

Impact of Temperature and Humidity on Temporal Changes in Bombyx Mori Gonads Growth

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ABSTRACT

Impact of temperature and humidity on the average rates of growth of gonads and testes for the different stages of Bombyx mori Linn, was evaluated in the present study. The larval gonads grew bigger with the advancement of age. The high temperature of $34\pm 1^{\circ}\text{C}$ shortened the duration and reduced the gonads weights. The average rates of growth per day was the highest at $26\pm 1^{\circ}\text{C}$ even though, the $18\pm 1^{\circ}\text{C}$ gonads were the less heavy. Concerning the pre-pupal gonads, they followed the same trend. In the pupal stage, the weight of testes increase gradually with the advancement of age to reach the maximum growth before the emergence of adult, then these weights began to decrease gains except in $26\pm 1^{\circ}\text{C}$ temperature when no reduction occurred. The average rate of growth per day was the highest in $26\pm 1^{\circ}\text{C}$ temperature and $80\pm 5\%$ RH. In respect of the adult stage weight of testes continued its gradual reduction till the end of the life span. The reduction which occurred in $18\pm 1^{\circ}\text{C}$ was more than that happened in $26\pm 1^{\circ}\text{C}$. Significant differences were obtained among all parameters of matereological factors.

1. Introduction

In India where silkworm rearing and silk production are practiced on commercial scale, a large number of eggs produced by the insects turn out to be unfertilized. Understanding the process of spermatogenesis in Bombyx mori is important for control of lepidopteron pests by the sterile male technique (Alphey, N et al., 2018). The gonads of male Bombyx mori consist of two testes that are connected to each other by sperm duct. Both testes contain four compartments, each of which is surrounded by thin connective tissue. The testicular follicles have along cavity and at the apex germ cells develop into mature sperm (Toshimori, K et al., 1979). Earlier workers high temperature was maximal at pre pupal stage followed by pupal stage (Osana, M et al., 1987). The multivoltine silkworm is reared indoor five to six time in year (El. Shaaraway, M, et al., 1975). The optimum condition required for rearing is $26\pm 1^{\circ}\text{C}$ and $80\pm 5\%$ RH and 12 ± 1 hrs light a day (Krishnaswami, S et al., 1978). The present investigatory was aimed the matereological effect of temperature and humidity which represent 18°C , 26°C and 34°C on the growth of gonads and testis during different stages of Bombyx mori. Hence an attempt has been made to understand the possible effect of high temperature on the biochemical constituents of testes/ gonads during spinning stage of in Bombyx mori. It is an attempt to find out the reasons of its drop at 18°C and 34°C .

2. Materials and Methods:

The rearing BOD incubator was adjusted according to the degrees of matereological temperature, humidity and photoperiod to represent three seasons under study as control parameters viz. $26\pm 1^{\circ}\text{C}$, $80\pm 5\%$ RH and 12 ± 1 hrs light a day and study at 18°C , 26°C , and 34°C comparative study as winter, spring and summer season for indoor rearers. Larva at

the beginning of Vth instar were sexed according to (Iwashita, T., 1979) points for females and Harold's point for male as describe by (Krishnaswami et al., 1978). In each parameters ten samples of larvae were killed and dissected in modified Belar's solution which was previously used by White et al., 1975. Gonads for each individual were extracted and weighed. The same procedure was repeated every two days along the Vth larval period. The average rate of growth per day for the gonads was calculated. The same method was followed to estimate the average rate of growth of the pre-pupal gonads pupal and adult testes.

3. Result and Discussion:

(1)-Matereological effect of growth rate of gonads during Vth larval instar and pre-pupal stage: - The data presented in (Table-1) clearly shows that the weight of larval gonads increase with the larval development. The lowest weights are obtained in 34°C when larval duration is the shortest 6days while at 26°C the heaviest weight are recorded comparatively longer period 12 days. At 18°C the larval duration is 10 days. The increase in the weight of gonads from first day of the Vth instar till the last day were 0.98, 0.64 and 1.04 during 26°C , 34°C and 18°C temperature respectively and when the average rates of growth per day estimated were 0.098, 0.080 and 0.089mg in the successive rearing seasons. It could be concluded that matereological temperature humidity during the 26°C resulted in the highest average rate of growth daily even though the heaviest weight was recorded in 26°C . The same conclusion could be deduced for the rate of growth in gonads during the pre-pupal as recorded in Table-1.

(2) Matereological effect on the rate of growth of testes during the pupal stage:-

The data presented in (Table-2) that the weights of pupal testes increased to reach their maximum growth at the 15th, 13th and 21th day of the pupal period in 18 °C, 26 °C and 34 °C, the testes diminished in size and are reduced in weight while no reduction occurred in 26 °C. At 18 °C the 23th day of pupal stage the increase in weight of the testes was 31.66mg which revealed 2.73mg of average growth daily. At 26 °C, it increased on the 15th day which was 38.10mg with 1.19mg of average growth per day. At 34 °C the same values were 25.26mg on the 13th day with the average increase of 1.18mg daily. It is clear that the maximum growth was obtained in 26 °C and the lowest occurred at 34 °C. This result may be due to the longest pupal period in 18 °C, when the duration was 28 days, while it was 16 days in both 26 °C and 34 °C. It is also clear that the

highest average rate of growth of testes per day was 1.88mg in the 26 °C with no reduction at the end of the stage.

(3) Matereological effect of temperature and humidity on the rate of growth of testes during adult stages:- The data presented in (Table-3) demonstrated that the male adult had a duration of 10 days in both 26 °C and 18 °C, while its life span reduced to 6 days at 34 °C. The lowest weight of adult testes at the time of emergence was recorded at 34 °C. In all seasons a gradual reduction in the weight of testes occurred till the male died but it was more obvious in fall than 26 °C. Differences between of testes among all seasons were significant. This result is due to the non-secretary testes and continuous migration of sperms from testes to the vas difference and vesicular Seminales.

Table-1: Matereological effect of temperature and humidity on gonads average rate of growth during larval Vth instar and pre-pupal stage of *Bombyx mori*.

Days of Growth	Mean Weight of Vth instar Gonads (mg)					Mean weight of pre pupal Gonads (mg)				
	18°C	26°C	34°C	F	L.S.D	18°C	26°C	34°C	F	L.S.D
1	2.17±0.39	2.53±0.39	1.66±0.24	-	-	5.34±0.59	5.74±0.58	2.98±0.17	-	-
2	2.74±0.28	2.88±0.20	1.99±0.19	-	-	6.24±0.33	6.61±0.32	3.45±0.27	-	-
5	2.80±0.27	2.94±0.17	2.17±0.20	-	-	-	-	-	-	-
7	2.98±0.31	3.04±0.16	2.30±0.20	-	-	-	-	-	-	-
9	3.15±0.32	3.31±0.33	2.30±0.20	-	-	-	-	-	-	-
11	3.57±0.23	3.60±0.25	N.Sd	-	-	-	-	-	-	-
Average	2.90	3.05	2.23	59.86	0.24	5.79	6.17	3.21	399	0.29
F (days)	13.80	19.26	18.55	-	-	45.00	34.45	22.20	-	-
L.S.D	0.27	0.19	0.25	-	-	0.32	0.31	0.21	-	-

N.Sd= Not survived

Table-2: Matereological temperature and humidity on the average rate of growth of testes during the pupa stages of *Bombyx mori*.

Days of Growth	Mean weight of pupa testes (mg)			F	L.S.D
	18°C	26 °C	34 °C		
1	8.88± 0.56	10.23±0.53	5.91±0.35	-	-
3	11.57±0.62	12.33±0.42	7.76±0.74	-	-
5	13.95±0.81	14.90±0.65	11.42±0.65	-	-
7	16.37±0.78	17.89±0.70	15.88±0.50	-	-
9	18.49±0.88	22.25±1.09	18.01±0.74	-	-
11	25.49±1.24	27.33±0.86	21.50±0.66	-	-
13	31.17±1.63	35.63±1.93	26.84±1.18	-	-
15	28.11±1.03	38.98±1.19	22.11±1.09	-	-
17	29.00±1.05	-	-	-	-
19	30.00±1.15	-	-	-	-
21	31.00±1.56	-	-	-	-
23	31.66±2.73	-	-	-	-
25	31.55±1.74	-	-	-	-
27	31.70±2.73	-	-	-	-
Average	24.21	22.44	16.18	17.36	1.78
F (days)	624.29	1097.29	703.79	-	-
L.S.D	0.19	0.93	0.93	-	-

Table-3: Matereological effect of temperature and humidity on the average rate of growth of testes during the adult stage of *Bombyx mori*.

Days of Growth	Mean Weight of testes(mg)			F	L.S.D
	18°C	26°C	34°C		
1	28.30±2.44	28.34±1.20	18.96±1.14	-	-
3	22.75±3.18	24.06±2.61	15.19±1.65	-	-
5	20.58±2.06	21.61±1.16	12.41±1.43	-	-
7	14.05±2.05	18.21±1.46	N.Sd	-	-
9	13.42±1.60	15.17±3.73	-	-	-
Average	19.82	21.48	15.52	3.15	-
F(days)	71.78	50.70	53.24	-	-
L.S.D (days)	2.09	2.04	1.31	-	-

N.Sd= Not Survived

4. Conclusion

Although the testis and ovaries in the early developmental stages showed several distinguishable features, morphological characteristics were almost similar between the testes and ovaries. Very careful and persistent observations are required to discriminate testis from ovaries. Formation and development of duct may be sensitive to sex determining signal and display sexual dimorphism in the early embryonic stages. The present study demonstrates that the most reliable temperature and humidity affect the gonad development and embryonic

development of *Bombyx mori* larvae. Gonad and embryonic development are affected the oviposition of egg. Our result investigations are demonstrate environmentally induced quality parameters that must not be ignored when analyzing and deploying silk cocoon, silk filaments or silk bio-polymers.

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