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EVALUATION OF HETEROSIS IN THE NEWLY EVOLVED BIVOLTINE HYBRIDS OF SILKWORM, *Bombyx Mori*

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ABSTRACT

The studies on the heterosis for the newly evolved bivoltine hybrids CSR2 x CSR4 and CSR2 x CSR5 and their reciprocals have shown significant superiority over their parents. Heterosis was recorded highest in case of CSR2 x CSR5 for fecundity (29.63%) as compared to other hybrids and also the heterobeltiosis (26.32%). Out of the hybrids studied as per evaluation index for all the traits, CSR2 x CSR5 registered maximum score *i.e.*, 58.59 than its reciprocal (44.14) and other hybrids CSR2 x CSR4 (53.61) and CSR4 x CSR2 (44.37), respectively. The hybrids CSR2 x CSR5 and CSR2 x CSR4 can be commercially exploited for obtaining maximum yield and better benefits at farmers level.

KEY WORDS : Silkworm, *Bombyx mori*, bivoltine hybrids, heterosis

The pioneering work of Toyama (1906) on the hybridisation of silkworm in Japan and the use of F1 hybrids for commercial rearings made an epoch in the history of sericulture. The hybrid era in Indian sericulture commenced in 1922 in Karnataka where crosses between indigenous Pure Mysore and Japanese races were popularised. During 1975, the improved cross breed PM x NB4D2 was introduced and since then, there has been a considerable improvement in cocoon yield, silk recovery, etc. Bivoltine have higher coccon yield and filament qualities than cross breeds. Several bivoltine hybrids were released with uniform hatching, robustness, shorter larval duration, higher cocoon economic characters than parent.

In the present study, the heterotic effects of newly evolved breeds *viz.*, CSR2, CSR4 and CSR5 were investigated.

MATERIALS AND METHODS

Newly evolved bivoltine silkworm races like CSR2, CSR4 and CSR5 by Central Sericultural Research and Training Institute, Mysore (India) and their combinations CSR2 x CSR4, CSR4 x CSR2, CSR2 x CSR5, CSR5 x CSR2 were utilised for the present study. Heterosis and heterobeltiosis were estimated using the above material. Rearing procedure and economic characters were recorded as suggested by Krishnaswami (1978). Heterosis, heterobeltosis and evaluation index were recorded as per the method suggested by Mano *et al.*, (1993). Hybrid which has higher value for the evaluation index can be selected for commercial exploitation.

RESULTS AND DISCUSSION

Rearing performance (Table 1) shows that CSR2 x CSR5 recorded significant values for all

Table 1. Evaluation of bivoltine hybrids and their parents

Race	Fecundity (No)	Yield/10,000 larvae		Cocoon Wt. (g)	Shell Wt. (g)	S.R. %	Pupation rate %
		By no.	By Wt. (Kg)				
CSR 2	483	9071	15.29	1.73	0.386	22.25	88
CSR 4	559	9044	15.09	1.75	0.389	22.20	86
CSR 5	509	8826	14.85	1.71	0.380	22.25	86
CSR2x CSR4	573	9466	16.88	1.80	0.422	23.56*	94*
CSR4x CSR2	551	9336	16.51	1.78	0.411	23.37	92
CSR2x CSR5	643	9390*	17.41	1.88	0.448	23.86	93
CSR5x CSR2	609	9303	16.54	1.82	0.419	23.15	91
CD (P=0.05)	46.90	197.44	0.85	0.05	0.021	0.60	2.84

Table 2. Heterosis values for seven different characters in silkworm (%)

Race	Fecundity (No)	Yield/10,000 larvae		Cocoon Wt.	Shell Wt.	S.R. %	Pupation rate %
		By no.	By Wt.				
CSR2x	9.98	4.51	11.12	3.44	9.29	6.03	7.65
CSR4							
CSR4x	5.75	3.41	8.68	2.29	7.31	5.17	5.74
CSR2							
CSR2x	29.63	5.03	15.52*	9.30	15.28*	7.23	6.59
CSR5							
CSR5x	22.78	3.96	9.75	5.81	9.54	4.04	4.29
CSR2							
CD (P=0.05)	15.27	0.96	4.14	4.27	4.73	1.86	1.96

the characters except yield by numbers followed by CSR2 x CSR4 for yield by number, shell ratio % and pupation rate. All the hybrids recorded yield/number more than 93% and SR 23%.

All the hybrids recorded positive heterosis for all characters (Table-2) and out of that CSR2 x CSR5 registered significantly higher values for yield by weight and shell weight [CSR2 x CSR5 (29.63) and CSR5 x CSR2 (22.78)] expressed maximum heterotic percentage values for fecundity.

Heterobeltosis values were all positive for all the hybrids for all characters except fecundity in case of CSR4 x CSR2 (-1.43). Only CSR2 x CSR5 recorded significant value for shell weight (Table-3). Compared to all the other hybrids, CSR2 x CSR5 showed higher percentage of heterosis as well as heterobeltosis values for all the characters and found to be the best among four hybrids.

Indian Sericulture is multivoltine oriented and successful introduction of bivoltine in Southern India during 1970 prompted the breeders to formulate systematic plans to develop superior strains of both multivoltine and bivoltine races. As a result, a number of promising lines has been isolated out of which KA, NB7, NB4D2 and NB18 are very popular and are being commercially exploited. Experiments have been conducted to evolve more and more productive superior quality strains.

It is clear from the results that the rearing and cocoon characters of both the hybrids and their reciprocals (CSR2 x CSR5, CSR2 x CSR4) are significantly superior than the parents in almost all the characters and these results are in agreement with findings of Osawa and Harada, (1944), Krishnaswami *et al.*, (1973), Gamo (1983) and Hirobe (1954) who have also reported higher heterotic value in hybrids of F1 than parents.

Heterosis is the function of dominance effect on the genetic distance between the parents (Goud *et al.*, 1989). The phenomenon of heterosis in *B. mori* has been investigated by many geneticists and breeders (Osawa and Harada, 1944, Hirobe, 1954, Yokoyama, 1957 ; Harada, 1961 ; Gamo, 1983). They reported that the F1 hybrids are superior to the parent races to a greater or lesser extent in many characteristics and extent of heterosis is closely correlated with the mid parent values. The results of present study are also in agreement with the findings of Osawa and Harada (1944) who also got less values for characters associated closely. Mid parent value, helps to predict the character of the F1 hybrid.

In the present study, CSR2 x CSR4 and CSR2 x CSR5 combinations had indicated the better performance as compared to its reciprocal and also with their respective parents. Evaluation index of all the traits had shown higher values of 53.61 and 58.59 than its reciprocals CSR4 x CSR2 and CSR5 x CSR2 with 44.37 and 44.14 respectively, which clearly indicated that these hybrids can be popularised in the filed. Further, the results showed that heterobeltiotic values were also found superior in all the hybrids as compared to their parents except for fecundity in CSR 4 x CSR2 (-1.43) (Strunnikov, 1966). The negative values for heterobeltiosis may be due to the higher value for that character in the parents involved.

Table 3. Heterobeltosis values for seven different characters in silkworm (%)

Race	Fecundity	Yield/10,000 larvae		Cocoon Wt.	Shell Wt.	S.R. %	Pupation rate %
		By no.	By Wt.				
CSR2x CSR4	2.50	4.35	10.39	2.85	8.82	5.88	6.43
CSR4x CSR2	-1.43	2.92	7.97	1.71	6.84	5.03	4.54
CSR2x CSR5	26.32	3.61	13.86	8.67	14.30*	7.23	5.68
CSR5x CSR2	19.64	2.55	8.17	5.20	8.61	4.04	3.40
CD (P=0.05)	18.38	1.09	3.77	4.23	4.45	1.86	1.83

Hence, the values have considerably reduced (Osawa and Harada, 1944). When the improvement of a particular character is high in the parental strains, the degree of heterosis declines in the hybrid. The heterosis for cocoon weight and shell weight is higher in female when compared with the male (Harada, 1961). The expression of heterosis will be maximum in single cross. In the present investigation eight economic characters were studied for heterosis. Heterotic values were recorded maximum for cocoon yield by weight, followed by shell weight and pupation rate. Negative heterobeltiosis were observed for fecundity in the cross CSR4 x CSR2 (-1.43). F1 hybrids are superior to the parental strain in most of the important commercial characters. Maximum heterosis was observed in the fecundity character of the cross CSR2 x CSR5. The hybrids CSR2 x CSR4 and CSR2 x CSR5 have shown better heterotic effect, when compared with others. The hybrids CSR2 x CSR4 and CSR2 x CSR5 which registered considerable heterosis for various economic characters and can be selected for multilocational trials and field release (Maribashetty and Sreerama Reddy, 1995). Evaluation index was also calculated to evaluate the performance of various hybrids studied. It is observed through evaluation index that CSR2 x CSR4 and CSR2 x CSR5 hybrids have shown better values and these hybrids can be utilized for commercial exploitation.

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