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INFLUENCE OF ABIOTIC FACTORS ON SEED (EGG) PRODUCTION OF MUGA SILKWORM (*ANTHERAEA ASSAMA*) WESTWOOD IN THE TERAI REGION OF WEST BENGAL, A NEWLY EXPLORED AREA

Indrajit Biswas*

Assistant Professor & HOD, Department of Zoology, Hiralal Mazumdar Memorial College for Women, Dakshineswar, Kolkata- 700035, West Bengal.

***Corresponding Author: Indrajit Biswas**

Assistant Professor & HOD, Department of Zoology, Hiralal Mazumdar Memorial College for Women, Dakshineswar, Kolkata- 700035, West Bengal.

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ABSTRACT

The experiment was conducted in the Terai region of West Bengal to identify conditions favourable for higher productivity of better-quality seed (egg) for commercial crop rearing in the Terai region of West Bengal, a newly explored area of mugaculture. Results revealed that abiotic factors like temperature, humidity, and photoperiod directly affected the pupal period, emergence period, mating period, and oviposition period of muga silkmoth (*Antheraea assama* Westwood). A shorter pupal period was observed when the temperature was high. High relative humidity along with high temperatures during July-August prolonged the emergence period. Photoperiod had a greater influence on mating and oviposition periods, longer dark periods increased both mating and oviposition periods. October-November was the best period for egg production (293.67 No. of eggs) when temperature and humidity ranged from 27.90°C-26.90°C (max) and 18.90°C-14.80°C (min)and 78.10% - 76.40%. The pupal period, emergence period, mating period, and oviposition period were 17.83 days, 1.22 min., 17.83 hrs., and 6.67 days respectively. July and August were found most adverse months for egg production (188.67 No. of eggs) due to high temperature, high humidity, and longer photoperiod coupled with heavy rainfall.

KEYWORDS: temperature; humidity; photoperiod; muga silkworm; fecundity.

INTRODUCTION

Requirements for successful commercial silkworm rearing include high-quality seed. The impact of seasonal variations on silkworm grainage performance is higher. The number of eggs deposited by a female is dependent on both intrinsic and external conditions, including the emergence, mating, incubation, and oviposition periods of adult moths, as well as temperature, humidity, and photoperiod. (Thangavelu et al., 1988). High temperature and humidity adversely affect larva and fecundity (Chaudhuri *et al*. 1999, Bardoloi and Hazarika, 1994). Longer photoperiod affects intrinsic factors influencing fecundity as well as hatchability of silkworms (Benchamin *et al*., 1990, Meenal et al., 1994). Though a good number of research works have been carried out in this aspect on mulberry silkworm (Ray and Senapati, 2001, Venugopala Pillai *et al*., 1987 & 1985, Zhang *et al*., 1991), such work is scanty in muga silkworm. The Muga silkworm, *Antheraea assama* (Lepidoptera: Saturniidae) is wild and endemic in Assam. A little work has been done in the Assam context, on environmental influence regarding grainage performances. A profound effect of temperature has been observed in the incubation period, hatching percentage, copulation, oviposition, and fecundity (Sahu *et al*., 1998). Also, low ambient temperature and low relative humidity affect the seed in the crop (Sahu *et al*., 1998). Studies on the effect of photoperiod on egg laying show that females lay more eggs under short-day than under long-day conditions (Mahanta und C Goswami, 1986), confirming environmental influence on grainage performances of muga silkworms. However, the Terai region of West Bengal has been selected as an extension area of restricted mugaculture Assam for its climatic contiguity and no such work has been undertaken. Moreover, a systematic study of environmental factors at different periods of the year influencing the fecundity of muga silkworm is a prerequisite. So, in the present study, an attempt has been made to investigate the environmental influence on fecundity as well as hatchability of muga silkworm during different periods of a year for sustainable development of the said culture in the area under exploration.

MATERIALS AND METHODS

The experiment was conducted during seven periods of a year (traditionally in the Assam region, the study is conducted six periods a year) namely, July-August,

September-October, October-November, November-December, and December-January. February-March and April-May. Cocoons, collected from Basic Seed Farm, Cooch Behar as well as farmers' houses of Cooch Behar district, were allowed to emerge in normal conditions prevailing during respective periods; pupal period, emergence period, mating period, and oviposition period as well as egg laying and hatching of eggs were recorded for each grainage. in the Assam region, Three replications of 10 pairs of cocoons for each replication were maintained and the data were statistically analyzed.

RESULTS

Extrinsic Factors

High temperature was recorded from June to August followed by May and September, high relative humidity was also observed from June to September and a longer light period was observed from May to August. During October-November and March-April moderate temperature was recorded, however, during March-April lowest humidity was recorded during the year, a shorter light period was observed during October and November while in March and April, light and dark periods were found almost equal. Very low temperature was recorded during December-February, the lowest being during January and the duration of sunlight was observed shortest during December-January in the calendar year. Low humidity was also observed during these months. (Table 1)

In the Terai region of West Bengal (25°57' and 27°.0' N latitude and 88°25' E and 89°54' E longitude) May to June is summer, July to September is the rainy season, October to November is autumn, December to February is winter and March-April is the spring season. The average annual rainfall of this zone varies from 2100 to 3300 mm. The maximum rainfall (about 80%) is recorded from July to September (District Meteorological Dept., Cooch Behar, West Bengal). The present observation conforms with the above meteorological data.

Effect of extrinsic factors influencing intrinsic factors

Pupal Period: Pupal period was found significantly the highest during December- January (35.67 days). In all other months, the pupal period varied from 21.17 days (Nov. – Dec.) to 16.89 days (July-Aug.). The lowest pupal period was observed during July - August. The order of descending pupal period was found Dec. - Jan. >Nov. - Dec. > Feb. - March > Apr. -May > Sept. - Oct. > Oct.- Nov. > July - Aug. (Table -2, fig 1.1)

Emergence Period: Seasonal variation was significant ranging between 1.22 min – 4.67 min., highest being during July - Aug and lowest during October - November. The emergence period when arranged in descending order was July - Aug. > Sep. -Oct. > Apr. - May > Oct. - Nov., Nov. Dec., Dec.- Jan. and Feb- Mar. (Table 2, Fig 1.2)

Mating Period: Significant seasonal variation was observed. The natural mating period was observed between 12.00 hrs. to 18.92 hours, the highest and lowest being during Dec. -Aug. respectively. The mating period in descending order was Dec.-Jan. > Nov. – Dec.> Oct.-Nov. > Feb. - Mar., April. - May > Sept. - Oct. > July Aug. (Table- 2, fig 1.3)

Oviposition Period: The oviposition period ranged from 5.00 to 6.67 days having significant variations. The highest oviposition period (6.67 days) was observed during Oct-Nov and Nov Dec., followed by grainage of December to May (6 days) and July to October (5 days). (Table 2, 1.4)

Effect of extrinsic factors influencing grainage parameters

Fecundity: Highest real fecundity was found during Oct-Nov. (290.00 no. of eggs) followed by Sept.-Oct. (249.00 no.), Nov-Dec (245.00 no.) and Apr.-May (232.00 no.). The lowest real fecundity was found during Feb-March (175.33 no.) followed by July-Aug (188.67 no.). However, potential fecundity during July-August (235.33 no.) was not so poor but realized fecundity was 188.67 no. of eggs reflecting retention of nearly 50 eggs in female moths. (Table 3, Fig. 2.1)

Incubation Period: The incubation period was higher during December -January (11.83 days) followed by November-December (11.00 days). During October-November and February-March, the period was 8.33 days, the lowest being from July to October (7.00 days) (Table -2).

Hatchability: Highest hatchability was recorded during October November (278.33) followed by November - December (242.33 no.). During July -August hatchability was very poor (12.33 no.) which was only 7.21% of eggs laid. (Table 3, Fig. 2.2).

DISCUSSION

Climate fluctuations throughout the year have a significant impact on grainage performances, which are influenced by internal factors as well. The experiment's data showed that the pupal, emergence, mating, and oviposition periods are directly influenced by temperature, humidity, and photoperiod. A shorter pupal time has been noted in response to the temperature change. According to Chaudhuri *et al.* (1999), the emergence time was prolonged by high temperatures and relative humidity in July and August. Longer dark periods increased both the mating and oviposition periods, indicating that photoperiodism in insects functions as a biological clock signalling seasonal changes and influencing their life cycle, distribution, and abundance (Meena *et al.* 1994). Photoperiod had a greater influence on the mating and oviposition periods.

In the terai region of West Bengal, October -November has been found the best period for egg production, when average temperature, humidity, and photoperiod ranged from 27.90°C -26.90°C (max.) and 18.90°C -14.80°C (min.), 78. 10% -76.40% and 10.92 L: 12.67 D respectively. The pupal period, emergence period, mating period, and oviposition period were 17.83 days, 1.22min., 17.83hrs.and 6.67 days, respectively. July-August has been observed as the most adverse month for quality egg production which may be due to high temperature, humidity, and longer light periods coupled with heavy rainfall followed by February - March, probably due to eggs coming from the cocoon reared during January when the temperature was very low.

Reports from Sahu et al. (1998) indicated that October–November was the best time of the six study periods in the Assam context. They also found that 19–26°C and RH of 70% or higher were optimal for hatching, while 23–26°C and 70–77% RH seemed to be the ideal range for copulation and oviposition. Mahanta and Goswami (1986) reported that at LD 6: 18, the hatching percentage was 96.5%, and females deposited more eggs during shorter days than during longer days. The current experiment's results in the Terai region of West Bengal are consistent with the findings mentioned above for Assam, and this will undoubtedly aid in creating an effective rearing plan for Terai region mugaculture.

Table 1: Meteorological Data.

Month & Year	Temperature		Relative Humidity (%)		Photoperiod		
	Max. (Avg.)	Min. (Avg.)	Max. (Avg.)	Min. (Avg.)	Light	:	Dark
July	34.40	27.10	83.50	75.70	13 hrs 17 min	:	10 hrs 43 min
August	32.90	25.10	82.80	77.20	12 hrs 51 min	:	11 hrs 09 min
September	31.70	23.50	84.90	80.20	12 hrs 13 min	:	11 hrs 47 min
October	27.90	18.90	78.10	76.70	11 hrs 32 min	:	12 hrs 28 min
November	26.90	14.80	77.30	76.40	10 hrs 53 min	:	13 hrs 07 min
December	22.50	10.10	75.60	70.40	10 hrs 37 min	:	13 hrs 23 min
January	20.60	9.20	74.70	67.40	10 hrs 45 min	:	13 hrs 15 min
February	24.10	11.90	79.70	62.10	11 hrs 13 min	:	12 hrs 47 min
March	26.60	15.80	67.60	54.30	11 hrs 52 min	:	12 hrs 08 min
April	28.70	19.00	76.60	69.00	12 hrs 32 min	:	11 hrs 28 min
May	32.00	23.00	75.80	70.30	12 hrs 57 min	:	11 hrs 03 min
June	34.00	25.90	89.50	74.90	13 hrs 26 min	:	10 hrs 34 min

Table 2: Data on intrinsic factors related to grainage during different seasons.

Month	Pupal Period (days)	Emergence Period (min.)	Mating Period (hours)	Oviposition period (days)	Incubation period (days)
July- Aug.	16.89	4.67	12.00	5.00	7.00
Sep.-Oct.	18.17	3.00	16.67	5.00	7.00
Oct.- Nov.	17.83	1.22	17.83	6.67	8.33
Nov.-Dec.	21.17	1.33	18.50	6.67	11.00
Dec.-Jan.	35.67	1.33	18.92	6.00	11.83
Feb.- March	20.33	1.37	17.17	6.00	8.33
April-May	18.83	2.58	17.00	6.00	7.33
CD at 5%	**0.74**	**0.75**	**0.28**	**0.82**	**0.82**

Table 3: Data on grainage parameters during different seasons.

Month	Potential Fecundity (No.)	Real Fecundity (No.)	Hatching (No.)
July- Aug.	235.33	188.67	12.33
Sep.-Oct.	259.67	249.00	173.00
Oct.- Nov.	293.67	290.00	278.33
Nov.-Dec.	250.00	245.00	242.33
Dec.-Jan.	221.33	213.33	197.67
Feb.- March	182.00	175.33	172.67
April-May	244.67	232.00	135.00
CD at 5%	**14.07**	**13.07**	**44.07**

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