ORIGINAL RESEARCH PAPER

Zoology

INFLUENCE OF TEMPERATURE ON FECUNDITY, INCUBATION PERIOD AND FERTILITY OF MULTIVOLTINE MULBERRY SILKWORM *(BOMBYX MORI LINN.)* EGGS.

KEY WORDS:

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ABSTRACT

The effect of temperature fluctuation on fecundity and incubation period of silkworm eggs lines was investigated during 10˚, 14˚, 18˚, 26˚, 34˚, and 38˚C by exposing IVth and Vth instar larvae. The minimum level of fecundity 248 eggs per female and the incubation period of eggs decreased considerably 21.67 days at 10˚C while it was maximum fecundity rate 385 per female and the incubation periods of eggs were 9.47 days at 26˚C. Above the 26˚C the fecundity and incubation period was sharply declined. The deleterious effect of temperature was observed on fecundity; incubation and fertility of inbreed silkworm lines. The best temperature and humidity for rearing silkworm lines for seed cocoons production to obtained higher number of eggs and shortest duration of incubation period of eggs with increased fertility is 26±1˚C with 80±5% and 12±1 hours light a day's which may be utilized in seed coon production and hybridization. Investigations elucidated that temperature and humidity variation during larval rearing resulted in low fecundity and high incidence of unfertilized eggs. The study suggested that fecundity, incubation and fertility can be enhanced by avoiding temperature and humidity fluctuations.

INTRODUCTION:

Sericulture has been identified as one of the important component for economic development in India. Its uniqueness in the fact that the sericulture activities not only engage the rural households in the cultivation of mulberry and silkworm rearing but also encompass in their fold a whole range of reelers and weavers. Present communication discusses in sericulture, it is established fact that several factors contribute in the incubation period, fertility of silkworm for the production of quality eggs. Quality of silkworm seed refers to richness of laying, egg viability, hatching uniformity and more importantly good rearing performance of the progeny **(Ullah and Narashimhana., 1981)**. Fecundity, fertility and the incubation period are the main factors of seed production. Influence of the temperature affect the fecundity, fertility and incubation period of silkworm races including aberrations in sex organs, faulty handling of moth during mating of adult and egg lying, defective. Temperature is key environmental factors that influence the physiology of *Bombyx mori* insects **(Biram et al., 2009).**

The silkworm egg production in India is lagging behind the potential of silkworm races and quite low as compared to other countries engaged in sericulture. The commercial seed production activities of sericulture need optimization to enhance returns to farmers and raw silk productivity. The challenging task of developing silkworm breeds which can produce eggs under providing condition of temperature. Perusal of literature reveals that no work has been carried out on the fecundity, fertility and incubation period of silkworm eggs. The present study, therefore, was conducted to find out the effect of variation in temperature on silkworm egg production (fecundity), egg fertility and incubation periods of silkworm eggs. The study would be helpful in establishing the cause low yield and low egg fertility in all sericulture station.

MATERIALS AND METHOD:

To observe the effect of varying temperature on the performance of Bombyx mori, six series of experiments were designed. The temperature regimes like 10˚, 14˚, 18˚, 26˚, 34˚ and 38˚C were chosen for conducting the experiments. In the first series of experiments, the DFLs, obtained from silk moth reared in the laboratory, were transferred chronically to BOD incubator maintained at 10±1˚C (One of the experimental temperature regimes) in the laboratory. The optimum conditions of the experiments like 26±1˚C temperature, 80±5% RH and 12±1 hours light a day were as control for experiments.

The disease free laying (DFLs) were washed with 2% formalin for 15 min to increase the adhesiveness of eggs on the card and surface disinfections and transferred chronically to the BOD incubator. For determining the fecundity, 30 normal egg laying (three batches of 10 laying in each batch) were taken for each replicates. Three replicates of each experiment were made. To observe the effect of temperature on the incubation period of silkworm eggs, the time required for incubation before the hatching of larvae was calculated for each set of experiment separately. Three replicates of 10 laying in each replicate were made. The average of the time taken by eggs for incubation, before hatching of larvae was calculated by taking the mean value of the data obtained. The average hatching of ten laying were taken as representative hatchability percentage per laying in case of each batch of the study. Thirty laying (three batches of ten laying in each batch) were counted for each replicate. Three replicates of each experiment were made.

$$\text{Hatchability (fertility) \%} = \frac{\text{No. Of hatched eggs per laying}}{\text{No. of fertilized eggs per laying}} \times 100$$

Statistically analyzed by one- way ANOVA of all experimental parameters.

RESULT AND DISCUSSION:

The data presented **(Table-1)** indicate that the egg laying capability of *Bombyx mori* increased with the increasing temperature from 14˚ to 26˚C but above 26˚C, fecundity started decline with the increasing temperature up to 34˚C.The minimum number of eggs laid per female moth was recorded to be 248 at 14˚C while maximum of 385 eggs per female were laid at 26˚C. The trend of variation in the increasing fecundity was notable with the increase in temperature from 14˚ to 18˚C, the trend of variation in fecundity with increasing temperature up to 26˚C was steady. Above 26˚C the eggs laying ability declined slowly and solely up to 34˚C. The fecundity is hereditary character **(Robertson., 1957 and Sidhu et al, 1969)** and its expression with in genotypic of an insect species like mulberry silkworm is in direct correlation with a number of physiological and ecological factors **(Yamaoka et al., 1971).** Fecundity of moths emerged from the pupae, obtained from the refrigerated eggs **(Pandey and Upadhyay., 2001)** and refrigerated pupae **(Goel et al., 1993)** has been noticed to be influenced exhibiting sharp decline in the egg laying potential of silkworm. However heavy fecundity was noticed, feeding *Bombyx mori* larvae on ascorbic acid treated mulberry leaves **(Rahman et al., 1990).** The quality of mulberry leaf was recognized to be the main factors for good fecundity in *Bombyx mori* **(Kumar., 1998)** while **(Sarkar et al., 2009)** suggested that the production of eggs is influenced by the mating duration in *Bombyx mori* . Heat treatment of *Bombyx mori* pupae caused improvement in the fecundity of silkworm **(Singh and Sengupta., 1980)** while rearing temperature showed positive correlation with the fecundity in *Bombyx mori* **(Singh., 1998).** It may be inferred that

the cause of poor fecundity at very low temperature regimes may be due to the scarcity of the content, essential oogenesis as silkworm larvae ingest least amount of mulberry leaf at very low temperature regimes and the metabolic rate and temperature are the main factor while causes for low fecundity at temperature.

Table-1: Influence of temperature on the fecundity (No. of eggs) of *Bombyx mori*.

TEMPERATURE(˚C)						F-ratio
10˚	14˚	18˚	26˚	34˚	38˚	n_1=3 n_2=8
175 ±5.35	248 ±6.35	345 ±6.89	385 ± 7.72	344 ±5.44	144 ±4.35	246*

Each value represents mean ±SD of three replicates, *P<0.01.

The data present **(Table-2)** clearly indicate that variation in the temperature regime notably influenced the incubation period of *Bombyx mori* eggs. With the increasing temperature from 10˚C to 38˚C, the incubation period of eggs decreased considerably from 21.67 days at 10˚C to the shortest duration of 6.57 days at 38˚C. With the increasing temperature from 10˚C to 14˚C, a sharp decrease from 21.67 to the level of 15.17 days, in the incubation period of eggs was recorded, while the rate of decrease in the duration of incubation period was moderate with the increase in the temperature at higher regimes. At 26˚C the incubation period of eggs was of 9.47 days. The thermal acclimation has significant effect on the incubation period of *Antheraea assama* **(Rao,K P., 1997; Reynolds and Rangaiah., 1995)**. Similarly, the mating duration also affected the incubation period of *Bombyx mori* **(Reddy et al., 1995)**. The activity of juvenile hormones considerably affected the incubation period of *Bombyx mori* eggs **(Ghosh., 1998)**. Genetic diversity among silkworm breeds may cause low egg recovery under different environments. Similarly finding has been reported by **(Ahsan and Rahman., 2008); Ahsan et al., 2000)** . It may be inferred that very low temperature regimes the development of eggs retarded due to slow mobilization of energy resources to fulfill the basic requirement for the development of eggs.

Table-2: Influence of temperature on the incubation period (days) of *Bombyx mori*.

TEMPERATURE(˚C)						F-ratio
10˚	14˚	18˚	26˚	34˚	38˚	n_1=5 n_2=12
21.67 ±0.47	15.17 ±0.61	13.33 ±0.65	9.47 ± 0.28	8.33 ±0.18	6.57 ±0.33	297.23*

Each value represents mean ±SD of three replicates.
*P<0.01

It is clear from the data obtained **(Table-3)** that temperature variation considerably influenced the percent of hatchability of *Bombyx mori* eggs. With the increasing temperature from 10˚C to 26˚C, the hatchability increased hatchability increased notably from 45.16% at 10˚C to the highest level of 92.70% at 26˚C. Further increase in temperature above 26˚C caused considerable decline in the hatching percentage which reached to the level of 73.70% at 38˚C. Minimum hatchability was recorded to be 45.16% at 10˚C. The survival and development of activities are restricted in accordance extent to their genetic built up **(Krishnaswamy et al., 1973).** The increasing duration of refrigeration of *Bombyx mori* eggs caused notable decline in the percent hatching **(Upadhyay and Pandey., 2001).** The refrigeration of early staged embryo has got adverse effect on the hatchability of insect eggs **(Krishaba and Hennebeery., 1986)** while older eggs are more suitable for long term cold preservation **(Janda., 1980)**. The treatment of ascorbic acid has no significant influence on the hatching percent of *Bombyx mori* eggs. The multiple and single mating made no significant differences in the percent hatching of *Bombyx mori* **(Singh et al., 1995)** whereas, the treatment of *Bombyx mori* eggs with HCL gave highest hatchability eggs **(Tiburcio,1985 and Hurkadli., 1998).** The ecological factors affected the hatching percent of *Bombyx mori* eggs **(Gaur and Upadhyay., 2001).** It is inferred that the mobilization of essential contents for the proper development of fertilized eggs and activity of the enzymes involves in the development of eggs resulting in low hatching percent. On the other hand at very high temperature (38˚C) the increased metabolic rate of the eggs may caused the wastage of energy resources on the cost of the essential resources required for the development of eggs resulting in the poor percentage of hatching.

Table-3: Influence of temperature on the hatchability (%) of *Bombyx mori*.

TEMPERATURE(˚C)						F-ratio
10˚	14˚	18˚	26˚	34˚	38˚	n_1=5 n_2=12
45.16 ±1.35	62.73 ±2.49	76.50 ±2.42	92.70 ±2.72	81.96 ±2.09	73.70 ± 2.07	344.94*

N.Sd = Not Survived *P<0.01

Each value represents mean ±SD of three replicates.

Conclusion: The study also suggests that other factor of seed cocoon (Fecundity, Incubation period of eggs and hatchability percent) production should be evaluated along with commercial traits by utilizing evaluation index method (EIM) for selection of silkworm lines for further studies for reelers/farmers.

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