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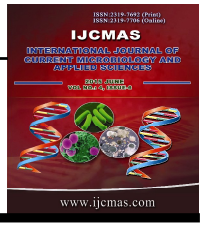

Original Research Article

High Altitude Seed Zones: A Ray of Hope for Muga Silk Industry

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A B S T R A C T

Keywords

Special seed zones, muga silkworm, Aherua, Bhodia, Nagaland, Mizoram

Pilot study conducted on large scale muga rearing in high altitude zones of Nagaland and Mizoram for two consecutive years during summer seed crops Aherua (June- July) and Bhodia (July –August) in 2012 and 2013 ensures that these cooler hilly areas are suitable for summer seed crops to meet the ever increasing demand for muga silkworm seed of commercial crops of Assam where the summer seed crops are a regular failure. The rearing performance of these cooler zones and that of Assam during summer season were analyzed based on the important economic characters viz. dfl cocoon ratio, fecundity, hatching (%,) larval weight (g) cocoon weight (g), shell Weight (g), and silk ratio (%). which showed better performance in Mizoram followed by Nagaland as compared to Assam.

Introduction

Muga Silkworm, *Antheraea assamensis* Helfer (Lepidoptera: Saturniidae) which produces the exclusively fascinating golden shimmering silk is geographically isolated to a single pocket of the world, i.e. North East India. This silkworm being wild and multivoltine in nature, with 5 to 6 broods in a year encounter intermittent climatic fluctuations and attack of season specific pests, predators and diseases causing a decline in productivity. Choudhury *et al.* (2010) reported that unprecedented climatic changes causing loss of silkworms due to diseases, pests, predators and natural vagaries has been raking havoc in the entire seed multiplication programmes of muga culture. The change in the abiotic factors also leads to poor cocoon yield, pupal mortality and emergence of high percentage of crippled moths, male sterility leading low hatching of dfls and reduced coupling aptitude. It was also reported by different authors that the abiotic and biotic factors of the environment during different seasons greatly influenced the growth and development of muga silkworm in the form of cocoon weight, pupal weight, shell percentage, potential fecundity (Chiang, 1985; Yadav and Goswami, 1989; Yadav, 2000; Rahmathulla, 2012). This phenomenon has been recurring for the last five years and these biotic and abiotic

vagaries affect dfl production for Kotia (Oct to Nov) and Jethua (Aril to May) commercial crops. Owing to the prevalence of such critical environmental conditions many of the traditional seed crops rearing zones of Assam have become redundant. In order to maintain a continuous supply of dfls and to meet the estimated and potential requirements of muga dfls which is between 125 to 150 lakh per annum, a seed linkage programme may be introduced by conducting muga rearings in cooler zones during adverse climatic conditions in the state of Assam. Hence, to combat crop failures and to introduce a seed linkage programme, with the initiative of Muga Silkworm Seed Organization, Central Silk Board, Guwahati, special seed zones for conducting muga rearing during summer in cooler pockets have been identified in nontraditional areas like Kolasib and Kanpui in Mizoram and Mokokchung in Nagaland where there prevails congenial climatic conditions of temperature ranging from 20C to 30 C in Summer. Explorations for identifying more summer seed zones areas for conducting summer seed crop rearing are being carried out in Arunachal Pradesh, Meghalaya and Manipur in North East and nontraditional areas viz. Panchmari, (Madhya Pradesh) and Chintapally (Andhrapradesh).

Materials and Methods

Field studies were conducted during Aherua and Bhodia crop for two consecutive years during 2012 and 2013 in three different locations viz. Narayanpur in Assam (latitude 27.14 N, Longitude 94.6 E and altitude of 101 m ASL) Mokokchung in Nagaland (Latitude 25.6 N latitude and 93.20 E longitude and altitude 1444.2 m ASL) and Kanpui in Mizoram (latitude 24.35 N and 93.2 E Longitude and altitude of 2065 m ASL). 500 gm muga dfls each in 5 replications were reared in these three locations to evaluate the rearing performance. pre-brushing care were taken to avoid pest and predators during rearing by removing dry leaves & twigs of the som plants and ant nests, cleaning of plots, and erection of nylon nets. Prophylactic measures were also taken to avoid disease incidence through dusting of lime & bleaching powder in the field before initiation of rearing. Incubation and black boxing techniques were followed in order to get uniform hatching. The rearing performance has been assessed by the following parameters viz. dfl: cocoon ratio, fecundity, hatching (%,) larval weight (g) cocoon weight (g), shell Weight (g), silk ratio (%). The abiotic factors were correlated with different economic parameters and the effect of the change in the climate on muga rearing was established.

Result and Discussion

The data on the rearing performance of Aherua and Bhodia crops in three locations viz. Narayanpur in Assam, Kanpui in Mizoram and Mokokchung in Nagaland are presented in table 1 and 2. The min. & max. Temperature and min. & max. relative humidity recorded in both the seasons in the three locations are also presented in figures 1,2,3 and 4. The data presented in table 1 and 2 shows that cocoon yield was highest in in Nagland during bodia with 51.41 & 45.10 cocoon/ dfl. Mizoram also recorded the same performance with 45.21 & 42.21cocoon per dfl followed by Aherua(38.2 & 30.2cocoon / dfl) in Aherua. A very poor yield was recorded in Narayanpur, Assam with cocoon yield of 2.10 & 3.77 in Aherua and 10.04 & 5.14 in Bhodia. The cocoon yield during the two seasons in the three different locations was correlated with the abiotic factors (Tables 3 & 4). Of these, max. Temperature and max. relative humidity had negative significant effect on the cocoon yield.

The fecundity is also highest during Bodia season in Nagaland with 190 & 180 eggs /moth followed by Mizoram with 160 & 165.The same trend was noticed in Aherua season with 170 & 172, 155 & 150 eggs per moth in Nagaland and Mizoram respectively. How ever low fecundity has been recorded in Narayanpur Assam with 125-130 and 120-125 during Aherua and bodia seasons respectively. The abiotic factors recorded in Narayanpur Assam during this season were max. temperature ranged from 36 to 38 0 C whereas it was within the optimum limit ranging from 26 to 30 in Mizoram and Nagaland. Correlation coefficient between fecundity and abiotic factors indicated negative correlation with the max temperature, max. relative humidity and min. temperature and positive correlation with min. relative humidity (significant with max temperature and max. relative Humidity). Due to high temperature in rearing season fecundity has decreased in Narayanpur which affected muga rearing economically. The fourth and fifth stage female worms when exposed to high temperature during the rearing period affects the rate of ovulation and the fecundity gets affected.

Hatching was remarkably poor in the seed prepared in Narayanpur recording only 10 to 40 % in Aherua crop when the max temp. ranged from 36 to 38°C. The hatching percentage of the dfls produced from Nagaland and Mizoram ranges from 75 to 82 in both the crops. Correlation studies (Tables 3 & 4) revealed that max. temperature, min. temperature and max. relative humidity showed negative association with abiotic factors and positive association with min relative humidity (significant with max. temperature and humidity. Rise in temperature and humidity affects the mating behaviour in moths, which may cause a lesser transfer of sperms resulting in increase of unfertilized eggs. It also leads to embryonic mortality, resulting in damage of the embryo, thus affecting the hatching. The larvae took significantly longer time to complete its life cycle in Mizoram and Nagaland (23 to 26 days) whereas the development completed faster in warmer conditions of Narayanpur with only 19 days in Aherua crop and 21 days in Bhodia crop which indicates that max. temperature had significant negative effect on larval development. The fifth instar larval weight in the farm rearing of Narayanpur ranged from 6.5 to 6.6 gm whereas it was heavier in the rearings of Mizoram (7.05 to 7.74 gm) and Nagaland (7.59 to 8.80 gm) where prevails a congenial climatic condition of 26 to 30 0 C temperature for conducting muga rearings. Correlation studies carried out with larval weight and abiotic factors showed a high negative significance with max. temperature and max. relative humidity. The cocoon weight was observed highest in Mizoram (4.81 gm) and Nagaland (5.91 gm). The least was recorded in Narayanpur (4.14 gm).

The highest shell weight of 0.49 gm was recorded in Mizoram followed by 0.48 gm in Nagaland during Bhodia crop in 2013. However, the lowest shell weight was recorded in Narayanpur rearing with only 0.32 gm. In accordance with the cocoon weight and shell weight the highest silk ratio was observed in Mizoram and Nagaland with 9.75 % and 9.95 % respectively. The grainages performance shows that farm rearing of Narayanpur gave very poor seed cocoon dfl ratio with only 1 dfl from 5 to 8 cocoons whereas the grainage performance is far better in Nagaland and Mizoram which yielded 1 dfl from 3 cocoons which is at par with norms for dfl recovery. There was heavy crippled moth emergence during Narayanpur farm grainages, low mating tendency of the moths, low fecundity and poor hatching in both the years.

Table.1 Comparative Performance of Muga silkworm rearings during Aherua & Bhodia Crop in 2012

Sl. No.	Parameters	Assam		Mizoram		Nagaland	
		Aherua	**Bhodia**	**Aherua**	**Bhodia**	**Aherua**	**Bhodia**
1	Larval Duration (days)	19	21	23	24	22	24
2	Dfl: Cocoon	1:2.10	1:10.04	1:38.2	1:45.21	1:28.19	1:51.41
3	Larval Wt. (Male)	6.50	6.65	7.39	7.26	7.60	7.79
4	Cocoon Wt. (M)	4.30	4.60	4.81	4.84	4.80	5.19
5	Shell Wt. (M)	0.36	0.38	0.42	0.44	0.43	0. 47
6	Silk Ratio	8.30	8.26	8.73	9.09	8.90	9.05
7	Seed Cocoon : Dfl	8.70:1	6.23:1	4.12:1	3.40:1	3.95:1	3.14:1
8	Fecundity	120	130	155	160	170	190
9	Hatching %	40	60	75	78	78	82

Table.2 Comparative Performance of Muga silkworm rearings during Aherua & Bhodia Crop in 2013

Sl. No.	Parameters	Assam		Mizoram		Nagaland	
		Aherua	**Bhodia**	**Aherua**	**Bhodia**	**Aherua**	**Bhodia**
1	Larval Duration (days)	19	21	23	24	23	26
2	Dfl: Cocoon	1:3.77	1:5.94	1:30.2	1:42.21	1:30.25	1:45.10
3	Larval Wt. (Male)	6.22	6.19	7.74	7.05	8.80	7.59
4	Cocoon Wt. (M)	4.14	4.64	4.78	4.66	4.60	4.82
5	Shell Wt. (M)	0.32	0.38	0.49	0.48	0.42	0. 48
6	Silk Ratio	7.72	8.18	9.75	9.70	9.10	9.95
7	Seed Cocoon : Dfl	7.79:1	5.52:1	3.05:1	3.90:1	3.50:1	3.80:1
8	Fecundity	110	135	150	165	172	180
9	Hatching %	10	65	76	80	77	80

Table.3 Correlation coefficient between biotic factors and abiotic factors during 2012

Parameters	Min. Temp	Max Temp	Min R.H	Max R.H
Larval Duration	– 0.147	– 0.833	0.201	– 0.480
Larval Wt.	– 0.284	– 0.906	0.580	– 0.796
Fecundity	– 0.206	– 0.914	0.492	– 0.776
Hatching %	– 0.085	– 0.849	0.349	– 0.580
Cocoon yield	– 0.409	– 0.840	0.141	– 0.436
Cocoon weight	– 0.310			
Shell Weight				

Table.4 Correlation coefficient between biotic factors and abiotic factors during 2013

Parameters	Min. Temp	Max Temp	Min R.H	Max R.H
Larval Duration	– 0.306	– 0.798	0. 804	– 0.638
Larval Wt.	– 0.803	– 0.933	0. 697	– 0.818
Fecundity	– 0.471	– 0.877	0.780	– 0.804
Hatching %	– 0.471	– 0.688	0. 472	– 0.573
Cocoon yield	– 0.302	– 0.850	0.900	– 0.533

Figure.1 Min and max temperature during Aherua & Bhodia Crop in 2012

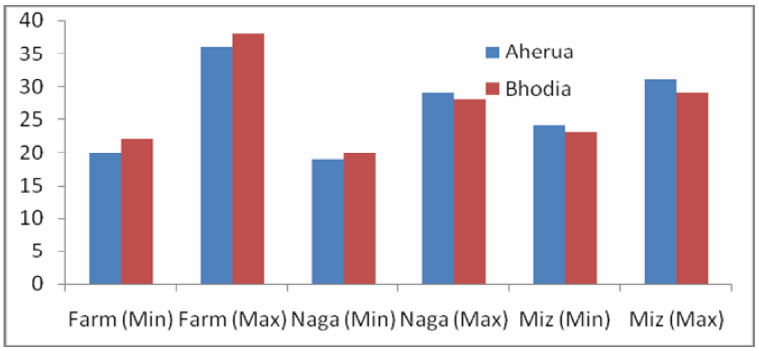


Figure.2 Min and max Humidity during Aherua & Bhodia Crop in 2012

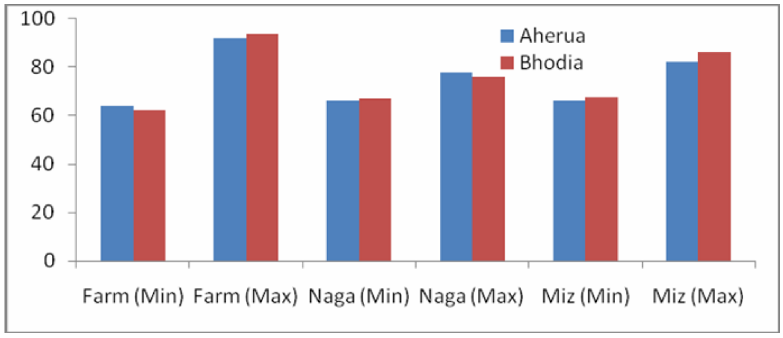


Figure.3 Min and max temperature during Aherua & Bhodia Crop in 2013

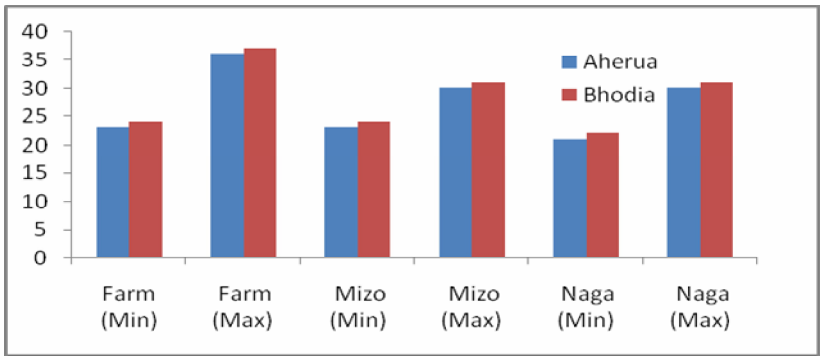
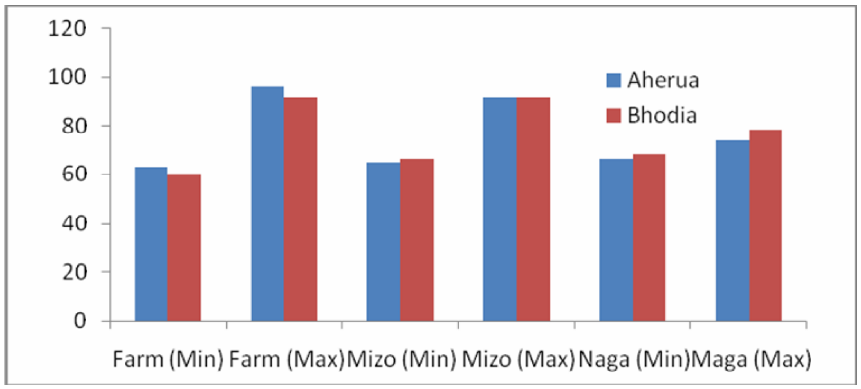


Figure.4 Min and max humidity during Aherua & Bhodia Crop in 2013



Large scale muga silkworm rearings in cooler zones viz. Nagaland and Mizoram has been taken up for the first time by Muga Silkworm Seed Organisation, Central silk Board, Guwahati to combat muga crop failures during summer seed crop rearings in Assam and bridge the gap of seed shortage during commercial crop rearings in Assam**.** The results of these study showed that the rearing performances during the seed crops in the cooler pockets of Mizoram and Nagaland revealed significantly better results than the rearings of Narayanpur, Assam where there prevails adverse climatic conditions during seed crops rearings. Similarly, Kakati (2012) & Pachau *et al.* (2012) reported that Nagaland and Mizoram ensure favourable climatic conditions for muga seed crop rearings and can be prospective seed zone for meeting the dfls demand during succeeding commercial crops in Assam. The cocoon yields and all the other economic parameters of cooler zones rearings were remarkably higher than the farm rearings of Narayanpur, Assam. The findings corroborate the report of Sekharappa and Gururaj (1989) who reported that temperature and humidity directly affect the biological activities of the silkworm. Dependence of muga cocoon yields on environment was also reported by Chaudhuri (2003). Since, muga silkworm being indispensible to outdoor rearing, the fluctuations in abiotic factors during different seasons greatly influence the development and survivability (Zamal *et al.*, 2010). Das and Roy (2013) in their study on temperature trends in Assam also observed that majority of the trends, both annual and seasonal, showed increasing tendency in temperature during the period 1981-2010. Hence, as an alternative, systematic planning for conduction of summer seed crop rearings in cooler areas to meet the dfls demand for commercial crop in Assam should be worked out.

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