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EVALUATION AND IDENTIFICATION OF SUPERIOR INTERSPECIFIC F1 HYBRIDS OF OAK TASAR SILKWORM

L. Somen Singh*, Subadas Singh, S. Subharani Devi, Reeta Luikham and Kartik Neog**

Regional Sericulture Research Station, Central Silk Board, Imphal -795002, Manipur, India

**Central Muga Eri Research and Training Institute, Central Silk Board, Lahdoigarh, Assam, India

*E-mail: somen_laishram@yahoo.com

ABSTRACT

In the present study, five interspecific F1 hybrids viz., *Antheraea pernyi x A. roylei, A. roylei x A. pernyi, A. proylei x A. roylei, A.roylei x A. proylei* and *A. roylei x A. frithii* were prepared. Out of the five hybrids the first 4 hybrids hatched with hatching percent ranging from 65.01% *in A. roylei x A. pernyi* to 69.85% in *A. proylei x A. roylei* while the *A. roylei x A. frithii* did not hatch. Among the four F1 hybrids viz., *A. pernyi x A. roylei, A.roylei x A. pernyi , A. proylei x A. roylei, A.roylei x A. proylei,* highest cocoon weight, shell weight and filament length of 8.50g, 1.02g and 969m respectively were recorded in the cross *A. roylei x A. pernyi*. The hybrids *A. roylei x A pernyi and A. pernyi x A. roylei* emerged as good heterotic hybrids which expressed significant heterosis in cocoon per dfl, cocoon weight, shell weight and filament length over mid parent value and better parent value. The evaluation index value of the four hybrids were work out and *A. roylei x A. pernyi & A. pernyi x A. roylei* recorded average Evaluation Index value of 55.63 and 53.99 respectively. The gain over *A. proylei* were also work out.

***Keywords*:** *Antheraea proylei*, *A. roylei, A. pernyi,* Oak Tasar, hybrid, heterosis, Evaluation Index.

Introduction

Manipur – a far flung north-eastern state of India is located between $93^0 03'$ to $94^0 78'$ east longitude and $23^0 83'$ to $25^0 68'$ north latitude, covering an area of 22,327 sq km with the elevation ranging from 740 to 2500m ASL. Hilly terrain of Nagaland, Assam and Mizoram surround the state in the north, west and south respectively, whereas in east it is abounded by Myanmar.

Manipur is one of the states of North-East India, where oak tasar is commercially exploited for production of oak tasar silk. The oak tasar silkworm which is commercially exploited in Manipur is *Antheraea proylei*. In spite of the vast wealth of naturally grown food plant of oak tasar silkworm, the production of oak tasar silk cannot reach the desired progress. Low production of oak tasar silk is due to the lack of high yielding breeds and hybrids of oak tasar silkworm. The average cocoon yield of *Antheraea proylei* ranging from 25-35 cocoons per dfl, cannot suffice the need of the farmers as well as of the industry.

The main purpose of crossing in silkworms is to produce superior cross combinations by use of hybrid vigor in order to maximize yield and productivity per unit area. In sericulture many traits are considered important as each of them contributes in different degrees in increasing the yield. However, the economic importance of different traits is not similar and all the yield contributing traits are rarely superior in a single hybrid combination. Thus, it is necessary to identify the superior breeds/hybrids based on cumulative effect of various traits (Narayanaswami *et al.*, 2002). Several methods are employed for simultaneous evaluation of multiple traits. Among the various evaluation methods used in silkworms, Multiple Trait Evaluation Index (E. I.) method of Mano *et al.* (1993) has been extensively used for selection of promising hybrids (Singh and Subba Rao, 1998; Naseema Begum *et al.,* 2000; Kariappa and Rajan, 2005; Nazia Choudhary and Ravindra Singh, 2006; Debaraj *et al.*, 2011). In oak tasar silkworms, the exploitation of hybrids for production of commercial cocoons has not been employed yet. Hence, to develop high yielding breeds/hybrids of oak tasar silkworm is the priority area of the breeding research. The present study is an attempt to examine the expression of heterosis in the important yield contributing traits in interspecific hybrids of oak tasar involving three species of Oak Tasar silkworm.

Materials and Methods

Four Oak Tasar Silkworm species *Antheraea pernyi, A. roylei A. proylei* and *A. frithii* were crossed and five crosses viz., *Antheraea pernyi x A. roylei, A. roylei x A. pernyi, A. proylei x A. roylei, A. roylei x A. proylei* and *A. roylei x A. frithii* were raised. The experiment was arranged in a randomized complete block design with three replications. These crosses along with the parents were reared indoor on oak (*Quercus serreta*) twigs inserted in water bottles at room temperature. When the worms attained the third instar, they were shifted to the oak bushes in the field. Data were recorded for fecundity, hatching, effective rate of rearing (ERR), cocoon per dfl, cocoon weight, cocoon shell weight, shell ratio and filament length in both parents and hybrids.

i. Heterotic effect in percentage over mid parent value and over better parent value were calculated as per the following formulae:
   1. Heterosis over mid parent value (MPV) $= \frac{F1 - MPV}{MPV} \times 100$
   2. Heterosis over better parent value (BPV) $= \frac{F1 - BPV}{BPV} \times 100$

ii. Multiple trait Evaluation Index (E.I.) method of Mano *et. al.,*(1993) was employed to identify superior hybrids as follows:

$$\text{Evaluation Index} = \frac{A - B}{C} \times 10 + 50$$

Where

A = Value obtained for a particular trait of a breed

B = Mean value of a particular trait of all the breed

C = Standard deviation of a particular trait of all the breeds

10 = Standard Unit

50 = Fixed Value

Evaluation index value for individual characters for each hybrid were calculated and average cumulative index value of the eight characters under study was obtained. The hybrid which recorded average index value of >50 was considered for selection and the hybrid which recorded average index value <50 was considered inferior.

Results and Discussion

Ten dfls each of the five interspecific hybrids viz., *Antheraea pernyi x A. roylei, A. roylei x A. pernyi, A. proylei x A. roylei, A.roylei x A. proylei and A. roylei x A. frithii* were prepared. Out of the five hybrids the first 4 hybrids hatched with hatching percent ranging from 65.01% in *A. roylei x A. pernyi* to 69.85% in *A. proylei x A. roylei* while the *A. roylei x A. frithii* did not hatch.

The expression of significant hybrid vigour over mid parent and better parent value along with *per-se* value are presented in Table-1. The three hybrids viz., *Antheraea pernyi x A. roylei, A. proylei x A. roylei and A.roylei x A. proylei* emerged as good heterotic hybrids which express significant heterosis in seven traits over mid parent values out of the eight traits while all the four hybrids i.e. *A. pernyi x A. roylei, A. roylei x A. pernyi, A. proylei x A. roylei and A.roylei x A. proylei* manifested high heterosis over better parent values in six traits out of eight traits.

In hatching, the hybrid *A. proylei x A. roylei* showed the highest heterotic effect (12.46%) followed by *A. roylei x A. proylei* (11.09%) over mid parent value. Highest heterotic effect over mid parent value for effective rate of rearing was exhibited by *A. pernyi x A. roylei* (47.32%) followed by *A. proylei x A. roylei* (42.78%). For cocoon per dfl, highest significant hybrid vigour over mid parent and better parent value was shown by *A. roylei x A. pernyi* (49.33%) and (33.33%) respectively.

For cocoon weight highest hybrid vigour over mid parent value was exhibited by A. *roylei x A. pernyi* (23.73%) followed by *A. pernyi x A. roylei* (18.92%) while maximum hybrid vigour for this trait over better parent value was also shown by *A. roylei x A. pernyi* (21.43%) followed by *A. roylei x A. proylei* (16.76%). High heterosis over mid parent value for cocoon shell weight was recorded by *A. roylei x A. pernyi* (50%) followed by *A. roylei x A. proylei* (49.23%). In filament length, maximum heterotic effect over mid parent value was recorded in *A. roylei x A. pernyi* (109.51%) while the hybrid *A. roylei x A. pernyi* also exhibited highest heterotic effect (43.55%) over better parent value.

In fecundity none of the hybrids showed significant heterosis. For effective rate of rearing, all the four hybrids exhibited as good heterotic hybrid vigour over mid parent value. Four hybrids were found possessing high heterosis for cocoon per dfl over mid and better parent value. In filament length, all the four hybrids exhibited as good heterotic hybrid vigor over mid parent value and better parent value. It was observed that expression of hybrid vigour was very high in some of the economic characters. It was noted that *A. roylei* and *A. pernyi* were good hybrid combination for cocoon per dfl and filament length. These two species were found to be involved either as male or female parent in most of the hybrids exhibiting economic traits like filament length in *A. roylei x A.pernyi* over MPV (109.51%) and over BPV (43.55%), cocoon per dfl in *A. roylei x A. pernyi* over MPV (49.33%) and over BPV (33.33%) and effective rate of rearing in *A. pernyi x A. roylei* over MPV (47.32%) and over BPV (21.26%). Manifestation of hybrid vigour has been studied in mulberry silkworm and eri silkworm for identification and revaluation of prospective hybrids for commercial exploitation (Datta, 1984; Ravindra Singh *et al.,* 1998; 2000; 2001; 2005; Debaraj *et al.,* 2011). It was noted that the hybrids did not exhibit significant heterotic effects in fecundity and hatching revealed significant heterotic effects in cocoon per dfl, shell weight and filament length. The present result is in conformity with that of Manohar Reddy *et al.* (2010) in case of certain hybrids of eco races of tropical tasar silkworm, *Antheraea mylita.*

Table 1: *Per-se* value of F_1 hybrids and heterosis (%) over mid parent and better parent value.

Cross		Fec.	Hat. %	ERR %	Cocoon/ dfl	cocoon weight (g)	shell weight (g)	SR%	Filament length (m)
A. roylei x A. pernyi		172	65.12	50.00	56	8.50	1.02	12.00	969
	MP	-0.29	3.89	37.40**	49.33**	23.73*	50.00**	20.24*	109.51**
	BP	-18.09	-7.46	13.09*	33.33*	21.43*	32.47*	8.40	43.55*
A. pernyi x A. roylei		142	68.30	53.61	52	8.17	1.00	12.23	950
	MP	-17.68	8.98*	47.32**	38.66**	18.92*	47.00**	22.54*	105.40**
	BP	-32.38	-2.51	21.26*	23.81*	16.71*	29.87*	10.48	40.74
A. proylei x A. roylei		136	69.85	50.53	48	8.10	0.95	11.72	902
	MP	-20.00	12.46*	42.78**	35.21**	18.07*	46.15**	22.98*	100.44**
	BP	-35.24	0.89	19.688*	26.31*	16.04*	33.80*	15.24	38.77*
A. roylei x A. proylei		145	69	50.00	49	8.12	0.97	11.94	920
	MP	-14.70	11.09*	41.28**	38.02**	18.36*	49.23**	25.28*	104.44**
	BP	-30.95	-0.33	18.42*	28.95*	16.76*	36.62**	17.40	41.54*

*and ** significant at 5% and 1% level respectively.

The gain over *A. proylei* is presented in Table-2. The hybrid *A. roylei x A. pernyi* exhibited highest gain over *A. proylei* in four traits out of the eight traits among the four hybrids. Whereas *A. pernyi x A. roylei* showed highest gain over *A. proylei* in two traits out of eight traits.

Table 2: Showing Percent Gain over *Antheraea proylei*

Cross	Fec.	Hat. %	ERR %	Cocoon/ dfl	cocoon weight (g)	shell weight (g)	SR%	Filament length (m)
A. roylei x A. pernyi	32.31	-5.93	18.43	47.37	21.78	43.66	17.99	49.08
A. pernyi x A. roylei	9.23	-1.34	26.97	36.84	17.05	40.84	20.25	46.15
A. proylei x A. roylei	4.61	0.89	19.68	26.31	16.04	33.80	15.24	38.77
A. roylei x A. proylei	11.54	-0.33	18.43	25.95	16.33	36.62	17.40	41.54

The evaluation index values of the four hybrids i.e., *A. pernyi x A. roylei, A. roylei x A. pernyi, A. proylei x A. roylei and A.roylei x A. proylei* which exhibited good heterotic effects in maximum traits are shown in Table-3. Among the four hybrids, three hybrids viz., *A. pernyi x A. roylei, A. roylei x A. pernyi and A.roylei x A. proylei* rscorded average E.I. value of >50 (50.20 to 55.63) and they were rated as the best hybrids with the hybrid *A. roylei x A. pernyi* ranking first. *A. roylei x A. pernyi* and *A. pernyi x A. roylei* exhibited individual E.I. values of >50 in six traits out of eight traits. The average E.I.values fixed for the selection of hybrid is >50 and the hybrids possessing E.I. value >50 were considered to have greater economic values. These promising two hybrids can be exploited for better prospects of oak tasar culture. In silkworm, many traits are considered economically important since each of them contributes to silk yield.

Table 3: Evaluation indices for four interspecific hybrids of oak tasar silkworm

Cross	Fec.	Hat. %	ERR %	Cocoon/ dfl	cocoon weight (g)	shell weight (g)	SR%	Filament length (m)	E.I.
A. roylei x A. pernyi	64.58	35.73	44.05	63.23	64.73	60.00	51.42	61.26	55.63
A. pernyi x A. roylei	45.76	51.16	64.91	52.08	47.37	53.33	62.38	54.92	53.99
A. proylei x A. roylei	42.00	58.69	47.11	41.00	43.68	36.67	38.09	38.90	43.27
A. roylei x A. proylei	47.65	54.56	44.05	43.73	44.73	43.33	48.57	44.91	50.20

Thus, it will be fair to make a decision jointly in selecting the promising hybrids based on a number of important yields contributing traits by a common index giving equal weightage to all the traits (Mano *et. al.,* 1993; Bhagava *et al.,* 1993; 1994; Rajalakshmi *et al.,* 2000). The results of the present study indicate the potential for exploitation of hybrid vigour for quantitative traits to increase silk yield and selection of superior parents/hybrids for breeding of oak tasar culture

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