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Rearing Performance of Muga Silkworm as Influenced by Abiotic Factors during Commercial Crops at Garo Hills Region

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ABSTRACT: Muga silkworm (*Antheraea assamensis* Helfer) is multivoltine, *i.e.* 5-6 times rearing of the silkworm can be done in a year. Muga silkworms are reared during the autumn and spring seasons which are termed as 'Kotia' and 'Jethua' crops, respectively. The cocoons produced during these two seasons are used for producing yarn commercially and hence, these two crops are called commercial crops. 'Kotia' commercial crop rearing is preceded by one crop rearing during June-July which is called 'Aherua' pre-seed crop and subsequent rearing during August-September is called 'Bhodia' seed crop. Similarly, 'Jethua' commercial crop rearing is preceded by 'Jarua' (December-January) pre-seed crop rearing followed by 'Chatua' seed crop rearing. The pre-seed and seed crops of Muga usually fall in adverse climatic seasons of extreme summer and winter and the productivity sometimes slashes down to 10- 20%. The present study was conducted on the effect of abiotic factors on commercial season among Jethua and Kotia in muga silkworm with respect to its rearing performance in Garo Hills. From the study (based on three-year data) it is revealed that the Kotia season recorded a significantly high Effective Rate of Rearing (pooled t-value is 20.79) as compared with the Jethua commercial crop while hatching percentage, larval period, male weight and female weight was statistically at par with both the commercial crop season. Heavy rainfall during brushing, hailstorms during the early stage, temperature fluctuations and high rainfall are the climatic factors which badly affect muga silkworm in the Jethua crop. Based on meteorological parameters it is advisable that the preponement of Jethua crop rearing may give them a good harvest as compared to the existing crop schedule. Based on the rearing performance it is also suggested that farmers of Garo Hills may increase the quantity of muga silkworm rearing in Kotia crops so they can earn more profit from practising muga culture.

Keywords: Muga, Jethua, Kotia and Rearing performance.

INTRODUCTION

Antheraea assamensis Helfer is endemic polyphagous insect and feeds on a wide range of different food plant species mainly Som (*Persea bombycina* (King ex Hook. f.) Kosterm, formerly named as *Machilus bombycina* (King ex Hook. f.)], Soalu (*Litsea monopetela* Roxb.= polyantha Juss.) and few other food plants (Kumar *et al*., 2022). Som is one of the major consumed species throughout North Eastern India for muga silkworm rearing that produces natural muga, or golden silk nowhere in the world (Chowdhury, 1982). The muga silkworm is multivoltine successive broods in a year in which the worms were bred and spun cocoons are designated in the Assamese calendar as 'Jethua', 'Aherua', 'Bhodia', 'Kotia', 'Jarua' and 'Chotua' (Sahu *et al*., 2000). The commercial crops during autumn and spring namely 'Kotia' and 'Jethua' producing quality silk and the other seed crops were Jarua, Chotua, Aherua and Bhodia (Singh *et al*., 2022). The silkworm is cold blooded (Poikilothermic) insect and by nature quite delicate and very sensitive to the environmental condition. Therefore, silkworm rearing has a certain amount of risk invariably experienced by the environmental factors, *i.e.* temperature, humidity, photoperiod and air current from incubation to cocooning (Tazima, 1978). Hence, it is essential to ascertain the seasonal effect of environmental condition in different crop which is the best for rearing of muga silkworm to get higher production and quality of silk an ultimate goal to increase the production and productivity of the cocoon per unit area and time with low cost of production for improving economic condition of the poor sericulture farmers. In this context the present study has been undertaken with the objective of to identify the best commercial crop season for muga silkworm rearing in the Garo Hills region.

MATERIALS AND METHODS

The study of commercial seasonal effects on the rearing parameters were carried out in Central Silk Board, MESSO, P-3 Unit, Rompara, North Garo Hills District, Meghalaya with Longitude 90.34°E, Latitude 25.50°N and 300 above mean sea level from April, 2018 to March, 2021. The general method of outdoor rearing of muga silkworm was followed as recommended by Central Silk Board, Muga Eri Silkworm Seed Organization, Guwahati, Assam. The rearing was conducted in two commercial crops/ seasons *i.e.* Jethua and Kotia with 100g of DFLs in 10 nos. of replications. Observations were made on different aspects of silkworm growth and rearing performance *i.e.* Hatching percentage, Larval period, Male weight, Female weight and Effective rate of rearing (ERR) as per MESSO norms.

Effective Rate of Rearing (ERR): The yield per 10,000 silkworm larvae brushed by both numbers and weight. This parameter, expressed in percentage, denotes the viability of the larvae and is calculated as shown below

$$ERR = \frac{\text{No. of cocoons harvested}}{\text{No. of larvae brushed}} \times 100$$

Statistical analysis: Student's 'T' (Student, 1908) test was calculated by using the following formula:

$$t = \frac{(X_1 - X_2)}{\sqrt{\frac{(S_1)^2}{n_1} + \frac{(S_2)^2}{n_2}}}$$

Where, X_1 = mean of the first set of observations
X_2 = mean of the second set of observations
S_1 = standard deviation of the first set of observations
S_2 = standard deviation of the second set of observations
n_1 = number of observations of the first set
n_2 = number of observations of the second set

Agro-climatic and edaphic conditions: The experimental site falls under sub-tropical to sub-humid agro-climatic region with adequate rainfall. The average annual rainfall of the region is about 2400 mm. The weather conditions prevailed from 2018-19 to 2020-21 were recorded at Meteorological Observatory and displayed in Fig 1. The rainfall received during the Jethua was 327.7 mm and in Kotia 42.8 mm in the first year of experimentation (2018-19). During the second year (2019-20), 320.0 mm in Jethua and 73.4 mm rainfall was received in Kotia crop. In the final year of experimentation (2020-21), Jethua recorded 700 mm and Kotia recorded 23.8mm of rainfall. The maximum and minimum temperatures in the Jethua crop were 19-28°C in 2018-19, 19-32°C in 2019-20 and 13-30°C in 2020-21, while Kotia crop recorded 15-34°C in 2018-19, 18-34°C in 2019-20 and 08-36°C in 2020-21. The maximum and minimum RH in the Jethua crop were 60-95% in 2018-19, 55-96% in 2019-20 and 56-96% in 2020-21, while Kotia crop recorded 55-96% in 2018-19, 46-91% in 2019-20 and 50-94% in 2020-21, respectively.

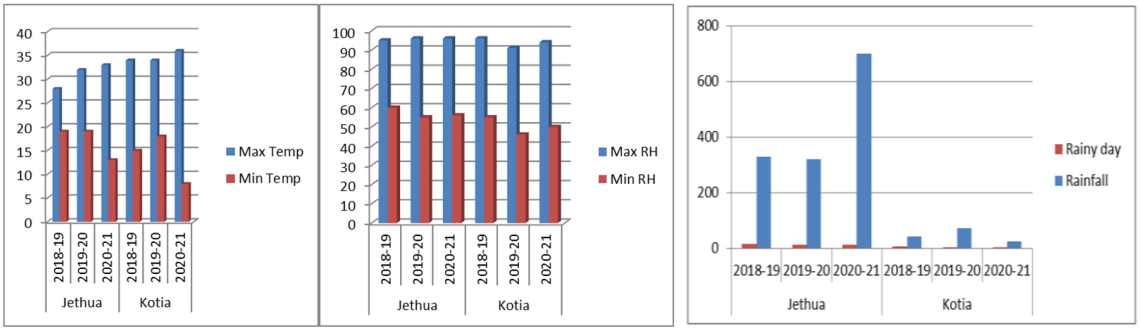

Fig. 1. Meteorological observations.

The composite samples from 0-30 cm depth were randomly collected from the trial field with the help of auger prior to experimentation. The soil of the experimental field was analyzed as acidic in nature (pH 5.5), available P was very low and organic carbon and available K was medium to high.

RESULTS AND DISCUSSION

The study reveals that there are considerable variations in rearing performance when the muga silkworm reared in both the commercial seasons/ crops. The growth and development of muga silkworm in both the crops are not equal. The growth and development of muga silkworm reared in all the both commercial seasons on Som are recorded as below.

A perusal of the data of table 1 that the maximum hatching percentage has been obtained from the cocoons reared in Jethua crop. The Jethua and Kotia were at par with each other in all the year of experimentation. Subharani and Jaiprakash (2015), 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 larval period is directly correlated with the surrounding environmental conditions specially temperature and relative humidity prevailing during the rearing. The larval duration was recorded 22.74±2.16,

24±2.11 and 27±2.54 days in Kotia crop which was statistically at par with 22±0.82, 22±1.63 and 24±2 days in Jethua crop of 2018-19, 2019-20 and 2021-22, respectively (Table 1). Similar study made by Kakati (2012) and found that the larvae complete within 20-25 days in summer and 45-55 days in winter.

Table 1: Hatching %, Larval Weight and Male Weight of muga silkworm (*Antheraea assamensis)* during commercial crop seasons.

Year	Hatching			Larval period			Male weight		
	Jethua	Kotia	t-value	Jethua	Kotia	t-value	Jethua	Kotia	t-value
2018-19	82±2.83	82±3.71	0.77	22±0.82	22±2.16	0.01	6.88±0.11	7.04±0.15	3.80
2019-20	80±3.16	79±2.26	0.77	22±1.63	24±2.11	2.00	7.7±0.41	8.1±0.43	1.81
2020-21	80±2.94	77±3.06	2.60	24±2	27±2.54	3.11	7.09±0.69	8.2±0.26	4.98
Pooled	80.67±1.78	79.33±1.72	1.72	22.67±0.9	24.33±1.47	2.96	7.22±0.3	7.78±0.16	4.61

Table 1 & 2 showed the full grown larval male and female weight of muga silkworm. The fully mature larva attains male 7.04±0.15, 8.1±0.43 and 8.2±0.26 gm, female 11.76±0.54, 11±0.8 and 11.6±1.0 gm in Kotia crop of 2018-19, 2019-20 and 2021-22, respectively, which was significantly at par with Jethua crop. Generally the female larvae are larger and heavier than the male larvae. Similar study made by Borpuzari *et al*. (2022) and found that the larval weight recorded significantly higher in Kotia as compare with Jethua, Bhodia and Chotua crop.

The highest ERR by percentage was 49.67±1.24, 55.58±2.35 and 46.33±2.68 % during Kotia crop followed by 31.79±1.38, 37.6±1.69 and 19.19±1.47 % in Jethua crop during 2018-19, 2019-20 and 2021-22, respectively, Kotia crop recorded statistically superior ERR as compare with Jethua crop. Similar results were reported by Siddiqui *et al*. (2000) and found that high rainfall during Jethua crop brushing time forced to conduct brushing in indoor condition. So, shifting of worms from indoor to outdoor there was some loss of worms observed. Apart from this temperature fluctuation was recorded in Jethua crop late age rearing enhanced the infestation of bacterial and viral diseases to the muga worms.

Table 2: Female Weight and ERR of muga silkworm (*Antheraea assamensis)* during commercial crop seasons.

Year	Female weight			ERR		
	Jethua	Kotia	t-value	Jethua	Kotia	t-value
2018-19	11.6±0.54	11.76±0.54	4.58	31.79±1.38	49.67±1.24	19.43
2019-20	9.01±0.78	11±0.80	6.21	37.6±1.69	55.58±2.35	15.54
2020-21	11.6±0.85	11.6±1.01	0.01	19.19±1.47	46.33±2.68	13.16
Pooled	11.12±0.4	11.4±0.44	1.57	29.53±0.88	50.53±1.13	20.79

Dependence of muga cocoon yields on environment was also reported by Chaudhuri (2003). Since, muga silk worm 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 rearing's in cooler areas to meet the dfls demand for commercial crop in Assam should be worked out.

CONCLUSIONS

India is a sub-tropical country and environmental conditions are the limiting factors of muga silkworm rearing. Majority of muga rearers encounters the various environmental problems and lose their crops or produce inferior quality of cocoon and silk. Based on the experiments, Jethua crop recorded lower effective rate of rearing and statically at par larval weight, larval duration and hatching percentage with Kotia crop, due to heavy rain and hailstorms at their early stage worms. High incidence of bacterial and viral diseases was also observed in Jethua crops late age rearing due to high temperature fluctuations. By all the above modification and suggestion, muga silkworm rearing may be conduct and quality of cocoons and silk can be improved where environmental variation is less.

FUTURE SCOPE

Muga silkworm being indispensible to outdoor rearing, the fluctuations in abiotic factors during different seasons greatly influence the development and survivability. Temperature trends in Assam also observed that majority of the trends, both annual and seasonal, showed increasing tendency in temperature with erratic rainfall from a long period of time. Hence, as an alternative, systematic planning for selection of suitable crop season to meet the dfls demand for commercial crop in Assam should be worked out.

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Conflict of Interest. None.

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