

## COMPARISON OF THREE SILKWORM RACES FED WITH THREE MULBERRY VARIETIES

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### ABSTRACT

Chinese, Japanese and F<sub>1</sub> (Korean) silkworm races were fed with Husang China, Japan Early and Chinese Evergreen mulberry varieties and were studied under laboratory conditions at Pakistan Forest Institute Peshawar during 2004-05. The interaction for sex ratio and fecundity was significantly high (45% female to male) 527.5 eggs/female were recorded in Chinese race fed with Husang China mulberry variety, and significantly lowest (14.5% female to male) 220 eggs/female as observed in F<sub>1</sub> (Korean) race x Chinese Evergreen mulberry variety. Among the races and varieties individually, the results of female to male sex percentage and fecundity was non-significant for *B. mori* races, while significant for mulberry varieties. The results of races x varieties interaction of larval, pupal and adult survival (%) were significant. Maximum larval (92.0%), pupal (83.0%) and adult (82.25%) survival was recorded in Chinese race fed with Husang China, while minimum larval (42.25%) pupal (37.25%) and adult (33.50%) survival was noted in F<sub>1</sub> (Korean) race fed with variety Chinese Evergreen. Among the races and varieties individually, the results of larval, pupal and adult survival percentage was significantly different for both the *B. mori* races and mulberry varieties.

**Key words:** *Bombyx mori* L., Mulberry, Silkworm, Variety

### INTRODUCTION

The science of rearing silkworm for the commercial production of raw silk is termed as sericulture and it includes the operations which are required for the production of silk fiber (Krishnaswami *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).

Sericulture is practiced in all the four provinces of Pakistan and also in 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). Pakistan's economy, largely depend on Agriculture and its raw products. The production of raw silk is inadequate to meet requirements of the textile industry. If the textile industry is provided with adequate raw silk, Pakistan can not only save its precious foreign exchange (i.e. reduce imports) but can also improve its economy by exporting the surplus commodity. Since the majority of population lives in rural areas and the villagers including men, women and children can increase their income through rearing of *B. mori* in their spare time. This process ends earlier than wheat crop harvest. Even they can

easily get two generation of *B. mori* one after the other (Ishfaq and Akram, 1999).

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 belongs to Genus *Morus* of Family Moraceae. There are 35 species of *Morus*, which are broadly classified into Dolichostylae with long style and Macromorus without style. At present there are more than 1000 variety of mulberry, which are being cultivated and classified into three types *M. bombycis* K., *M. alba* L., and *M. latifolia* L. (Gopal, 1994).

Kobayashi (1982) reported that varietal improvement of mulberry through breeding not only gives superior leaf yield for feeding the *B. mori* but also better raw silk and its adaptability to climatic conditions and resistance against diseases. 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). The growth rate of *B. mori* larvae and subsequent silk production depend mainly on the nutrient contents of mulberry leaves.

Keeping in view the above-mentioned importance of *B. mori* and sericulture, the experiment was conducted with the objective to study the effects of

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three mulberry varieties on the performance of three *B. mori* races.

#### MATERIALS AND METHODS

The research was conducted at Sericulture Wing of Forest Department, Shami Road, Peshawar during 2004-05 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°C temperature and 70% RH up to 5<sup>th</sup> 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 1<sup>st</sup> instar.

White-washed rearing room was used fumigated with sulphur dioxide gas. Rearing trays, stands, incubator and all other tools were disinfected with Formaldehyde (2%) solution. Six hundred larvae of 1<sup>st</sup> 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 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> instars, while 60 cm x 75 cm for 4<sup>th</sup> and 5<sup>th</sup> 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.

#### Climatic conditions for incubation of the eggs of Chinese, Japanese and $F_1$ (Korean) races

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

Two days before the expected date of hatching all the eggs laid on cards, specially meant for this purpose, 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: Sex ratio (%), Fecundity (no. of eggs/female) and Survival percentage.

#### RESULTS AND DISCUSSION

In this section, the results as well as discussion of the different experiments on the studies on the performance of three silkworm (*Bombyx mori* L.) races on three mulberry varieties are presented.

##### Female to Male Sex Ratio (%)

Table I indicates the results concerning the mean sex ratio of female to male. The sex ratio of female to male sex of Chinese race of *B. mori* was 45, 33 and 19% when fed with the Husang China, Japan Early and Chinese Evergreen varieties of mulberry respectively. In case of Japanese race the sex ratio was 43, 31 and 16.50% respectively and in case of  $F_1$  (Korean) race the sex ratio was 40.50, 28.50 and 14.50% on these respective varieties of mulberry. Statistical analysis showed that the mean sex ratio was significantly maximum on Husang China mulberry variety followed by Japan Early and then Chinese Evergreen. It is clear from the results given in the table that sex ratio of the three *B. mori*

races on three mulberry varieties were not significantly different.

The results of the female to male sex percentage was non significant for *B. mori* races, while significant for the mulberry varieties. Highest (42.83%) female to male sex percentage was obtained in Husang China and lowest (16.67%) in Chinese Evergreen variety. Among the races the Chinese race gave better results. The interaction among races and varieties was significant with maximum female to male sex percentage observed in Chinese race x Husang China mulberry variety. Similar work has been done by Ray *et al.* (2000) and Sarker *et al.* (1995).

##### Fecundity (Number of Eggs/Female)

The results related to mean fecundity are given in Table II. The mean number of eggs/female in case of Chinese race of *B. mori* was 527.5 on Husang China, 400 on Japan Early and 263.8 on Chinese Evergreen. In case of Japanese race, the mean number of eggs/female was 509.5, 375 and 247 respectively on Husang China, Japan Early and Chinese Evergreen, where as in case of  $F_1$  (Korean) race the respective numbers was 480, 355 and 220 per female. Statistical analysis of the data showed that the mean of eggs/female on mulberry variety was significantly highest on Husang China followed by Japan Early and then Chinese Evergreen. Among the three *B. mori* races there were no significant differences in the numbers of eggs/female when fed on different mulberry varieties.

The fecundity (no. of eggs/female) for the mulberry varieties was significantly different with highest (505.7 eggs/female) mean fecundity recorded in variety Husang China. The fecundity of *B. mori* for the races was non-significant. The results of races x varieties was significant with highest fecundity recorded in Chinese race fed with mulberry variety Husang China. Previous authors have reported variations in fecundity of *B. mori* i.e. 300-400 eggs/female (Borror and DeLong 1954), 300-500 eggs/female (Metcalf and Flint 1962), 500-750 eggs/female (Moldoveanu 1972), and 500-800 eggs/female by (Craioiu and Craioiu 1975).

Bheemanna *et al.* (1997) also studied fecundity due to the influence of different mulberry varieties on different silkworm races. Evangelista and Takahashi (1997) and Madhuri *et al.* (1997) reported similar results. The reason for the higher fecundity reached in the present experiments might be due to the positive influence of leaf moisture and protein contents of the leaves of the mulberry varieties. In addition, the different environmental conditions as well as *B. mori* races were used during the conduction of the experiments.

#### **Survival of Different *B. mori* Developmental Stages**

##### **Larval Survival (%)**

Table III shows the results of the larval survival of the three *B. mori* races on three mulberry varieties. The percent larval survival was 92, 67.50 and 45.7 in case of Chinese race of *B. mori* when fed on Husang China, Japan Early and Chinese Evergreen varieties of mulberry respectively. In case of Japanese race the percent larval survival was 83.25, 63.50 and 42.75 respectively on Husang China, Japan Early and Chinese Evergreen mulberry varieties and 78.75, 59.75 and 40.25 in F<sub>1</sub> (Korean) race respectively. Statistical analysis of the data showed that significantly maximum larval survival was found in Husang China mulberry variety followed by Japan Early and Chinese Evergreen. Among the races, the maximum larval survival was recorded in Chinese race followed by Japanese race, while Japanese and F<sub>1</sub> (Korean) race were statistically non significant.

##### **Pupal Survival (%)**

Table IV indicates the results of the pupal survival of the three *B. mori* races on three mulberry varieties. In percent pupal survival was 83, 60 and 43 in case of Chinese race of *B. mori* when fed on Husang China, Japan Early and Chinese Evergreen varieties of mulberry respectively. In case of Japanese race the percent pupal survival was 78.50, 56 and 39.75 respectively on Husang China, Japan Early and Chinese Evergreen mulberry varieties and 74.75, 52.25 and 37.25 in F<sub>1</sub> (Korean) race respectively.

Statistical analysis of the data showed that the significantly maximum pupal survival was found in Husang China mulberry variety followed by Japan Early and Chinese Evergreen. Among the races, the pupal survival maximum larval survival of Chinese race and Japanese race were statistically non significant, while the significant difference were found between Chinese and F<sub>1</sub> (Korean) race of *B. mori*.

##### **Adult Survival (%)**

Table V indicates the results of the adult survival of the three *B. mori* races on three mulberry varieties. In percent adult survival was 82.25, 58.25 and 40.50 in case of Chinese race of *B. mori* when fed on Husang China, Japan Early and Chinese Evergreen varieties of mulberry respectively. In case of Japanese race the percent adult survival was 78.25, 54.50 and 36.50 respectively on Husang China, Japan Early and Chinese Evergreen mulberry varieties and 74, 49 and 33.50 in F<sub>1</sub> (Korean) race respectively. Statistical analysis of the data showed that the significantly maximum adult survival was found in Husang China mulberry variety followed by Japan Early and Chinese Evergreen. Among the races, the adult survival of Chinese race and Japanese race were statistically non significant, while the significant difference were found between Chinese and F<sub>1</sub> (Korean) race of *B. mori*.

The survival percentage for the larvae, pupae and adult of the three *B. mori* races was significant. Maximum survival percentage for larvae (68.42%), pupae (62.0%) and adult (60.33%) was recorded in Chinese race. Among the varieties, the survival percentage was also significantly different with the highest larval, pupal and adult recorded in variety Husang China. The interaction between *B. mori* races and mulberry varieties was also significantly different, where maximum survival percentage for larval, pupal and adult was recorded in Chinese race x variety Husang China. Baig *et al.* (1990) reared *B. mori* using previously contaminated rooms, trays and seat papers without disinfections. The diseases, flacherie and grasserie were 29.53 and 14.35%, respectively, as compared with 6.35 and 14.21% following disinfections. There were corresponding reductions in yield. The higher survival percentage recorded might be due less disease prevalence in the present experiments.

#### **CONCLUSION**

The performance of three *Bombyx mori* races fed with three mulberry varieties was studied in the Sericulture Wing of NWFP Forest Department, Shami Road, Peshawar. The results of female to male sex percentage among the *B. mori* races was non significant, but it was significant different for

varieties. The highest (32.33%) female to male sex percentage was noted for Chinese race and maximum (42.83%) for Husang China variety. The interaction for races x varieties was significant with maximum (45%) female to male sex percentage observed in Chinese race x Husang China mulberry variety. The fecundity results for the races were non-significant with maximum no. of eggs/female (397.1) recorded in Chinese race. *B. mori* laid significantly highest no. of eggs/female (505.7) on variety Husang China. The results also showed significant interaction between races x varieties with the highest fecundity no. of 527.5 eggs/female

in Chinese race x variety Husang China. The results of larval, pupal and adult survival of *B. mori* races were significantly different. Larval survival was maximum with 68.42%, pupae with 62.0% and adult 60.33% of Chinese race. Among the varieties, the survival percentage of different stages was also significantly different with the highest larval 84.67%, pupal 78.75% and adult (78.17%) survival recorded in variety Husang China. The results of races x varieties interaction were also significantly different. Maximum larval survival 92.0%, pupal, 83.0% and adult 82.25% was recorded in Chinese race x variety Husang China.

**Table I. Mean sex ratio (%) of females to males of three *B. mori* races reared on three mulberry varieties**

<i>B. mori</i> Races	Mulberry Varieties			Means of Races
	Husang China	Japan Early	Chinese Evergreen	
Chinese race	45.0 a	33.0 b	19.0 c	32.33
Japanese race	43.0 a	31.0 b	16.50 c	30.17
F <sub>1</sub> (Korean) race	40.50 a	28.50 b	14.50 c	27.83
Means of Varieties	42.83 a	30.83 b	16.67 c	

LSD value at 0.05 level of probability for interaction = 7.366; for varieties = 4.253

**Table II. Mean number of eggs/female of *B. mori* races reared on three mulberry varieties**

<i>B. mori</i> Races	Mulberry Varieties			Means of Races
	Husange China	Japan Early	Chinese Evergreen	
Chinese race	527.5 a	400.0 b	263.8 c	397.1
Japanese race	509.5 a	375.0 b	247.0 c	377.2
F <sub>1</sub> (Korean) race	480.0 a	355.0 b	220.0 c	351.7
Means of Varieties	505.7 a	376.7 b	243.6 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 = 64.03; for varieties = 36.97

**Table III. Percent larval survival of three *B. mori* races reared on three mulberry varieties.**

<i>B. mori</i> Races	Mulberry Varieties			Means of Races
	Husang China	Japan Early	Chinese Evergreen	
Chinese race	92.0 a	67.50 c	45.75 d	68.42 a
Japanese race	83.25 b	63.50 c	42.75 d	63.17 b
F <sub>1</sub> (Korean) race	78.75 b	59.75 c	40.25 d	59.58 b
Means of Varieties	84.67 a	63.58 b	42.52 c	

LSD value at 0.05 level of probability for interaction = 8.114; for races = 4.685 for varieties = 4.685

**Table IV. Percent pupal survival of the three *B. mori* races reared on three mulberry varieties.**

<i>B. mori</i> Races	Mulberry Varieties			Means of Races
	Husange China	Japan Early	Chinese Evergreen	
Chinese race	83.0 a	60.0 b	43.0 cd	62.0 a
Japanese race	78.50 a	56.0 b	39.75 d	58.08 ab
F <sub>1</sub> (Korean) race	74.75 a	52.25bc	37.25 d	54.75 b
Means of Varieties	78.75 a	56.08 b	40.0 c	

LSD value at 0.05 level of probability for interaction = 11.34; for races = 6.548 for varieties = 6.548

**Table V. Mean adult survival (%) of the three *B. mori* races reared on three mulberry varieties**

<i>B. mori</i> Races	Mulberry Varieties			Means of Races
	Husang China	Japan Early	Chinese Evergreen	
Chinese race	82.25 a	58.25 b	40.50 cd	60.33 a
Japanese race	78.25 a	54.50 b	36.50 d	56.42 ab
F <sub>1</sub> (Korean) race	74.0 a	49.0 bc	33.50 d	52.17 b
Means of Varieties	78.17 a	53.92 b	36.83 c	

LSD value at 0.05 level of probability for interaction = 12.43; for races = 7.177 for varieties = 7.177  
Means followed by different letters are significantly different at 0.05 level of probability using LSD test.

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