STUDYING THE PERFORMANCE OF SILKWORM, Bombyx mori L. RACES FED WITH DIFFERENT MULBERRY VARIETIES

Article · January 2007

1 author:

Syed IShfaq Ali Shah
China Agricultural University
19 PUBLICATIONS **23** CITATIONS

SEE PROFILE

STUDYING THE PERFORMANCE OF SILKWORM, *Bombyx mori* L. RACES FED WITH DIFFERENT MULBERRY VARIETIES

Syed Ishfaq Ali Shah[*], Imtiaz Ali Khan[*], Zahid Hussain[**], Maqsood Shah[*], Amjad Usman[*] and Amna Sadozai[*]

ABSTRACT

The performance of three silkworm (*Bombyx mori* L.) races viz; Chinese, Japanese and F_1 (Korean) on three mulberry varieties (Husang China, Japan Early and Chinese Evergreen) was studied under laboratory conditions of 25±2°C, 70±10% RH and 16:8 (L:D) photoperiod at Peshawar. The life cycle and mean size of full grown larvae, mean number of late moulters and cocoon shell ratio were greatly influenced by the nutritive value of the different mulberry varieties. The interaction between mulberry varieties and *B. mori* races was significant for the mean size of full grown larvae and cocoon shell ratio. The maximum size of full grown larvae (6.81 cm) and cocoon shell ratio (21.81%) was recorded in Chinese race fed with Husang China variety and minimum size of full grown larvae (5.57 cm) and cocoon shell ratio (18.60%) was recorded in F_1 (Korean) race fed with Chinese Evergreen. The races and varieties individually were significantly different regarding size of full grown larvae and cocoon shell ratio. Similarly, there was significant interaction between the varieties and races for the mean number of late moulters. A minimum number of late moulters (8.5) were recorded in Chinese race x Husang China variety and maximum (28.5) in F_1 (Korean) x Chinese evergreen. Non-significant results regarding mean number of late moulters were recorded for *B. mori* races, while significant for mulberry varieties.

Keywords: *Bombyx mori*, Cocoon, Larvae Size, Mulberry Variety, Races, Shell Ratio, Silkworm

INTRODUCTION

Sericulture is the science of rearing silkworm for the commercial production of raw silk and includes the operations, which are required for the production of silk fiber (Krishna-swami *et al.* 1973). *Bombyx mori* L. (Lepidoptera, Bombycidae) is the common silkworm. *B. mori* undergoes complete metamorphosis, i.e. its life cycle passes through four stages including egg, larva, pupa and adult. Besides silk used in manufacturing of cloth, it is also used in making of surgical sutures, artificial blood vessel, tire lining, parachute, electric insulating material, oil, protein and artificial vitamins; even its waste material (excreta) is used as artificial diet for animals and as green manure for crops (Ishfaq and Akram, 1999).

In Pakistan, sericulture is practiced in all the four provinces and Azad and Jammu Kashmir; however, the main activity of natural silk production is practiced around the irrigated forest plantation of Changa Manga, Kamalia, Chichawatni and Multan in Punjab province (Anonymous, 1990). *B. mori* adults are creamy white in colour with several faint brownish lines. They do not feed, rarely fly and usually live only for a few days.

Each female lays 300 to 500 eggs and the eggs hatch in about 12 days. When used for a commercial purpose, the pupae are killed before the adults emerge, otherwise the emergence of the moths break the fibers into pieces. Each cocoon is composed of single thread of about 914 meters long. About 3000 cocoons are required to make a pound of silk (Borrer *et al.* 1981).

The *B. mori* is host specific insect and feeds only upon leaves of mulberry (*Morus* species) to make cocoon as its protective layer. Substance that attract the *B. mori* larvae to the leaves have been identified as citral, linalyl, acetate, linalool, terpinyl acetate and hexenol, the first three being more effective. Betasitosterol along with some sterols and water-soluble substance is the main factor which during feeding stimulates the biting action of *B. mori* (Anonymous, 1976). Mulberry leaves are rich in protein and amino acids. It is known that there is high correlation between leaf protein level and production efficiency of cocoon shell, which means cocoon shell weight to the total amount of mulberry leaves consumed by the *B. mori* (Mechii and Katagiri, 1991). Therefore, increase in protein level may lead to improvement in productivity of cocoons and silk.

Qader *et al.* (1992) investigated the nutritive effects of leaves of three mulberry varieties on larval growth and cocoon characters of three *B. mori* races. The result revealed that mature larval weight, single cocoon weight, shell weight, shell percentage and length of filament were greatly influenced by the nutritive value of different mulberry leaves. Different species of mulberry may have compositional differences and might lead to varying effects on *B. mori* growth and silk productions (Mahmood *et al.* 1987).

Keeping in view the above-mentioned importance of *B. mori* in sericulture, the experiment was conducted with the objective to study the effects of three mulberry varieties on the performance and life cycle of three *B. mori* races.

[*] Department of Entomology, NWFP Agricultural University Peshawar - Pakistan
[**] Department of Weed Science, NWFP Agricultural University Peshawar - Pakistan

MATERIALS AND METHODS

The research was conducted at the Sericulture Wing of Forest Department, Shami Road, Peshawar in which three *B. mori* races i.e. Chinese, Japanese and F_1 (Korean) were reared each on three mulberry varieties i.e. Husang China, Japan Early and Chinese Evergreen under laboratory conditions at 25±2°C temperature and 70±10% RH up to 5th larval instar in a 15 x 14 ft rearing room. There were 9 experimental units (3 races x 3 varieties) replicated 4 times. Each experimental unit comprised of a rearing tray, which had 50 larvae of 1st instar.

The rearing room was white-washed and fumigated with sulphur dioxide gas. Rearing trays, stands, incubator and all other tools were disinfected with Formaldehyde (2%) solution. Six hundred larvae of 1st instar were selected from the bulk of each race of *B. mori*. Wooden trays with size of 20 cm x 32 cm were used for rearing of 1st, 2nd and 3rd instars, while 60 cm x 75 cm for 4th and 5th instars larvae. The orders of the trays were changed daily. Chopped mulberry leaves of each variety were provided 5 times daily at the interval of 3-5 hours. First feed was given at 6 am while last feeding was at 10 pm daily.

1st and 2nd instar larvae were fed with 1st and 2nd leaves starting from the tip of the branch and chopped double in size of larvae. During 3rd, 4th and 5th instars they were fed with full leaves. Bed change was carried out two times in 2nd instar, 3 times in 3rd instar and daily during 4th and 5th instars. Nets with meshes of various sizes were used for cleaning. The larvae were highly dusted before the first feed with (3%) bleaching powder during active stages. During molting or sleeping stage, the larvae were not fed or dusted.

For incubation the eggs of Chinese, Japanese and F_1 (Korean) races were kept in incubator under the following climatic conditions.

Days	Humidity	Light (Lux)	Temperature
1-3	70-75 %	30-50	15 °C
4	75-80 %	30-50	20 °C
5-6	80-85 %	30-50	23-24 °C
Till Hatching	80-85 %	30-50	25-26 °C

Two days before the expecting date of hatching all the eggs laid on cards were wrapped in wax paper to avoid the mixing of races. After hatching the larvae of each race were brushed with the help of white hen feather and transferred into general tray. Before brushing, the newspaper was placed at the bottom of each rearing tray, which was moist and covered with plastic sheet to conserve humidity. Temperature and R.H. was recorded with the help of Hygro-thermometer.

The data were collected on the following parameters: Size of full grown larvae (cm), Mean number of late moulters and Cocoon shell ratio (%).

RESULTS AND DISCUSSION

Size of full grown larvae

The results about the mean size of full grown larvae of each race of *B. mori* on each variety of mulberry are given in Table I. The mean size of full grown larvae of Chinese race of *B. mori* was 6.81, 6.65 and 5.70 cm; of Japanese race was 6.68, 6.45 and 5.65 cm and 6.66, 6.40 and 5.57 cm for F_1 (Korean) race when fed on the Husang China, Japan Early and Chinese Evergreen varieties, respectively.

Analysis of the data showed that on Husang China variety of mulberry the larvae attained significantly maximum size followed by Japan Early and then Chinese Evergreen variety. Similarly, the size attained by the Chinese and Japanese race of *B. mori* (being non-significant from one another) was significantly more than F_1 (Koran) on all the three varieties of mulberry.

Mean number of late moulters out of 50 larvae

Table II shows the results of experiment on mean number of late moulters of the three *B. mori* races on three mulberry varieties. The mean number of late moulters in Chinese race of *B. mori* was 8.50, 17.25 and 25; in Japanese race 10, 19 and 26.25 and in F_1 (Korean) race the number of late moulters was 11.65, 16.50 and 28.50 when fed on mulberry varieties Husang China, Japan Early and Chinese Evergreen respectively. Moreover, the mean number of late moulters i.e 10, 17.58 and 26.58 in these varieties were significantly different. In case of *B. mori* races, the mean numbers of late moulters were not significantly different.

Cocoon shell ratio (%)

Table III represents the results of experiment on mean of cocoon shell ratio (%) of the three *B. mori* races on three mulberry varieties. Mean of cocoon shell ratio of Chinese race of *B. mori* was 21.81, 21.58 and 21.24%; of Japanese race 21.76, 21.38 and 20.77%; the mean cocoon shell 19.77, 19.37 and 18.60% of F1 (Korean) when fed on the

mulberry varieties Husang China, Japan Early and Chinese Evergreen respectively.

Statistical analysis of the data indicates that significantly highest cocoon shell ratio was recorded in Chineses race when fed on Husang China mulberry variety followed by Japan Early, while in case of *B. mori* races the significantly maximum cocoon shell ratio was observed in Chinese race followed by Japanese race.

Mean size of full grown larvae

The three *B. mori* races showed significant variation in means size of full grown larvae (cm) when fed on three mulberry varieties. Maximum means size of full grown larvae 6.38 cm was recorded of Chinese race, while minimum of 6.2 cm of F_1 (Korean) race. Mean size of full grown larvae was significantly differed on the three mulberry varieties. Among the varieties, Husang China was the best variety. Similarly, the interaction of the races and mulberry varieties were also significant. The best results were shown by the Chinese race fed with mulberry variety Husang China. Ahmad (1987) found mean size of full grown larvae of the *B. mori* 80- 60 mm in case of bivoltine races and 70-53 mm in multivoltine races.

The differences observed in the results of present and earlier experiments might be due to the fact that different *B. mori* races and varieties were tested. Also, the present and earlier experiments were conducted in different climatic conditions.

Mean number of late moulters

Means number of late moulters differed significantly for the mulberry varieties resulting in lowest mean number of 10 late moulters as obtained from Husang China and maximum mean number of late moulters 26.58 from Chinese Evergreen. The races were non-significantly different. The highest mean number of late moulters was recorded in F_1 (Korean) race, while less in Chinese race. There was significant interaction between mulberry varieties and *B. mori* races with the highest mean number of late moulters were observed in F_1 (Korean) x Chinese Evergreen. Chaluvachari and Bongale (1995) analyzed leaf quality of several mulberry varieties. They reported that moulting ratios and higher larval weights were associated with higher values of leaf moisture content, moisture retention and lower values of sugar: protein ratios.

Cocoon shell ratio (%)

In these experiments the results for cocoon shell ratio of *B. mori* races fed with three mulberry varieties were significantly different. Maximum (21.54%) cocoon shell ratio was noted in Chinese race, while minimum (19.25%) in F_1 (Korean) race. The cocoon shell ratio differed significantly among the mulberry varieties, with highest cocoon shell ratio recorded in variety Husang China and lowest in Chinese Evergreen. The interaction between mulberry varieties and *B. mori* races were also significant, showing maximum cocoon shell percentage by Chinese race having fed on variety Husang China while significantly smallest cocoon shell percentage was observed in F1 (Korean) race on variety Chinese Evergreen. Muslim (1977) reported almost similar results that single cocoon weight was 1.85g, cocoon shell weight was 0.37g and cocoon shell ratio percentage was 21.51%. Bheemanna *et al*. (1989) obtained cocoon shell ratio percentage with 24.66 g/10 cocoons of *B. mori* fed with mulberry varieties Mysore local.

The reason behind the maximum cocoon shell ratio (%) may probably be due to the optimum leaf moisture, higher protein and sugar content of the mulberry variety and different climatic conditions as well as different *B. mori* races in the present and earlier experiments.

CONCLUSION AND RECOMMENDATIONS

The performance of three *Bombyx mori* races to three mulberry varieties was studied in the Sericulture Wing of NWFP Forest Department, Shami Road, Peshawar. The results of the three *B. mori* races mean size of full grown larvae was recorded on the three mulberry varieties were significantly different. Mean size of full grown larvae was largest (6.38 cm) of Chinese race. Mean size of full grown larvae the *B. mori* was (6.71cm) on variety Husang China. Similarly, the interaction effect was significant with the largest mean size of full grown larvae (6.81 cm) of Chinese race fed with Husang China variety. The results of the mean number of late moulters differed significantly for the mulberry varieties with highest mean number of 26.58 from Chinese Evergreen. The results of experiment for the races were non-significantly different. There was found significant interaction between mulberry varieties and *B. mori* races highest mean number of 28.50 late moulters in F_1 (Korean) x Chinese Evergreen.

The results for cocoon shell ratio of *B. mori* races fed with the three mulberry varieties were significantly different. Highest cocoon shell ratio 21.54% was recorded in Chinese race. The cocoon shell ratio differed significantly among the mulberry varieties; with highest 21.11% cocoon shell ratio recorded in variety Husang China The interaction effect was also significant, showing maximum 21.81% cocoon shell ratio for Chinese race fed on variety Husang China.

Table-I: ***Size of full grown larvae (cm) of three B. mori races reared on three mulberry varieties***

Races of B. mori	*Mulberry Varieties*			*Means of Races*
	Husange China	*Japan Early*	*Chinese Evergreen*	
Chinese	6.81 a	6.65 ab	5.70 d	6.38 a
Japanese	6.68 a	6.45 bc	5.65 d	6.26 ab
F_1 (Korean)	6.66 ab	6.40 c	5.57 d	6.21 b
Means of Varieties	6.71 a	6.50 b	5.64 c	

Means followed by different letters are significantly different at 0.05 level of probability using LSD test.
LSD value at 0.05 level of probability for interaction = 0.23; for races = 0.135; for varieties = 0.135

Table-II. ***Mean number of late moulters of three B. mori races reared on three mulberry varieties***

Races of B. mori	*Mulberry Varieties*			*Means of Races*
	Husange China	*Japan Early*	*Chinese Evergreen*	
Chinese	8.50 e	17.25 cd	25.0 ab	16.92
Japanese	10.0 e	19.0 bc	26.25 a	18.42
F_1 (Korean)	11.50 de	16.50 cd	28.50 a	18.83
Means of Varieties	10.0 c	17.58 b	26.58 a	

Means followed by different letters are significantly different at 0.05 level of probability using LSD test.
LSD value at 0.05 level of probability for interaction = 6.076; for varieties = 3.53

Table-III: ***Percent cocoon shell ratio of three B. mori races reared on three mulberry varieties***

B. mori Races	*Mulberry Varieties*			*Means of Races*
	Husang China	*Japan Early*	*Chinese Evergreen*	
Chinese race	21.81 a	21.58 ab	21.24 c	21.54 a
Japanese race	21.76 a	21.38 bc	20.77 d	21.31 b
F_1 (Korean) race	19.77 e	19.37 f	18.60 g	19.25 c
Means of Varieties	21.11 a	20.78 b	20.20 c	

Means followed by different letters are significantly different at 0.05 level of probability using LSD test.
LSD value at 0.05 level of probability for interaction = 0.238; for races = 0.137 for varieties = 0.137

REFERENCES

Ahmad, M. 1987. Comparative studies on the effect of the food on the larval development and silk yield in an exotic and indigenous strain of *Bombyx mori*. M.Sc (Hons) Thesis, Deptt. Agric. Entomol. Univ. Agric. Faisalabad.

Anonymous. 1976. Council of Scientific and Industrial Research. The Wealth of India. 11 Vols. New Delhi.

Anonymous. 1990. Sericulture in Pakistan. Pak. J. Forest. 4(2): 23-27.

Baig, M., B. Nataraju and M.V. Samson. 1990. Studies on the spread of diseases in the rearing of *Bombyx mori* through different sources of contamination. Ind. J. Seric. 29(1): 145-146.

Bheemanna, C., R.Govindan, J.Ashoka and T.K. Narayanaswamy. 1989. Growth indices for *Bombyx mori* on some mulberry varieties. Environ. and Ecol. 7(3): 743-747.

Borrer, D.J., D. M. Delong and C.A. Triplehorn. 1981. An Introduction to the study Insect. 5th Edition. CBS College Pub. New York. 535p.

Chaluvachari, and U.D. Bongale. 1995. Evaluation of leaf quality of some germplasm genotypes of mulberry through chemical analysis and bioassay with *Bombyx mori*. Indian J. Seric. 34(2): 127-132.

Ishfaq, M. and W. Akram. 1999. Reshum kay kerhun key parwarish. 1st Edition. Pak Book Empire Publishing, Lahore. 11-12pp.

Krishnaswami, S.j., M.N. Narasimhanna, S.K. Suryanarayan and S. Kumararaj. 1973. Manual of Sericulture, silkworm rearing. F.A.O. United Nation, Rome. 121p.

Mahmood, K., M. Ahmad and A.H. Gilani. 1987. Effect of Feeding Leaves of *Morus alba* & *Morus Leavigata* on larval Growth and silk yield of silkworm, *Bombyx mori*, Pak. J. Zool. 19(3): 239-243.

Mechii, H. and K. Katagiri. 1991. Varietal difference in nutritive values of mulberry leaves for rearing silkworms. JARQ. 25(2): 202-208.

Muslim, M.M. 1977. Trials on autumn rearing in Pakistan. Pak. J. forestry. 27(2): 55-109.

Qader, M.A., R. Haque and N. Absar. 1992. Nutritative effects of different types of mulberry leaves on larval growth and cocoon characteristics of *Bombyx mori* L. Pak. J. Zool. 24(4): 341-345.