J. Agric. Sci. Mansoura Univ., 32 (12): 10455 - 10468, 2007

EFFECT OF MULBERRY VARIETIES ON SOME BIOLOGICAL CHARACTERS OF CERTAIN SILK WORM BREEDS (*Bombyx mori* L.)

Khalil, S.I.*; M.A. El-Deeb*; A.M.A. Mohsen* and M.S.I. Saad**
*** Plant Protection Dept. Fac. Agric. Zagazig Univ. Egypt**
**** Plant protection Research Institute**

ABSTRACT

The effect of diet mulberry varieties (Kanva-2, Kokuso-27, Mortiana and Balady) on some biological aspects of certain *Bombyx mori* L. breeds were studied under laboratory conditions.

Duration period of larval stage varied significantly between silkworm breeds or between mulberry varieties. The shortest duration period of larval stage was 28.11 days for CG 16 breed when the larvae reared on Kanva-2 cultivar. While, the longest duration period was 33.58 days for JH3 reared on Mortiana.

Also, the larval mortality percentage was clearly affected where the highest mortality values were recorded in CG16 breed reared on Balady mulberry cultivar (35.55%).

Larval body weight was significantly increased in JH3 breed reared on kanva-2 than other mulberry cultivars.

Length and weight of silk gland were significantly increased in larvae fed on kanva-2 leaves, while these parameters showed insignificant differences between the tested breeds. Larvae of EM6 fed on leaves of kanva-2 exhibited the highest percentages of cocooning and pupation.

Pupal duration and adult emergence % were affected by breed and mulberry variety. Breed JH3 fed on kanava-2 gave the highest value of pupal weight

Moritiana mulberry variety and EM6 breed recorded the highest values of female longevity. Mean while, the superior longevity of male (breed JH3 and Moritiana variety) was responsed to silkworm breed and mulberry variety.

Adult fecundity was decreased in female orison from larvae fed on Balady variety and CG16 breed. A positive relationship was detected between weight of pupae and fecundity.

Fertility of female moth increased in CG16 larvae fed on kakuso-27 variety.

INTRODUCTION

The mulberry silkworm, *Bomby mori* L. is a monophagous species fed on the mulberry leaves (*Morus spp.*). The mulberry leaves vary greatly in their nutritional value according to variety and other factors. Many investigators found that the biological characters of silkworm were directly affected by mulberry leaf varieties (Gabriel and Rapusas, 1976; Bheemanna, *et al.*, 1989 a,b; Qader *et.al*, 1995; Petkov, 1995; Raman, *et. al.*, 1995; Basavarajappa and Savanurmath, 1996 and Mahmoud, Sauad, 2000).

The present work was carried out to evaluate the effect of four mulberry varieties (i.e. Kanva-2; Kokuso-27; Moritiana and Balady) on some biological characters of three bivoltine silkworm breeds (CG16, EM6 and JH3).

MATERIALS AND METHODS

The present study was carried out in the laboratories of sericultural Hgro-Mier Company, Assuit Governorate, during seasons of 1998 and 1999.

Four mulberry varieties were used i.e. Moritiana, Kokuso-27, Kanva-2 and Balady. Three biovltine silkworm breeds (JH3, CG16, EM6) were obtained from Hgro-Mier Company.

The effect of mulberry varieties on some biological characters of the above mentioned breeds were studied. Each breed was fed on leaves of four mulberry verities separately by using 300 silk-worm larvae, for each replicate. So, larvae of each replicate were kept on a plastic tray (100 x 70 x 15 cm.) under rearing room at 27 $\pm$ 2°C and 75 $\pm$ 5RH%.

Mulberry leaves were plucked twice daily for larval feeding, i.e. at 8a.m and at 4 p.m., thereafter, the leaves were washed, dried and stored until needed and offered 4 times daily.

The larval bed was cleaned daily. Mature larvae were handily transferred to the mounting fork. The cocoons were harvested for studying the biological characters. After emergence, each couple of moth was impaired in paper sacule for copulation and oviposition.

All biological parameters of different stages were carried out and measured throughout the study as follows:

1.Larval stage:

a. Percentage of larval mortality.
b. Larval instar duration period
c. Weight of full- grown larvae and silk gland at the end of the 5th instar just before moulting (ten full grown larvae were take at random in each replicate).
d. Percentage of cocooning.

2. Pupal stage:

a. Percentage of pupation
b. Pupal duration.
c. Pupal weight.

3. Adult stage:

a. Percent emergence of adult moths.
b. Longevity of male and female moths.
c. Fecundity (No. of deposited eggs / female).
d. Fertility (No. of fertile eggs/ female).

Chemical analysis of mulberry leaves components:

Fresh mulberry leaves of varieties Kanva-2, Kokuso-27 , Moritiana and Balady were subjected to a chemical analysis to determine the leaf content of total crude protein, total carbohydrate and humidity (Table 1).

1. Estimation of total nitrogen was carried out according to Koch and Meekin (1924) method.
2. The total crude protein content of the leaves was calculated by multiplying total nitrogen by 6.25 (according to formula crude protein = nitrogen content x 6.25). Kjeldhl methods (A.O.A.C. 1965).

3.Determination of the total carbohydrates was achieved according to Bermfeld (1955) methods.

4. Determination of humidity was made by subtracting the difference between the completely dried (in an oven 105ºC till the constant weight) and fresh leaves weight.

Data obtained were statistically analyzed according to Snedecor and Cochran (1976) and by using software costat program.

Table (1): Total nitrogen, total crude protein, total carbohydrate and moisture content in four different mulberry varieties.

Components / mulberry Variety	Total nitrogen	Total crude protein (%)	Total carbohydrate (%)	Moisture content (%)
Kanva-2	3.27	20.43	23.34	72.68
Kokuso-27	3.03	18.93	23.70	72.84
Moritiana	3.15	19.68	25.63	70.07
Balady	3.05	18.06	24.33	69.65

RESULTS AND DISCUSSION

1-Larval stage :

1.1.Larval duration :

Data recorded in Table (2) declare that, larvae fed on the leaves of Moritiana var. induced the longest duration period of the 1st (5.28 days), 3rd (6.12 days), 4th (7.29 days) instars and the total larval duration (32.32 days). Meanwhile, the shortest period, in general was recorded with Kanva-2 var. (29.48 days).

Regarding the silkworm breeds, it was noticed that breed JH3 gave the longest period of the 2nd (4.03 days) and the 4th (7.38 days) instars; whereas, breed CG16 showed the shortest period.

Significant differences were detected between the tested breeds in 4th and 5th larval instars and the total larval duration period.

It could be concluded that the shortest and significant duration period of larval stage of the three studied silkworm breeds was recorded when the larval was fed on the leaves Kanva-2 variety; However, the longest one was recorded for larvae of breed JH3 fed on Moritiana variety leaves.

Accordingly, the duration period of the larval stage varied significantly from one breed to another being the longest period (33.58 days) was recorded for JH3 breed; while, the shortest duration period (30.78 days) was recorded for CG16 breed. In addition, leaves of mulberry variety has much more effect in this concern than the role of silkworm breeds and differences of larval duration period ranged between (29.48 days) for Kanva-2 and (32.32 days) for Moritiana variety. This variation could be attributed to the nutritional values of the tested mulberry varieties. For instance, data recorded in Table (1) revealed that Moritiana leaves contain the highest total carbohydrates (25.63%) whereas Kanva-2 variety leaves contain the lowest total carbohydrates (23.34%). On the contrary, Moritiana leaves contain the lowest moisture content (70.07%) as compared to leaves of Kanava-2 variety (72.68%).

Data of the present work in parallel with those of Pillai and Jolly (1985), Silayach and Khokhar (1995) and Mahmoud, Souad (2000). However, data of the present work disagreed with those of Gabriel and Rapusas (1976) who reported that there was no significant difference in the duration period of larval stage when fed on leaves of mulberry varieties.

1.2. Larval mortality percentage :

Data in Table (3) revealed that the percentage mortality in the first larval instar significantly affected by silkworm breeds which the highest values were detected in larvae of breeds CG16 fed on mulberry leaves of Balady variety. However, the percentage of larval mortality was not affected by other mulberry varieties, while the second and 3rd instars were not affected either by silkworm breed or mulberry variety.

The fourth instar was significant affected by mulberry variety where Moritiana and Balady varieties increased mortality percentage and not affected by silkworm breeds.

On the contrary, mortality percentage in the fifth instar was not affected by mulberry varieties; while significant variations were detected between breeds.

As for the larval mortality, the obtained data show that significant differences were noticed between the total mortality percentage and silkworm breeds, being the highest values (29.80%) were recorded with JH3 breed, and the lowest (22.91%) recorded with EM6. Also, larval mortality recorded the highest values when fed on leaves of Moritiana and Balady varieties.

Mortality of larvae of silkworm could be attributed to the low protein content of Moritiana and Balady leaves (18-19%) while, protein content in Kanva-2 variety (that caused the least percent mortality) was relatively higher (20.43%). In addition, low moisture content in leaves of Moritiana and Balady (70.07-69.65%) may be also a responsible for increasing percent of mortality as compared with the percent of moisture in Kanva-2 and Kokuso-27 vars. that ranged between 72.68-72.84%, Table (1).

These results are in partial accordance with those of **Hafiz (1992)**, who reported that the higher protein content in mulberry leaves caused lower mortality percentage.

1.3. Larval body weight (g.) :

The obtained data (Table, 4) showed significant differences between mulberry varieties and silkworm breeds reared. As such, larvae of JH3 breed showed the heaviest body weight (3.122 g.) however, breed CG16 showed the lowest one (2.714 g.) regardless of mulberry variety. In addition, feeding larvae on leaves of Kanva-2 induced the highest significant body weight, regardless of silkworm breed reared.

The same results were also reported by many investigators (Muhammad, *et al.*, 1984; Raman *et al.,* 1995; Karimullah *et. al,* 1989; Bheemanna, *et. al.,* 1990; Das and Vijayaraghavan, 1990; Hafiz, 1992 and Mahmoud, Soad, 2000) who found that the varied effect of feeding larvae on mulberry leaves of different varieties on the growth and weight of larvae. In addition, Giridhar and Reddy, 1991; Qader *et al.,* 1992 and Qader *et al.,* 1995) reported that the varied larval growth and weight of tested silkworm breed also detected.

1.4. Length and weight of silk gland :

Data recorded in Table (4) showed insignificant differences between silkgland larvae of tested breeds fed on leaves of different mulberry varieties either silkgland length or weight; however, differences between mulberry varieties concerning silkgland length are significant, where larvae fed on both kanva and Moritiana gave the longest silkgland (29.36 & 29.28 cm) respectively.

As for the silkgland weight, larvae fed on Kanav-2 gave the heaviest silkgland (0.9063 g.).

It can be concluded that nutritional value of the leaves of Balady variety may contribute in reducing the growth and weight of the silkgland of larvae. The chemical analysis of the leaves of tested mulberry varieties (Table 1) cleared that the leaves of Balady contain the lowest percentage of protein (18.06%), carbohydrate (24.35%) and moisture (69.65%) as compared to the other three varieties. This conclusion is in accordance with that of Qader *et al.* (1995), Qader and Haque (1996).

2. Pupal stage :

2.1.Cocooning percentage :

Obtained data (Table 5) revealed that mean cocooning percentage is greatly affected by both silkworm breed and mulberry variety, where larvae reared on Kanva-2 leaves induced the highest percentage cocooning (96.33%) in general. Concerning silkworm breeds, EM6 breed showed the highest percentage (94.35%). Anyhow, the highest absolute cocooning percentage (97.57%) was recorded for JH3 breed fed on Kanva-2; while, the lowest one (89.26%) was recorded for the breed (JH3) fed on Balady leaves.

The differences between breeds and varieties were mostly significant. The same trend was also reported by many investigators (Gabriel and Rapusas, 1976 and Bheemanna *et al.,* 1989a,b,c).

2.2. Pupation percentage :

Data obtained indicate that feeding silkworm larvae on the leaves of Kanva-2 induced the highest values (88.46%), the lowest one was recorded for breed CG16 (85.03%). Generally, the highest pupation (92.50%) was detected for larvae of breed EM6 where fed on Kanva-2 leaves.

2.3. Pupal duration :

It is clearly that from the same Table (5), feeding larvae of the tested breeds on the leaves of Kokuso-27 and Kanva-2 showed significant short duration period of pupal stage (10.52 and 10.62 days). In addition, JH3 larvae have the least duration period (10.67 days).

The differences between treatments were mostly significant. Data of the present work are in partial accordance with those of Silayach and Khokhar (1995) who reported that the duration period of pupal stage ranged between 11.96-13.6 days. However, data of Alvarez (1993) are relatively higher than the data of the present work as the author recorded 15.4 days as a mean duration period of pupal stage. This wide variation could be attributed to the silkworm breed and the mulberry variety or to the two factors together.

2.4. Pupal weight :

Data also revealed that the highest pupal weight (1.181 g.) was noticed in JH3 breed followed by breed EM6 (1.037 g.) then breed CG16 (1.036 g.) without significant differences between CG16 and EM6 breeds. In addition, feeding larvae on Kanva-2 leaves caused significant increase in the pupal weight recorded (1.318 g.).

3.Adult stage :

3.1. Percent emergence of adult moth :

The percentage of adult moth emergency (Table 6) showed significant differences between mulberry varieties and between silkworm breeds. For instance, the highest values were recorded for larvae fed on mulberry variety Kanva-2 (95.36%) with EM6 breed (94.59%).

These results are in parallel with those reported by Silayach and Khokhar (1995) who stated that the percent emergence of adult silkworm ranged between 95 to 98.73%. Similarly, Shaheen *et al.,* (1992) stated that the nutritional value of mulberry leaves offered to silkworm larvae affected significant the percentage of adult emergence. Also, Bheemanna *et al.,* (1990) stated that percent emergence of adult silkworm differed from one mulberry variety to another.

3.2. Male longevity :

The mean longevity (days) of male moth arisen from larvae of silkworm fed on the tested mulberry varieties was slightly affected (insignificant); meanwhile, significant differences were detected between the silkworm breeds where the highest value was recorded for breed JH3.

3.3. Female longevity :

Obtained results clear that both mulberry varieties and silkworm breeds induced significant effect on the female longevity manifested. Generally, the highest values (13.58 days) were recorded for breed EM6 when fed on variety Moritiana. 3.4. Fecundity :

Data in Table (6) indicate that the highest mean number of eggs laid per female (428.02 eggs) was recorded for breed EM6 followed closely by breed JH3 (427.04 eggs). Concerning mulberry varieties, it is obvious that feeding larvae on the leaves of Moritiana and Kokuso-27 induced the fertility of female moth recording : 431.66 and 430.66 eggs/female, respectively. The highest female moth fecundity (449.0 eggs/female) was recorded for breed EM6 when fed on the leaves of Kokuso-27. Differences between treatments were significant in most cases.

Obtained data show positive significant correlation coefficient between the weight of pupae and fecundity. The conclusion is in agreement with that of (Jayaswal *et al.,* 1991; Shaheen *et al.,* 1992 and Narayanswamy and Gowda, 1989) who detected positive significant correlation between the two parameters. The varied number of eggs/female according to the variety of mulberry leaves previously fed to the larvae recorded in the present work is in agreement with that of Pillai and Jolly (1985).

3.5. Fertility percentage :

The mean percentage of fertile eggs/female moth resulted from larvae of the three breeds fed on leaves of the tested mulberry varieties nearly similar with the exception that of breeds : EM6 and JH3 when fed on the leaves of Balady and Moritiana varieties (Table 6). Yet, the best result in this concern was recorded for breed CG16 fed on different mulberry varieties (96.44 to 96.94%). Raju *et al.,* (1990) reported that percentage of fertility of laid eggs clearly differed due to mulberry varieties and silkworm races.

REFERENCES

Alvarez, R.J.A. (1993). Biology of silkworm, *Bombyx mori* L. (Lepidoptera: Bombyeidae) Revista colombiana de Entomologia. 19 (4) : 119-122.

A.O.A.C. (1965). Official methods of analysis 10th Ed. Washington, D.C.

Basavarajappa, S. and Savanurmath, C.J. (1996). Effect of different mulberry varieties during late age silkworm *Bombyx mori* L. on incidence of grasseri and cocoon characters. Under pradesh Journal of Zoology : 16 (2) : 104-108.

Bermfeld, P. (1955). Method in enzymology. Vol. (1):149-154 (Acad. Press.; New York) in S. P. Colowick and N. O. Kaplan (Eds.)

Bheemanna, C.; Govindan, R.; Ashoka, J. and Narayanaswaney, T.K. (1989a). Larval traits of bivoltine silkworm breeds as influenced by mulberry varieties. Mysore Journal of Agricultural Science : 23 (4) 520-525.

Bheemanna, C.; Govindan, R.; Ashoka, J. and Narayanaswaney, T.K. (1989b). Effect of mulberry varieties on pupal and allied traits of some bivoltine silkworm races. Karnaika Journal of Agricultural Science, 2 (3) : 192-198.

Bheemanna, C.; Govindan, R.; Ashoka, J. and Narayanaswaney, T.K. (1989c). Growth indices for silkworm *Bombyx mori* L. on some mulberry varieties. Environment and Eology.7(3):743-747.

Bheemanna, C.; Govindan, R.; Ashoka, J. and Narayanaswaney, T.K. (1990). Growth indices for NB7 breed of silkworm *Bombyx mori* L. on some mulberry varieties. Environment and Eology. 8 (3) : 816-820.

Das, P. K. and Vijayaraghavan, K. (1990). Studies on the effect of different mulberry varieties and seasons on the larval development and cocoon characters of silkworm *Bombyx mori* L. Indian Journal of Sericulture : 20 (1) : 44-53.

Gabriel, B. P. and Rapusas, H. R. (1976). The growth and development of *Bombyx mori* L. at different leaf maturity and variety of mulberry. Philippine Agriculturist : 60 (3-4): 139-146.

Giridhar, K. and Reddy, N. S. (1991). Performance of parental bivoltine silkworm (*Bombyx mori* L.) breeds on new mulberry (*Morus sp.*) varieties. Indian Journal of sericulture 30 (1):23-29.

Hafiz, J. A. (1992). Effect of mulberry varieties on the development and cocoon shell of Japanese varieties of *Bombyx mori* L. Pakistan Journal of Forestry : 42 (4) : 228-235.

Jayaswal, K.P.; Singh, T. and Rao, G.S. (1991). Effect of female pupal weight on fecundity in mulberry silkworm *Bombyx mori* L. Indian Journal of Sericulture : 30 (2) : 141-143.

Karimullah; Qaisar, Jamal; Ahmad, M. I.; Hafiz, I.A.; Ashiq. M.N.; Shah, M.F. and Jamal, Q. (1989). Effect of some varieties of mulberry on the development of *Bombyx mori* L. and cocoon quality. Sarhad Journal of Agriculture: 5 (5):489-492.

Koch, F.C. and Mc.Meekin, T. L. (1924). Rapid determination of total nitrogen. Journal American Chem. Soc., 20 : 46-66.

Mahmoud, Souad (2000). Feeding effect of different mulberry varieties on *Bombyx mori* L. silkworm. Egypt Journal Appl. Sci. 15 (6) : 253-261.

Muhammad, Saleem and Manzoor-UL-Haq (1984). Rearing of silkworm, *Bombyx mori* L. on different mulberry varieties. Journal of Agriculture Research, Pakistan : 22 (1) 63-66.

Narayanswamy, T. K. and Gowda, B.I.V. (1989). Influence of pupal weight on performance of fecundity, rearing and reeling in the silkgland (*Bombyx mori* L.). Mysore Journal of Agricultural Sciences : 23 (1) : 57-61.

Petkov, Z. (1995). Study of hybrid progeny of the mulberry varieties kinriu and Kokuso-21 following open pollination Rastenier “dni Nauki” 32 (7-8) : 153-158.

Pillai, S. V. and Jolly, M. S. (1985). An evaluation on the quality of mulberry varities raised under hill conditions and the crop of *Bombyx mori* L. Indian Journal of sericulture : 24 (2) : 48-52.

Qader, M. A.; Haque, R and Asbar, N. (1992). Nutritive effects of different types of mulberry leaves on larval growth and cocoon characters of *Bombyx mori* L. Pakistan Journal of Zoolog : 27 (4) : 341-345.

Qader, M. A.; Haque, R and Asbar, N. (1995). Nutritive effects of bush and low cut and tree mulberry leaves of economic characters of silkworm, *Bombyx mori* L. Pakistan Journal of Zoology. 27 (1) : 77-81.

Qader, M. A. and Haque, T. (1996). Estimation of fibroin protein in posterior silkgland of *Bombyx mori* L. feeding mulberry leaves under different cultivation forms. Pakistan of Zoology : 28 (1) : 9-24.

Raju, C.S; Pallavi, S.N.; Reddy, M.M.; Suryanarayana, N.; Singhal, B.K. and Senguptu, K. (1990). Evaluation of four new mulberry varieties through silkworm rearing under irrigated condition. Indian Journal of sericulture : 29 (2) : 240-247.

Raman, K.V.A., Mala, V.R.; Magadum, S.B. and Daha, R.K. (1995). Effect of seasons and mulberry varieties on the fed compression efficiencies of different silkworm hybrids of *Bombyx mori* L. Uttar Pradesh Journal of Zoology : 15 (3) : 15 (3) : 157-161.

Shaheen, A.; Trag, A.R.; Nabi, G. and Ahmed, F. (1992). Correlation between female pupal weight and fecundity in bivoltine silkworm *Bombyx mori* L. Entomon : 17 (1-2) : 109-111.

Silayach, US. and Khokhar, K.S. (1995). The biology of silkworm, *Bombyx mori* L. on various cultivars of mulberry. Annals of Biology. Ludhiana : 11 (1-2) : 145-149.

Snedecor, G.W. and Cochran, W.G. (1976). Statistical methods. Iowa State University Press, Iowa, USA.

تأثير التغذية على أصناف التوت المختلفة على بعض الصفات البيولوجية لبعض سلالات ديدان الحرير التوتية (*Bombyx mori* L.)

سعد إبراهيم يوسف خليل*، محمد على الديب*، عبدالعزيز محمود محسن* و محمود سعد إبراهيم**

*** قسم وقاية النبات - كلية الزراعة بالزقازيق – جامعة الزقازيق**

**** معهد بحوث وقاية النباتات بالزقازيق**

فى دراسة أجريت عن تأثير التغذية بأربعة أصناف من أوراق التوت (Kanva-2, Kokuso-27, Mortiana and Balady) على بعض الصفات البيولوجية لديدان الحرير تحت الظروف المعملية أوضحت النتائج المتحصل عليها ما يلى :

تختلف طول مدة الطور اليرقى اختلافاً معنوياً بين سلالات ديدان الحرير او بين اصناف التوت . وسجلت اقصر مدة طور يرقي (28.11 يوم) للسلالة CG16 عندما ربيت اليرقات على صنف التوت Kanva-2 . وكان اطول مدة طور يرقي (33.58 يوم) للسلالة JH3 المرباه على الصنف Mortiana .

وبالإضافة إلى ذلك تأثرت النسبة المئوية لموت اليرقات معنوياً بسلالة ديدان الحرير وصنف التوت والعمر اليرقى ، وسجلت أعلى القيم للسلالة CG16 وصنف التوت البلدى والعمر اليرقى الأول (35.55 %) .

ولقد أوضحت النتائج أن وزن جسم اليرقة يزيد زيادة معنوية فى السلالة JH3 وفى اليرقات التى تتغذى على أوراق التوت صنف Kanva-2 عند مقارنتها بسلالات ديدان الحرير وأصناف التوت محل الدراسة.

وفى هذا المجال اتضح أيضاً أن وزن وطول غدة الحرير يزداد معنوياً فى اليرقات التى تتغذى على أوراق التوت صنف Kanva-2 عند مقارنتها بالأصناف الأخرى. بينما كان طول ووزن غدة الحرير غير معنوياً بين يرقات سلالات ديدان الحرير المختبرة الاخرى.

وسجلت اليرقات من السلالة EM6 المغذاة على أوراق صنف التوت Kanva-2 أعلى نسب فى التشرنق والتعذر0

سجلت السلالة JH3 والصنف Kanva-2 أكبر وزن للعذارى. كذلك أعطت السلالة EM6 وصنف التوت Kanva-2 أعلى القيم للنسب المئوية لخروج الفراشات .

كما أوضحت النتائج أن فترة حياة إناث الفراشات تتأثر معنوياً بصنف التوت وسلالة دودة الحرير (حيث سجل الصنف Moritiana والسلالة EM6 أعلى القيم في هذا الصدد). بينما تأثرت فترة حياة الذكور بسلالة ديدان الحرير فقط (السلالة JH3 تتفوق فى هذا المجال) .

وفيما يتعلق بخصوبة الفراشات الاناث الناتجة من يرقات ربيت على التوت البلدى فقد لوحظ انخفاض الخصوبة فيها عند استخدام السلالة CG16, كما لوحظ وجود علاقة موجبة بين وزن العذارى والخصوبة.

كذلك اتضح أن النسبة المئوية للبيض المخصب يزداد معنوياً فى يرقات السلالة CG16 المرباه على اوراق صنف التوت Kokuso-27 بالمقارنة بسلالات ديدان الحرير أو أصناف التوت الأخرى.

Table (2): Larval duration periods of different instars (in days of three silkworm breeds affected by feeding on different mulberry varieties during autumn season of 1998.

Larval instar	1st				2nd				3rd				4th				5th				Total larval stage			
Silkworm breeds / Mulberry variety	CG_{16}	EM_6	JH_3	Mean	CG_{16}	EM_6	JH_3	Mean	CG_{16}	EM_6	JH_3	Mean	CG_{16}	EM_6	JH_3	Mean	CG_{16}	EM_6	JH_3	Mean	CG_{16}	EM_6	JH_3	Mean
Kanva-2	5.11	5.06	5.08	5.08	3	4	4.13	3.71	5	5.98	5.66	5.22	6	6	7.43	6.47	9	9	8	8.66	28.11	30.04	30.31	29.48
Kokuso-27	5.13	5.33	5.09	5.20	4	4	4	4	6	5	5	5.33	5.92	8.02	7.08	7.01	11	9.27	9.98	10.08	32.05	31.62	31.20	31.62
Moritiana	5.24	5.35	5.26	5.28	4	4	4	4	6	6	6.35	6.12	6.89	7	7.99	7.29	9.67	9.24	9.98	9.63	31.80	31.59	33.58	32.32
Balady	5.21	5.25	5.02	5.16	4	4	4	4	4.9	6	5	5.33	7	7	7	7	10.05	10.21	10.85	10.37	31.16	32.46	31.87	31.83
Mean	5.17	5.24	5.11		3.75	4	4.03		4.49	5.5	5.5		6.45	7	7.38		9.93	9.43	9.70		30.78	31.43	31.74	
LSD var.	N.S				N.S				N.S				0.2781**				0.2723**				0.4625*			
LSD breed	N.S				N.S				N.S				0.1986*				0.2592*				0.3893*			
LSD var.x breed	N.S				N.S				N.S				0.3972*				1.6394*				0.7787*			

Table (3): Mortality percentage of different instars larvae affected by feeding silkworm breeds on different mulberry varieties during autumn season of 1998.

Larval instar	1st				2nd				3rd				4th				5th				Total larval stage			
Silkworm breeds / Mulberry variety	CG_{16}	EM_6	JH_3	Mean	CG_{16}	EM_6	JH_3	Mean	CG_{16}	EM_6	JH_3	Mean	CG_{16}	EM_6	JH_3	Mean	CG_{16}	EM_6	JH_3	Mean	CG_{16}	EM_6	JH_3	Mean
Kanva-2	1.56	0.77	2.66	1.66	1.79	1.45	3.08	2.11	0.34	1.81	4.35	2.17	1.49	1.95	2.28	1.91	4.87	2.46	3.28	3.54	17.77	17.77	28.44	21.32
Kokuso-27	3.33	0.99	1.11	1.81	3.33	1.79	1.64	2.25	3.80	2.36	2.36	2.84	2.98	2.59	3.17	2.91	8.40	3.40	3.76	5.19	26.99	17.66	26.55	23.73
Moritiana	2.22	2.33	2.55	2.36	2.72	1.82	3.19	2.57	3.96	4.63	3.54	4.04	5.44	4.49	2.66	4.20	8.81	6.62	1.88	5.77	30.77	29.66	32.55	30.99
Balady	3.44	2.66	3.33	3.14	2.99	2.62	3.41	3.00	3.55	5.40	3.52	4.16	4.95	5.45	3.42	4.60	8.35	6.53	3.41	6.10	35.55	26.55	31.66	31.25
Mean	2.63	1.69	2.41		2.71	1.92	2.83		2.91	3.55	3.44		3.72	3.62	2.88		7.61	4.75	3.08		27.77	22.91	29.80	
LSD var.	N.S				N.S				N.S				1.3231**				N.S				4.1736**			
LSD breed	0.6922*				N.S				N.S				N.S				1.437**				2.9498**			
LSD var.x breed	1.3846*				N.S				N.S				N.S				N.S				5.8999**			

NS (Not significant) *** Significant** **** Highly significant**

Table (4): Average weight of the larvae three silkworm breeds and weight and length of their silkgland as affected by feeding on mulberry varieties during autumn seasons 1998.

Larval instar	Larval body weight (g.)				Silkgland length (cm.)				Silkgland weight (g.)			
Silkworm breeds / Mulberry variety	CG_{16}	EM_6	JH_3	Mean	CG_{16}	EM_6	JH_3	Mean	CG_{16}	EM_6	JH_3	Mean
Kanva-2	3.948	3.902	3.518	3.789	30.00	31.26	26.83	29.36	0.9156	0.8916	0.9118	0.9063
Kokuso-27	2.420	2.402	3.274	2.698	28.40	27.53	29.93	28.62	0.7325	0.7730	0.8253	0.7769
Moritiana	2.295	2.659	2.653	2.535	29.53	29.06	29.26	29.28	0.5693	0.5840	0.5693	0.5742
Balady	2.196	2.402	3.046	2.548	23.93	25.46	26.60	25.33	0.6506	0.6142	0.6140	0.6263
Mean	2.714	2.841	3.122		27.96	28.33	28.15		0.717	0.715	0.730	
LSD var.	0.1246*				0.9628**				0.2887**			
LSD breed	0.0820*				N.S				N.S			
LSD var.x breed	0.1640*				2.2300**				4.6957*			

Table (5): Biological aspects of pupal stage of three silkworm breeds affected by feeding on four mulberry varieties during autumn season of 1998.

Larval instar	Cocooning (%)				Pupation (%)				Pupal duration (days)				Pupal weight (g)			
Silkworm breeds / Mulberry variety	CG_{16}	EM_6	JH_3	Mean	CG_{16}	EM_6	JH_3	Mean	CG_{16}	EM_6	JH_3	Mean	CG_{16}	EM_6	JH_3	Mean
Kanva-2	93.89	97.54	97.57	96.33	84.70	92.50	88.20	88.46	10.63	11.06	10.16	10.62	1.421	1.196	1.338	1.318
Kokuso-27	90.37	95.41	89.69	91.82	87.50	87.79	82.65	85.98	9.93	10.66	10.96	10.52	0.924	1.110	1.190	1.074
Moritiana	89.58	91.32	90.77	90.56	84.25	86.35	83.89	84.83	13.46	11.03	10.76	11.75	0.939	1.001	1.052	0.997
Balady	96.08	93.13	89.26	92.82	83.68	87.54	86.38	85.86	11.80	11.06	10.80	11.22	0.860	0.844	1.125	0.943
Mean	92.48	94.35	91.82		85.03	88.55	85.28		11.45	10.95	10.67		1.036	1.037	1.181	
LSD var.	0.9663**				2.3403*				0.3258**				0.1886**			
LSD breed	1.5070**				2.4568*				0.3616**				N.S			
LSD var.x breed	3.0042**				N.s				0.7232**				N.S			

Table (6): Biological aspects of emerged adult moth of three silkworm breeds as a fffected by feeding on different mulberry varieties during autumn season of 1998.

Larval instar	Emergency (%)				Male longevity (days)				Female longevity (days)				Fecundity				Fertility (%)			
Silkworm breeds / Mulberry variety	CG_{16}	EM_6	JH_3	Mean	CG_{16}	EM_6	JH_3	Mean	CG_{16}	EM_6	JH_3	Mean	CG_{16}	EM_6	JH_3	Mean	CG_{16}	EM_6	JH_3	Mean
Kanva-2	93.26	97.49	95.34	95.36	3.62	4.29	4.87	4.26	9.66	10.33	11.75	10.58	400.58	441.58	443.25	428.47	96.87	95.63	95.57	96.02
Kokuso-27	91.72	95.03	88.79	91.85	3.31	4.20	4.61	4.04	11.66	11.48	10.58	11.24	409.91	449.00	436.08	431.66	96.62	96.76	95.77	96.38
Moritiana	95.49	92.76	88.66	92.30	3.46	4.29	4.11	3.95	11.08	13.58	11.64	12.10	430.33	430.33	431.33	430.66	96.44	94.67	94.69	95.26
Balady	88.88	93.09	90.37	90.78	3.70	4.37	4.95	4.34	10.59	13.34	11.75	11.89	388.75	391.16	397.50	392.47	96.94	93.79	94.66	95.13
Mean	92.34	94.59	90.79		3.52	4.29	4.63		10.75	12.18	11.43		407.39	428.02	427.04		96.72	95.21	95.17	
*r													0.915	0.912	0.525		0.728	0.633	0.795	
LSD var.	2.5467*				N.S				0.8952*				8.6279**				0.8337*			
LSD breed	2.3242*				0.2313**				0.4631*				8.0996**				0.8936**			
LSD var.x breed	N.S				N.S				0.9264*				16.2000**				N.S			

*** r = correlation between female pupal weight, fecundity and fertility**

J. Agric. Sci. Mansoura Univ., 32 (12): 10455 - 10468, 2007