J. Agric. Sci. Mansoura Univ., 30 (11): 7141 - 7146, 2005

EFFECT OF PHOTOPERIOD ON SOME BIOLOGICAL PARAMETERS AND UTILIZATION OF FOOD OF THE MULBERRY SILKWORM *Bombyx mori* L. (LEPIDOPTERA: BOMBYCIDAE)

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ABSTRACT

The effect of photoperiod on the relative developmental speed of fifth instar larvae of mulberry silkworm *Bombyx mori* were studied. Tested photoperiodic conditions were : 24 hours light:0 hours darkness(24L:0D), (12L:12D) and 0L:24D). The mean weight of each of mature larvae, pupae, shell cocoon and silk glands significantly increased under complete darkness. Also, the other biometric measurements,i.e, the total mean laid eggs/female and utilization of food increased significantly under complete darkness compared with those reared under other tested photoperiods.

Keywords: *Bombyx mori*, Photoperiod, Utilization of food

INTRODUCTION

In Egypt the mulberry silkworm *Bombyx mori* L., has been reared for more than 100 years as a univoltine race where it is reared for only one crop of cocoon in the spring season. Hence, the local production of raw silk is not sufficient for domestic demand. So, Egypt covers its requirement form abroad. Krishnaswami *et al.* (1973) stated that in order to increase silk production in temperate zones, the mulberry silkworm must be reared for two or three generations throughout the year. In the light of this statement, the climate conditions in Egypt allow for more than one rearing season if the suitable varieties of mulberry and silkworm are available.

The fact that the mulberry silkworm, *B. mori* L., is monophagous insect, Legay (1958) considered silkworm nutrition as the major area of research in sericulture. Also, Kumaraj *et al.* (1972) decided that the important factor influencing the growth and reproduction of silkworm is the nutritional factor.

Among the factors that govern the biological activities of insects, light plays a major role, particularly in noctuid species. Among Noctuidae, species differ markedly to the effect of the day-length on their development which may be accelerated, inhibited or kept normal Danileveskii, 1961; Zohdy and Aboul-Ella, 1975; Ebeid, 1981).

The present study was designated to investigate the effects of different photoperiodic conditions (continuous light, 12 hours light/12h dark and complete darkness) on the weights of *Bombyx mori* 5th instar

Larvae, pupae, shell cocoon and silk glands. Also, the number of the deposited eggs and the % of utilization of food within the three conditions were calculated.

MATERIALS AND METHODS

Mulberry silkworm, *Bombyx mori* L. Novi race was obtained as eggs from the laboratory of Serriculture, El-Sabahia Research Station, Agricultural Research Center, Alexandria, Egypt. After hatching, the larvae were fed on mulberry leaves of white variety (*Morus alba*) and were reared under laboratory conditions of 22-25°C and 70-75% RH. Newly hatched larvae were placed on rearing trays until the fourth instar. Fifth instar larvae were reared on conventional silkworm trays with wire goose bottom fixed on a wooden frame (150X180X10cm). Newly moulted fifth instar *Bombyx mori* larvae were placed in different day length of 24h light:0h darkness (24L:0D); 12L:12D or 0L:24D and daily provided with a large amount of fresh mulberry leaves. 20 larvae were used with 3 replicates,

To evaluate the effect of different day length on the relative developmental speed of *B. mori* larvae, the weight of each full grown larvae, pupae, cocoon shells and silk glands were estimated. Also, to estimate the egg-laying potentiality of *B. mori* female, five couples of newly emerged moths under each day length were selected and kept till the end of egg deposition period then the number of deposited eggs per female was counted. To study the effect of day length on food utilization by *B. mori* larvae, three groups of newly moulted 5th instar larvae were daily provided with known weight of mulberry leaves under the test photoperiodic conditions. The offered and left over food,fecal pellets and the larvae were weighed daily. Food consumption was estimated by a standard gravimetric technique (Waldbauer, 1968). Plant material and feces were dried in an oven at 120°C. for 72hrs. Utilization of food was calculated daily within each condition. Data in tables were represented as means $\pm$SE.

RESULTS AND DISCUSSION

Three groups of fifth instar larvae of silkworm *Bombyx mori* L. were reared under different hours of light to complete darkness. Daily weight of larvae, pupae, silk gland, cocoon shell and number of deposited eggs of resulted female moths were studied. Food utilization was daily calculated within the three conditions.

In the present study, the effect of photoperiod on some biological parameters leads to significant difference.

Table (1) and figure(1) showed different larval weight when 5th instar larvae were exposed to different photoperiodic conditions. The test photoperiods (Light L: Darkness D) were (24 L: 0 D),(12 L: 12 D) and complete darkness (0L : 24D).

The averages of obtained weights were significantly higher at 0L:24D comparing with those obtained at 24L:0D.

El-Singaby (2001) reported that the growth rate of the 5th instar larvae of *Spodoptera littoralis* was significantly higher at short day length than other photoperiods. Hegazi *et al.* (1989) mentioned that different photoperiods produced specific response on the developmental time of the immature

stages of *S. littoralis* larvae. The latters developed faster at short day length (6L :18D) than the other test photoperiods

Table (1): Daily mean weight (±SE) of fifth instar larvae of *B. mori* at three day length.

	weight(in grams) /duration (in hrs)						
Day length	0 hr.	24 hr.	48 hr.	72 hr.	96 hr.	120 hr.	144 hr.
24 L:0D	0.331± 0.0035	0.466± 0.016	0.598± 0.008	0.814± 0.009	1.076± 0.024	1.270± 0.012	1.448± 0.008
12L/12D	0.343± 0.0155	0.504± 0.026	0.731± 0.019	1.034± 0.0005	1.275± 0.005	1.505± 0.025	1.655± 0.015
24 D:0L	0.346± 0.0015	0.520± 0.025	0.738± 0.002	1.159± 0.016	1.485± 0.083	1.725± 0.073	1.987± 0.012

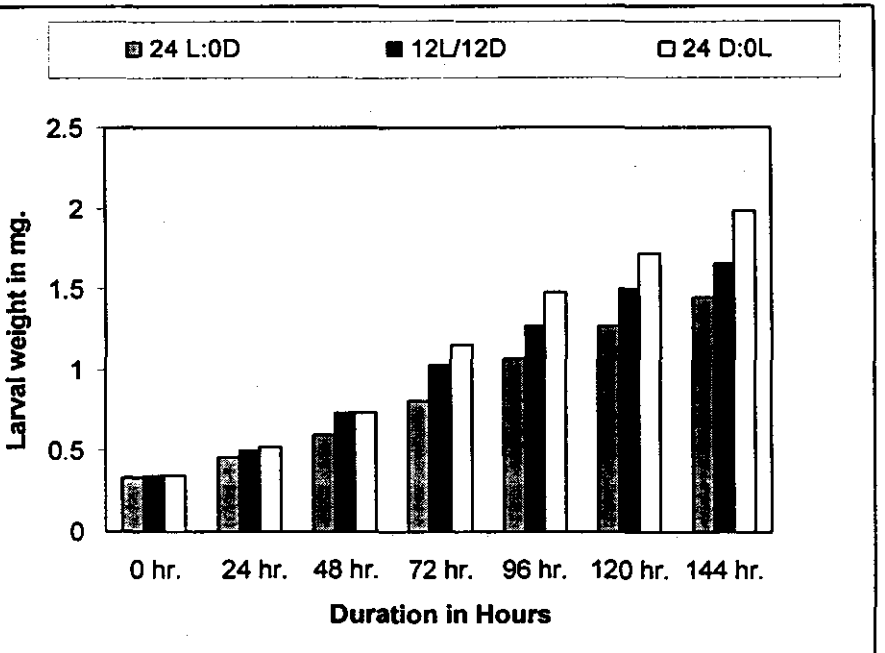

Figure (1): Average daily weight of the fifth instar larvae of *B. mori* reared at different photoperiods

Table (2): shows the effect of day length on some biometric measurements of silkworm (5^{th} instar larvae). The pupal weight, increased from 0.618±0.033,to 0.686±0.06 and 0.775±0.023 grams at the day length of 24L:0D, 12L:12D, and 0L:24D respectively. The highest average weight of increment was at complete darkness.

The obtained data presented in table (2)indicated that the increase in fresh weight of cocoon shell followed the same trend of pupal weights. They weighed 0.129±0.0005 at 24L:0D, 0.162±0.003 at 12L:12D and 0.192±0.003

grams at)L:24D. The fresh weight of cocoon shell increased significantly at 24 hours darkness. The results agree with those reported by El-singaby (1987) who mentioned that silk production of the larvae of the Eri-silkworm, *Philosamia ricini* was higher under complete darkness.

Also, the increment in fresh silk gland weight was significantly higher (0.517±0.022gram) at complete darkness (Table 2).

Table (2): Biometric measurements of 5th instar larvae *B. mori* fed on mulberry leaves under different day Length.

	Photoperiod		
Measured Parameter (in g)	**24L:0D**	**12 L/12 D.**	**0L: 24 D**
Pupal weight	0.618+0.033	0.686+0.06	0.775+0.023
Cocoon shell weight	0.129+0.0005	0.162+0.003	0.192+0.003
Silk gland weight	0.352+0.005	0.457+0.042	0.517+0.022

The egg production is also affected by the day length. Data in figure (2) showed an increase in the total number of deposited eggs per female when the day length decreased. Highest number of eggs /female was 380 at complete darkness versus 335 eggs at 12L: 12D. and 315 eggs at 24L:0D.

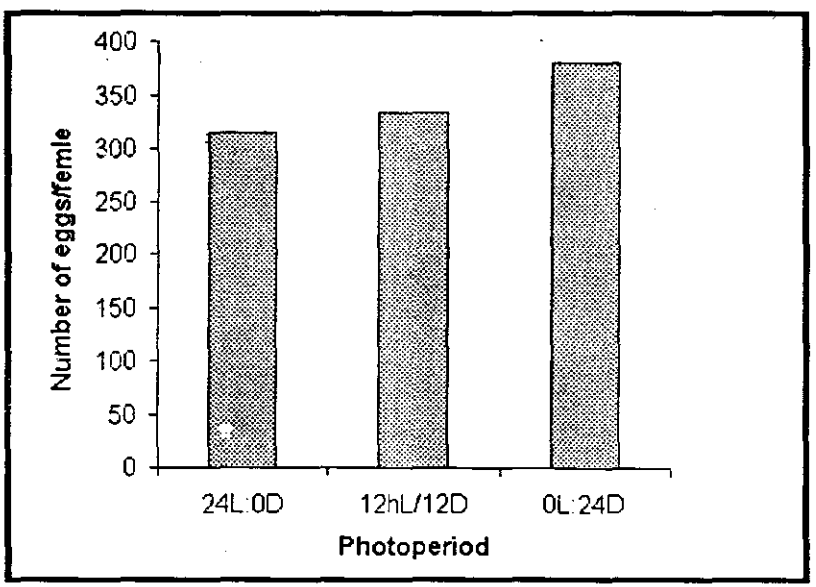

Figure (2): Effect of photoperiod on the egg laying production Of *Bombyx mori*

The effect of photoperiods on the percentage of the utilization food is shown in figure(3). The effect of photoperiod on the % of utilization food was very obvious at the complete darkness compared with other test photoperiods. For instance, the % of utilization food at the 5th day of the last larval instar was 55.6, 56 and 63.5 under 24L:0D, 12L:12D and 0L:24D, respectively. This results suggest that the last larval instar utilized food better at night than at the day time. El-Singaby (1987), reported that Analysis of the utilization of castor bean leaves by *Ph. ricini* larvae suggests that growth rate was better when the last instar larvae were kept under complete darkness.

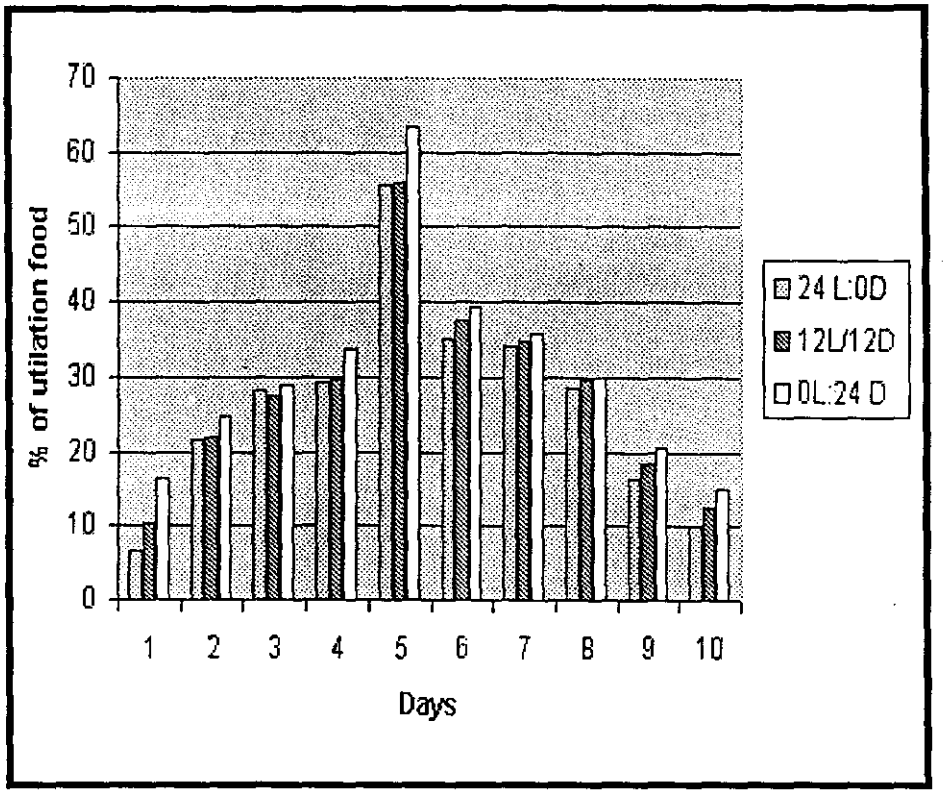

Figure (3): Effect of photoperiods on the percentage of utilization food of 5th instar silkworm larvae *Bombyx mori*

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تأثير الفترة الضوئية علي بعض القياسات البيولوجيةو التمثيل الغذائي لدودة حرير القز بومبكس موراي (رتبة حرشفية الأجنحة: نوكتوادي).

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يتناول البحث دراسة تأثير الفترة الضوئية ،عندما رُبيت دودة حرير القز على فترات ضوئيةمختلفة. كانت الفترات الضوئية التى تم إختبارها ٢٤ ساعة ضوء إلى صفر ظلام و ١٢ ساعة ضوء إلى ١٢ ساعة ظلام و ٢٤ ساعة ظلام إلى صفر ضوء. وأظهرت النتائج أن أوزان اليرقات و العذارى و قشرة الشرنقة و الغدد اللعابية زادت مع الظلام التام (٢٤ ساعة أظلام). أيضا زاد عدد البيض الموضوع بواسطة الأنثى و معدل نمو اليرقات والنسبة المئوية للتمثيل الغذائى لليرقات تحت ظروف الأظلام التام.