EVALUATION OF FOUR LOCAL SIMPLE HYBRIDS OF SILKWORM *BOMBYX MORI* L.

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INTRODUCTION

Hybrid vigour have been extensively carried out by plant (Marani, 1967; Kaushik *et al.*, 1984) and animal breeders (Singh *et al.*, 1990 and Eid *et al.*, 2002) to select suitable parents, which can use to produce the hybrid every season and hybrids to assess the nature and magnitude of gene action involved in various characters. Heterosis of F_1 hybrids was calculated in terms of better-parent (an equation use to evaluate the heterosis over the better parent value), mid-parent (an equation to evaluate the heterosis over the mid parent value) and evaluation index (an equation used to evaluate the hybrids) (Singh *et al.*, 2001; Rao *et al.*, 2002; Reddy *et al.*, 2003 and Begum *et al.*, 2003). The present study was undertaken to study the hybridization between the bivoltine and bivoltine or monovoltine inbreeds to improve their characters. Also, to determine elite hybrids which exploited to isolate the evolved local parents and also, to identify the promising combination for commercial exploitation, which can be distributed to the farmers for silk production.

MATERIAL AND METHODS

Two bivoltine inbreeds (DjM and DchP) and three monovoltine inbreeds (380, NoviP and NoviM) obtained from the Sericulture Research Department (SRD) have been utilized in the present study. The characteristics of these inbreeds are as follows:

1-DchP have plain larvae, oval and white cocoons.

2-DjM have larvae with dark markings. The cocoons white in colour and pea-nut in shape.

3-380 M, a Chinese univoltine entry. Larvae are dark markings, oval and white cocoons.

4- Novi M, an Italian univoltine entry. It has dark marking larvae. Cocoons white in colour, elongated waisted in shape.

5- Novi P, an Italian univoltine entry. It has plain larvae. Cocoons white in colour, elongated waisted in shape. The bivoltine inbred were derived from hybrid, while monovoltine inbred imported from Italy, each of them subjected a breeding program since 1993 to isolate pure lines. The crosses were made and coded as follows:

1- DjM X 380 (A).
2- DjM X DchP (B).
3- DchP X NoviP (C).
4- NoviM X DchP (D).

Silkworm rearing was carried out according to Krinshswamy 1978. Three replicates from each hybrid were reared during one Autumn season (September-October) under the laboratory normal conditions at 23.54°C and 66.81 % RH, each replicate contained 400 larvae in a wooden trays, the dimensions of each rearing tray was 120 x 60 cm . Data were recorded for cocoon weight (CW), cocoon shell weight (SW), pupal weight (PW), cocoon shell ratio (SR), silk productivity (SP) and total larval duration (LD).The weights of cocoon, cocoon shell and pupa were recorded by gram, while cocoon shell ratio as percentage, larval duration recoded by day and silk productivity were recorded by centigram/day. So, the data were transformed to percentage by using the formulae of heterosis over better and mid parent value and absolute value by using the formula of evaluation index.

Silk productivity was estimated by using formula of Chattopadhyay *et al.*, 1995.

$$\text{Silk productivity (cg/day)} = \frac{\text{Cocoon shell weight (cg)}}{\text{Fifth instar duration (day)}}$$

Where cg: Centigram

Cocoon shell ratio for each entry was calculated for both sexes according to Tanaka (1964) as follows:

$$\text{Cocoon shell ratio (\%)} = \frac{\text{Cocoon shell weight (cg)}}{\text{Fresh cocoon weight}} \text{ X } 100$$

Heterosis was estimated by using the following formulae of Rao *et al.* 2002:

1- Heterosis over better parent value (BPV) = $\frac{\bar{F}_1 - BPV}{BPV} \times 100$

2- Heterosis over mid parent value (MPV) = $\frac{\bar{F}_1 - MPV}{MPV} \times 100$

Where: F_1: mean of hybrid

BPV: The best value of the parents involving in the hybridization.

MPV: The average value of the parents involving in the hybridization.

The best hybrid that has a positive value over better and mid parent for any character, while the hybrid has negative value is better for larval duration.

Also, evaluation index was calculated by using the following formula according to Mano *et al.*, (1993):

$$\text{Evaluation index (EI)} = \frac{A - B}{C} \times 10 + 50$$

Where:

A= Value obtain for a particular trait of the particular hybrid.

B= Mean value of the particular trait of all the considered hybrids.

C= Standard deviation (n-1) of a particular trait all the considered hybrids.

10 = standard unit, 50 = Fixed value

In order to judge superiority of hybrid genotypes impartially, a common evaluation index is necessary to be adopted giving equal emphasis to all the commercial economic traits. The average of evaluation index value fixed to select a hybrid genotype is over 50. Only the hybrids with an evaluation index value higher than 50 have been considered of great economic importance.

RESULTS AND DISCUSSION

Data registered in Table.1 showed that the hybrid C was the best for cocoon weight (1.79 %), cocoon shell weight (4.18 %), pupal weight (1.56 %), cocoon shell ratio (0.64 %). Hybrid D was the better for cocoon weight (9.63 %), cocoon shell weight (0.64 %), pupal weight (15.64 %). Direction and value of heterosis is diversified for different characters and also for different hybrids. Similar results are obtained by Rao and Sahai (1989), Singh *et al.*,(1990) , Rahman *et al.*,(1992) and

Singh *et al.*,(2002) who studied heterosis in different hybrid combinations for many characters of *Bombyx mori* L. involving cocoon weight, cocoon shell weight and cocoon shell ratio. The results explain that the degree and direction of heterosis varied for different characters and for different hybrid combinations.

Table 2 showed the heterosis over mid parent value. It is obvious that hybrid C was the better hybrid for cocoon weight, cocoon shell weight, pupal weight and cocoon shell ratio. Main values of mid parent were 2.55, 6.72, 2.20 and 3.29 % for the previous character, respectively. While, hybrid D was the best for cocoon weight (14.05 %), cocoon shell weight (7.17 %) and pupal weight (17.79 %). The data revealed that some hybrids acquired positive heterosis for some characters and the others acquired negative heterosis. So, the hybrids, which acquired positive hybrid vigour can be used to increase silk production and to select suitable parents for breeding. These results are in agreement with the findings of Singh *et al.*, (1998) and Roa *et al.*, (2002) who evaluated hybrid vigour for different hybrid combinations (several F_1 hybrids of silkworm, *B. mori*), the results of the hybrid vigour effects over mid parent value for several quantitative characters (cocoon weight, shell weight, shell ratio, fecundity and cocoon yield by number and weight). The results indicated that some hybrids manifesting positive hybrid vigour for quantitative characters. So, these hybrids can be used to increase silk production and to select suitable parents for breeding.

Evaluation index values are presented in table 3. It is revealed that, the hybrid A was the better for cocoon weight, cocoon shell weight, pupal weight, cocoon shell ratio, silk productivity and total larval duration (LD). Evaluation index values were (63.08 ♀ & 60.39 ♂ an absolute values), (63.53 ♀ & 63.08 ♂), (60.58 ♀ & 59.38 ♂), (56.49♀ & 57.56 ♂) and (64.35 ♀ & 64.57 ♂) (35) for cocoon weight, cocoon shell weight, pupal weight, cocoon shell ratio, silk productivity and larval duration, respectively. Also, A hybrid was the best for the average of evaluation index (58.91). Meanwhile, hybrid D showed better evaluation index for cocoon weight (52.57 ♀ & 55.35 ♂) and pupal weight (56.265 ♀& 56.63♂), and also has a better average of evaluation index (50.45). Some hybrids earned best values for evaluation index and also for average of evaluation index. Similar findings were reported by Babu *et al.*, (2002) who evaluated eighteen new bivoltine simple silkworm *B. mori* hybrids by using evaluation index method. The results indicated that one hybrid combination being the best among the 18 hybrids. Also, Singh (2001) studied evaluation index in some three way crosses. Results recorded that, some hybrids have better values of evaluation index and mean of evaluation index.

TABLE (I)

Hybrid vigour values (%) over better parent value for four silkworm hybrids.

Variety	*A			B			C			D		
Characters	Female	Male	Mean	Female	Male	Mean	Female	Male	Mean	Female	Male	Mean
**CW	-1.66	-6.20	-3.93	-7.11	-20.53	-13.82	10.69	-7.11	1.79	15.58	3.68	9.63
SW	-5.46	-7.53	-6.50	-15.48	-23.08	-19.28	16.36	-8.00	4.18	3.91	-2.64	0.64
PW	-1.25	-6.15	-3.70	-4.93	-19.72	-12.32	12.02	-8.90	1.56	20.97	10.31	15.64
CSR	-4.60	-1.86	-3.23	-8.89	-3.26	-6.07	2.88	-1.61	0.64	-11.60	-7.53	-9.57
S P	-3.58	-7.53	-5.55	-36.61	-42.31	-39.46	-15.38	-33.09	-24.24	-24.43	-29.19	-26.81
LD	0.00			3.33			6.90			3.33		

Note: *A: DjM X 380, B: DjM X DchP, C: DchP X NoviP , D: NoviM X DchP

**CW: Cocoon weight, SW: Shell weight, PW: Pupal weight, CSR: Cocoon shell ratio, SP: Silk productivity, LD: Larval duration.

TABLE (II)

Hybrid vigour values (%) over mid parent value for four silkworm hybrids.

Variety	A			B			C			D		
Characters	Female	Male	Mean	Female	Male	Mean	Female	Male	Mean	Female	Male	Mean
CW	-0.27	-3.33	-1.80	1.01	-9.49	-4.24	12.07	-6.97	2.55	18.10	10.00	14.05
SW	-4.53	-3.91	-4.22	-2.87	-9.36	-6.12	18.81	-5.37	6.72	9.29	5.04	7.17
PW	0.06	-3.03	-1.48	4.18	-9.73	-2.77	12.78	-8.39	2.20	22.11	13.48	17.79
CSR	-4.09	-0.98	-2.53	-4.03	0.65	-1.69	5.19	1.40	3.29	-7.37	-5.28	-6.33
S P	0.55	0.94	0.75	-27.15	-32.02	-29.59	-8.63	-27.25	-17.94	-16.10	-19.48	-17.79
LD	-1.695			3.33			5.09			3.33		

TABLE (III)

Evaluation index value of different characters for four silkworm hybrids.

Characters Variety	CW		SW		PW		CSR		SP		LD	Average
	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male		
A	63.08	60.39	63.53	63.08	60.58	59.38	56.49	57.56	64.35	64.57	35	58.91
B	42.18	46.59	41.72	47.75	43.43	46.45	46.35	53.93	41.38	44.12	55	46.26
C	42.18	37.68	51.53	38.88	39.72	37.54	59.55	53.24	37.62	35.27	55	44.38
D	52.57	55.35	43.22	50.30	56.26	56.63	48.43	42.87	45.85	48.45	55	50.45

SUMMARY

Two bivoltine and three monovoltine inbred have been utilized in the present study. Four hybrids were crossed and evaluated during Autumn seasons, the hybrids were coded A, B, C and D. It could be concluded that, hybrid C was the best for cocoon weight, cocoon shell weight, pupal weight, cocoon shell ratio, while hybrid D was the better for cocoon weight, cocoon shell weight , pupal weight over the better and mid parent values. Hybrid A was the better for all characters under study for evaluation index value .Also, hybrid A was the best hybrid for the average of evaluation index.

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