International Journal of Current Research in Life Sciences
Vol. 4, No. 6, pp. 221-224, June, 2015

ISSN: 2319-9490

www.ijcrls.com

Full Length Research Article

Comparative growth of V Instar silkworm (*Bombyx mori* L.) larval and silk gland under certain temperature and humidity conditions

***,[1]Lakshminarayana Reddy, P., [2]Sujatha, B., [2]Shanthan Babu, M. A. and [2]Sankar Naik, S.**

*[1]Regional Sericultural Research Station, CSB, PB No. 50, Anantapur - 515 001, Andhra Pradesh, India
[2]Department of Sericulture, S. K. University, Anantapur, India

Accepted 27th May, 2015; Published Online 30th June, 2015

ABSTRACT

The growth of V instar silkworm (*Bombyx mori* L.) larval and silk gland was studied in certain temperatures (25, 30 and 35 ºC) and relative humidity (RH; 60, 70 and 80%) under natural photoperiodic (LD 12: 12) conditions. Disease free layings (DFLs) of two pure silkworm breeds, Pure Mysore (PM, a multivoltine breed) and NB_4D_2 (a bivoltine breed), and their hybrid, PM x NB_4D_2 were introduced into the experimental condition on the 3rd day of oviposition till completion of cocooning. Exact weights of the larval and silk gland were recorded at every 4 hours intervals in a day (06.00, 10.00, 14.00, 18.00, 22.00 and 02.00 h.) all through the 5th instar. No circadian rhythmicity was observed, both fro larval and silk gland growths. Resolved to daily averages curves, they documented additive curvilinear (sine wave) pattern up to 6th day for larval and up to 7th day for silk gland growth. Amplitude of NB_4D_2 was high in all the case for larval and silk gland growth. Increase in rearing temperature and reduce in the humidity resulted in reduction of both larval and silk gland growth. The results are discussed based on our earlier publication, emphasizing the synergic effects of temperature and humidity on the larval and silk gland growth.

Key words: Silkworm, *Bombyx mori*, Larval, Silk gland, Comparative Growth, Temperature, Humidity.

INTRODUCTION

Implications of temperature and humidity on hatching (Lakshminarayana Reddy *et al*., 2005), moulting and moulting survival (Lakshminarayana Reddy *et al*., 2003), pupation (Lakshminarayana Reddy *et al*., 2002a), adult eclosion (Lakshminarayana Reddy *et al*., 2002b) and cocoon economic traits (Lakshminarayana Reddy *et al*., 2003) in the silkworm *Bombyx mori* L were reported. In the present communication, the implications of temperature and humidity on the 5th instar larval and silk gland growth patterns are reported.

MATERIALS AND METHODS

Disease free layings (DFLs, each DFL containing 350 to 450 eggs laid by single silk moth on a single day) of two pure breeds, PM (Pure Mysore, a multivoltine breed) and NB_4D_2 (a bivoltine breed) and their hybrid, PM x NB_4D_2 of the silkworm, *Bombyx mori* were procured from the Government Grainage, Hindupur and Madakasira (Anantapur District, Andhra Pradesh, India). These DFLs were introduced into alternative light and dark schedules (LD 12 : 12; photophase from 06:00 h and the scotophase from 18:00 h local time). Three temperatures (25, 30 and 35 ºC and three humidity (60, 70 and 80% RH) conditions were imposed.

Corresponding author: Lakshminarayana Reddy, P.,
Regional Sericultural Research Station, CSB, PB No. 50, Anantapur - 515 001, Andhra Pradesh, India

The silkworm larvae were reared in the experimental conditions on V1 mulberry (*Morus* spp.) leaves till mounting for cocooning. Exact weights of the larval and silk gland were recorded at every 4 hours intervals in a day (06.00, 10.00, 14.00, 18.00, 22.00 and 02.00 hr.) all through the 5th instar (8 days) larval period from a random sample of 20 worms from each experimental condition. The macroscopic data on the larval and silk gland weights were analyzed by single cosinor method of Kaukkari *et al*. (1974).

RESULTS

Clear-cut circadian fluctuations in the 5th instar larval and silk gland were not observed. Hour-to-hour and day-to-day larval and silk gland weights of the silkworm, *Bombyx mori* (PM, NB_4D_2 and PM x NB_4D_2) documented additive curvilinear patterns. Hence, day-to-day average values for the 5th instar *Bombyx* larval and silk gland weights were resolved for the entire length of the 5th instar period graphically to represent growth trends. The trends in 5th instar larval growth under for 25 ºC and 80% RH are depicted in figure 1 and those for silk gland in figure 2. The larval growth documented additive curvilinear, sine wave patterns up to 6th day. On the 7th day, however, these values recorded a downward trend. It can be seen that the amplitude of the NB_4D_2 larval growth is high followed by PM x NB_4D_2 and PM.

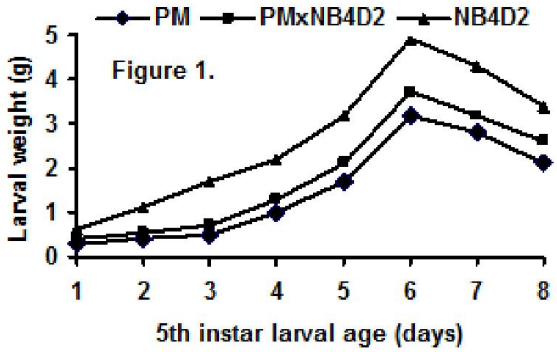

Fig. 1. Growth patterns of the multivoltine (PM), bivoltine (NB_4D_2) and their hybrid (PM x NB_4D_2) silkworm, *Bombyx mori* larvae during 5th instar period under 25 ºC temperature and 80% RH. Note the amplitude of growth on the 6th day of 5th instar period

Interestingly, silk gland growth trends also showed additive curvilinear, sine wave patterns. However, the peak growth was observed on the 7th day (figure 2), from which point, the growth values recorded a downward trend. As seen for the larval growth, the amplitude for silk gland in the bivoltine breed, NB_4D_2 was high followed by PM x NB_4D_2 and PM.

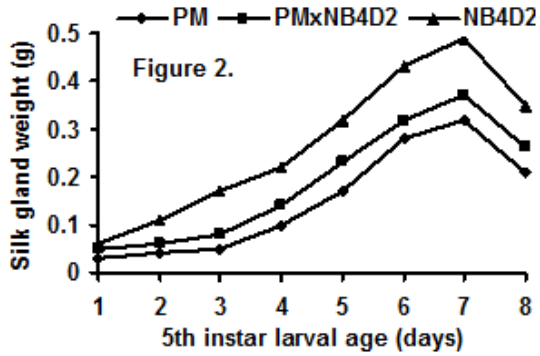

Fig. 2. Growth patterns of the silk gland of multivoltine (PM), bivoltine (NB_4D_2) and their hybrid (PM x NB_4D_2) silkworm, *Bombyx mori* during 5th instar period under 25 ºC temperature and 80% RH. Note the amplitude of silk gland growth on the 7th day of 5th instar period against that on the 6th day for larval growth

The trends in the larval and silk gland growth recorded in all the silkworm breeds/hybrids was identical to that furnished in figures 1 and 2, cresting on 6th and 7th day respectively. Hence, only larval and silk gland weights of all the silkworm breeds/hybrids on 6th and 7th day respectively under 25 ºC and 80% RH are depicted in figures 3 to 8. The bivoltine breed, NB_4D_2 recorded maximum weights among three varieties studied, followed by PM x NB_4D_2 and PM. Among rearing temperatures, all the three silkworm varieties recorded maximum weights of larval and silk gland at 25 ºC. Increase in the rearing temperature resulted in reduction of larval as well as silk gland weights. Similarly, the silkworm larval and silk glands recorded maximum weights under relative humidity of 80%. The larval and silk gland weights decreased according to the decrease in relative humidity. The data of larval (figures 3 to 5) and silk gland (figures 6 to 8) weights on the 6th day and 7th day respectively are only given in the paper and those under other temperature and humidity conditions are not given to avoid confusion.

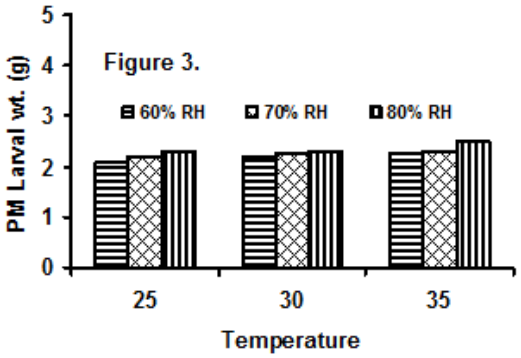

Fig. 3. Larval weights of multivoltine silkworm, PM (*B. mori*) on the 6th day of 5th instar under imposed temperature & humidity conditions

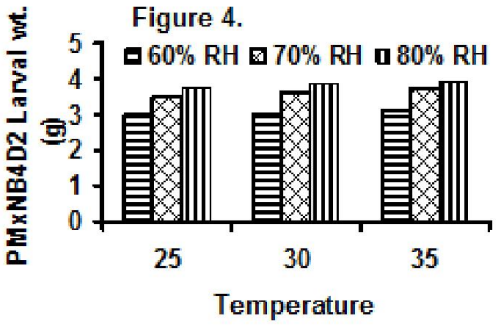

Figure 4. Larval weights of hybrid silkworm, PM x NB_4D_2 (*B. mori*) on the 6th day of 5th instar under imposed temperature and humidity conditions

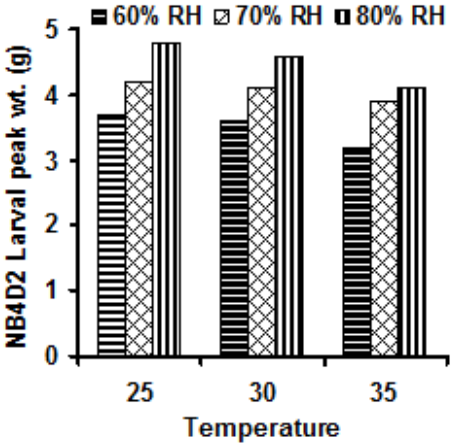

Fig. 5. Larval weights of bivoltine silkworm, NB_4D_2 (*B. mori*) on the 6th day of 5th instar under imposed temperature and humidity conditions

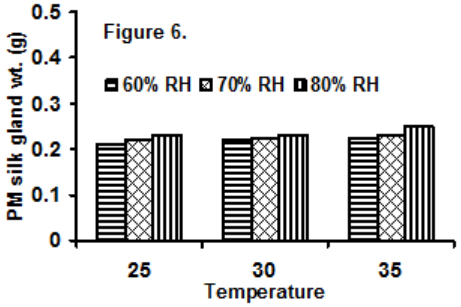

Fig. 6. Silk gland weights of multivoltine silkworm, PM (*B. mori*) on the 7th day of 5th instar under imposed temperature & RH conditions

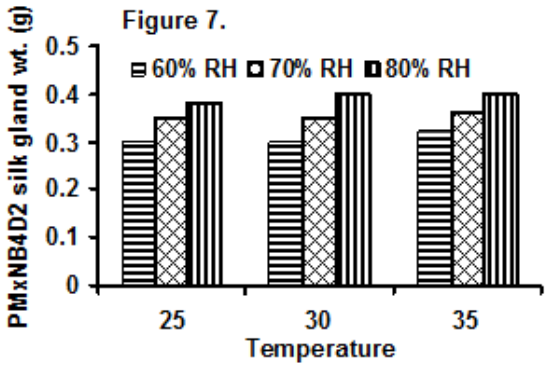

Figure 7. Silk gland weights of hybrid silkworm, PM x NB_4D_2 (*B. mori*) on the 7th day of 5th instar under imposed temperature and RH conditions

DISCUSSION

The silkworm, *Bombyx mori* is the only fully domesticated insect, with specialized silk gland for massive synthesis of natural silk. The silk production in the *Bombyx* silkworm is directly related to both the larval and silk gland (Sivarami Reddy, 1993). The studies on the growth in insects has primarily moved around two parameters; the relative developmental rates in terms of number of days required to attain specific stage (*e.g*. completion of larval period) and the rate of weight gain. In the present study, the rate of growth, in terms of weight has been emphasized.

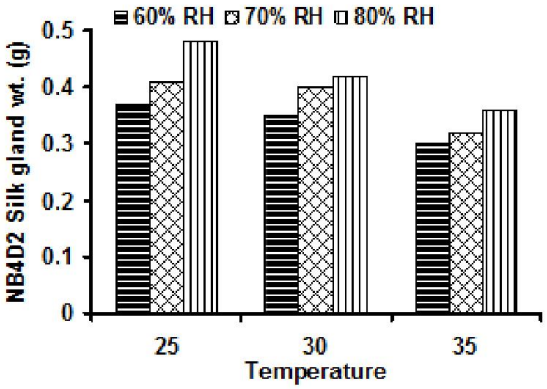

Fig. 8. Silk gland weights of bivoltine silkworm, NB_4D_2 (*B. mori*) on the 7th day of 5th instar under imposed temperature and RH conditions

Among the three silkworm varieties, the bivoltine, NB_4D_2 has shown maximum growth rate followed by the hybrid, PM x NB_4D_2 and the multivoltine, PM (Figure 1). Such variations are well ascribed to the voltinisim and hybrid vigor (Lakshminarayana Reddy, 2001). Similar trends in the silk gland growth are reported (Figure 2) in the present study. The peak of the larval growth was observed on the 6th day (Figure 1) and the silk gland growth on the 7th day (Figure 2), interestingly. In other words, the peaks of larval and silk gland are not phase locked. They are away by 45º *i.e*., 24 hours (6th day or 270º for larval growth and 7th day or 315º for silk gland; Sivarami Reddy, 1993; Sivarami Reddy *et al*., 1999). This can amply be demonstrated with the fact that the larval growth is primarily due to intake of food (a digestive process) and the silk gland growth is mainly due to utilization of digested macronutrients for protein manufacture in the silk gland (a synthetic process) which are supposed to be not phase locked (Sivarami Reddy, 1993; Sivarami Reddy *et al*., 1999).

The effects of imposed temperature and humidity conditions definitely exerted their effect on both the larval (figures 3 to 5) and silk gland growths (figures 6 to 8). The effects are more profound on bivoltine silkworm (NB_4D_2) larval weights (figure 5) and silk gland (figure 8) where the increase temperature and decreased humidity conditions decreased both the larval and silk gland weights on the 6th and 7th day respectively. This can be attributed to the fact that the bivoltine silkworms are more vulnerable to fluctuating environmental (temperature and humidity) conditions. In other sense, rearing of bivoltine silkworm in extreme temperature and humidity conditions is not feasible (Lakshminarayana Reddy, 2001). On the other hand, the effects of temperature and humidity on the multivoltine silkworm, PM are comparatively less (figure 3 and 6), as the breed is more acclimatized to local conditions (Lakshminarayana Reddy, 2001). These effects on the hybrid, PM x NB_4D_2 (figure 4 and 7) are moderate, indicating that the hybrids are more resistant to such environmental fluctuations (Suresh Kumar and Yamamoto, 1995).

Prior to this communication, implications of temperature and humidity on hatching (Lakshminarayana Reddy *et al*., 2005), moulting and moulting survival (Lakshminarayana Reddy *et al*., 2003), pupation (Lakshminarayana Reddy *et al*., 2002a), adult eclosion (Lakshminarayana Reddy *et al*., 2002b) and cocoon economic traits (Lakshminarayana Reddy *et al*., 2003) in the silkworm *Bombyx mori* L were reported. In all these reports, the high temperature and low humidity together seems to exert synergic effects on the *Bombyx* silkworm. The findings in the present study are exactly supporting the above hypothesis.

REFERENCES

Kaukkari, W. L., Duke, S. H. Halberg, F. and Lee, J. 1974. Circadian rhythmic leaflet movements: Students exercises in chronobiology. *Chronobiologia*, 1: 281-302.

Lakshminarayana Reddy, P. 2001. Implications of high temperature and low humidity on the silkworm (*Bombyx mori* L.) physiology and its economics of rearing. Ph. D. Thesis, Sri Krishnadevaraya University, Anantapur, India.

Lakshminarayana Reddy, P., Sankar Naik, S. and Sivarami Reddy, N. 2002a. Implications of temperature and humidity on pupation patterns in the silkworm, *Bombyx mori* L. *Int. j. Indust. Entomol*., 5(1): 67-71.

Lakshminarayana Reddy, P., Sankar Naik, S. and Sivarami Reddy, N. 2002b. Implications of temperature and humidity on the adult eclosion patterns in silkworm, *Bombyx mori* L. *J. ent. Res*., 26(3): 223-228.

Lakshminarayana Reddy, P., Sankar Naik, S. and Sivarami Reddy, N. 2003. Implications of temperature and humidity on the moulting and moulting survival in the silkworm, *Bombyx mori* L. *Int. j. Indust. Entomol*., 6(1): 21-25.

Lakshminarayana Reddy, P., Sankar Naik, S. and Sivarami Reddy, N. 2005. Implications of high temperature and low humidity on the hatching in the silkworm, *Bombyx mori* L. under LD 12 : 12 conditions. *Int. j. Indust. Entomol*., 11(2): 139-143.

Sivarami Reddy, N. 1993. Implications of photoperiod on the silkworm, *Bombyx mori* L. Ph. D. Thesis, Sri Venkateswara University, Tirupati, India.

Sivarami Reddy, N., Lakshminarayana Reddy, P., Sankar Naik, S. and Pavan Kumar, P 1999. Rhythmic characteristics of larval and silk gland growth in 5th instar silkworm, *Bombyx mori* L. under different photoperiodic conditions. *Proceedings of National Seminar on Tropical Sericulture*, 127-128.

Suresh Kumar, N. and Yamamoto, T. 1995. Maternal effect of resistance to high temperature in F_1 hybrids between polyvoltine and bivoltine silkworm races. Paper presented at the annual Conference at Nigata, Japan.

****