was 20 and 33 days respectively. Total rainfall recorded at the 2 places was 524.689 in 11 days and 240.167 mm in 9 days respectively (Fig 10). Emergence of moths was observed after 60 days facultative pupal diapauses from Sangaithel lots. In both seasons total worm loss % recorded were 98.04 and 87.74% at Pailapool but in Narankonjil and Sangaithel the total loss recorded was 37.51 and 14.10% (Table 1).

The observations on the occurrence of naturally grown *Persea bombycina*, *Litsea monopetala*, *L. salicifolia L. citrata L. glutinosa* were in the line of earlier reports (Bindroo et al., 2006). Historically Som is an important tree to the Meitei communities of Manipur. The natural distributions were considered to be caused by birds as the ripened seeds are often observed eating by birds. The undigested fruits of muga host plants were disseminated by birds (Nath et al., 2008) and after establishment of seedlings they become trees in wide areas including river banks. Reports on the dispersal of fruits of some other *Lauraceae* family by birds are also available (Mazer and Wheel Wright, 1993). Wild muga occurrence on these trees was due to presence of suitable ecological conditions. Sahu et al. (2006) had reported the occurrence of wild muga in the state.

Congenial environmental conditions and availability of varieties of silkworm host plants are the main driving force for providing shelter to many silk moths in an area and their occurrence were reported from the state (Arora and Gupta, 1979; Chaoba et al., 2007). Explanations of habitat information are an important aspect for further analysis of their adaptability to natural conditions. The information appropriately added the potential sites for muga rearing during different seasons when there is failure due to unfavourable climatic conditions in the traditional plane areas of Assam. The habitat of wild muga provides actual information for success of muga rearing. The collection site itself informs all its requirements for multiplication as well as their survival. Among the moist loving lepidopterans wild muga were also one of them as indicated by their habitat.

All important aspects of muga rearing performance studied were found better at Narankonjil and Sangaithel than Pailapool in two seasons. This may be attributed to prevalence of optimum climatic conditions such as Temperature. The temperature range recorded at these places during the rearing period was 20- 31^{0}C and 12- 31^{0}C whereas at Pailapool the data was 27- 40^{0}C and 17- 36^{0}C. Choudhury (1981), reported that the optimum meteorological conditions of muga silkworm rearing are 20-31^{0}C temperature and 65- 95% RH. Due to the exothermic nature of insects, metabolic rate is extremely dependent upon environmental temperature (Neven, 2000). Change of climatic factors, specially temperature and relative humidity affects almost every aspects of the life cycle of silkworm including their development and survival (Gohain and Borua, 1983). Even, the change of season can influence the consumption and utilization of food in muga worms (Das et al., 2000). Individual insect species' responses to climate change, however, will depend on their geographic range, trophic level and natural history (Stange and Ayres, 2010).

There is ample scope of intensive survey throughout the valley and hill districts of Manipur state for proper documentation of muga host plants and also for summer muga rearing. This information might enable wild muga conservationist for in-situ or ex-situ conservation.

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