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DEVELOPMENT OF PRODUCTIVE DISEASE TOLERANT BIVOLTINE SILKWORM HYBRID, CSR52N x CSR26N OF *BOMBYX MORI* L. FOR HIGHER COCOON YIELD

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ABSTRACT: In the present study, six oval type namely, CSR2, CSR17, CSR27, CSR50, CSR 52 and S8 and six dumbbell type, CSR4, CSR6, CSR16, CSR26, CSR51 and CSR53 recurrent bivoltine parental breeds and two donor bivoltine parents MASN 6A (oval type), 5N (dumbbell type) were utilized as materials for the breeding programme. Twelve breeding lines (Oval x oval and dumbbell x dumbbell) were prepared by crossing the recurrent and donor bivoltine parental breeds. The second moult larvae of the breeding lines, CSR2N, CSR4 N, CSR6 N, CSR16N, CSR17N, CSR26N, CSR27N, CSR50N, CSR51N, CSR52N, CSR53N and S8N were exposed for BmNPV inoculation at the dose of $2x10^6$. Based on survival, two oval breeds (Chinese type), CSR52N and S8N and three dumbbell breeds (Japanese type) viz., CSR6N, CSR16N and CSR26N were selected for preparation of F1 hybrids. These hybrids were evaluated in the laboratory for the characters like survival percentage, cocoon yield, cocoon weight, shell weight, shell percentage, raw silk percentage, filament length, filament size, reelability and neatness. Based on rearing and reeling performance, evaluation index and cocoon uniformity, the hybrid CSR52N x CSR26N) was selected for commercial exploitation.

Key words: Bivoltine silkworm, *Bombyx mori*, performance, hybrid evaluation

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INTRODUCTION

The superiority of the hybrids is judged by their cocoon yield and yield attributes as compared to their parents. It is well documented that F1 hybrids are superior to their parents in many qualitative and quantitative characters. Majority of Indian silk is from polyvoltine origin produced by small scale operators which cannot compete in international market in quality and uniformity. Therefore, there is further need to intensify the efforts to increase bivoltine silk production. Towards this goal many productive and robust bivoltine hybrids have been developed by Central Silk Board and State institutes and are being extensively reared by the farmers of South India [1, 2,3,4]. Even though, these hybrids are qualitatively superior productive bivoltine hybrids, they are sensitive to poor management leading to frequent crop failures due to disease. However, silkworm diseases particularly grasserei caused by *Bombyx mori* nuclear polyhydrosis virus is major cause of the cocoon crop loss in the field. Rearing of disease resistant silkworm breeds and implementation of disease control technology are major aspects in minimizing the incidence of Bm NPV disease. In order to minimize the loss due to this disease, besides following the control technology there is an urgent need to evolve BmNPV tolerant silkworm hybrids which can perform well even under adverse eco-climatic and unhygienic conditions to get sustainable cocoon yield.

Keeping in view of above factors, the present study was under taken for evolving bivoltine F1 hybrids with higher productivity and crop stability.

MATERIALS AND METHODS

Selection of parental breeds: In the present study, the already available twelve recurrent bivoltine parental breeds namely, CSR2(oval type), CSR4 (dumbbell type) , CSR6 (dumbbell type), CSR16 (dumbbell type), CSR17 (oval type), CSR26 (dumbbell type), CSR27 (oval type), CSR50 (oval type), CSR51 (dumbbell type) , CSR 52 (oval type), CSR53 (dumbbell type) and S8 N (oval type) and two donor parents MASN 6A (oval type), 5N (dumbbell type) were utilized as materials for the breeding programme. Twelve breeding lines (Oval x oval and dumbbell x dumbbell) were prepared by crossing the recurrent and donor bivoltine parental breeds. The second moult larvae of the breeding lines, CSR2N, CSR4 N, CSR6N, CSR16 N, CSR17 N, CSR26 N, CSR27 N, CSR50 N, CSR51 N, CSR52 N, CSR53 N and S8 N were exposed for BmNPV inoculation at the dose of $2x10^6$. The rearing was conducted till cocooning and survival was calculated based on live pupae. The family/bed with high survival were selected and continued. Back crossing and continuation of screening of progeny for tolerant to BmNVP was carried out from BC2 to BC6. Inbreeding of last back cross progeny was carried out for isolation of homozygous lines. Hybrid evaluation was conducted at laboratory for identification of promising bivoltine single hybrids.

Preparation of hybrids: Based on performance, two oval type bivoltine breeds, CSR52N and S8N and three dumbbell type breeds, CSR6N, CSR16N and CSR26N were selected. Six F1 hybrids, CSR52N x CSR6N, CSR52N x CSR16N, CSR52N x CSR26N, S8N x CSR6N, S8N x CSR16N and S8N x CSR26N were prepared by utilizing the selected parental breeds and evaluated. The popular hybrid, CSR2 x CSR4 served as control hybrid.

Composite layings prepared from twenty disease free layings of all the hybrids was brushed en-masse. After third moult, 250 larvae with three replications each were retained and rearing was conducted following the standard method [5]. The important parameters that govern silk quality and quantity such as fecundity, pupation, cocoon yield, cocoon weight, shell weight, shell percentage, reelability, filament length, raw silk percentage, filament size and neatness were considered. Hybrid vigour was calculated based on mid parental value. All these hybrids were evaluated by multiple trait evaluation indexes as suggested by Mano *et al*., [6].

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

Where, A = Value obtained for a trait in a hybrid

B = Mean value of a trait of all the hybrid combinations, C = Standard deviation of a trait of all the breeds

10 = Standard Unit 50 = Fixed value

The index values for each nine traits taken under the study were pooled together and mean (evaluation index) was calculated for each new hybrid combinations. Further, the values for negative and positive traits are calculated separately and only positive traits were considered for evaluation. The hybrids with index value > 50 are considered to be better performers which were otherwise, the resultant of index measurement made on nine important traits covering various economic parameters.

Cocoon uniformity:

100 cocoons were taken at random and cocoon length and width were measured using a vernier calipers specially designed for cocoon uniformity. The ratio of length to width was calculated.

Cocoon length and width ratio = (Length/width) x 100. The ratio used for calculation of standard deviation (SD).

RESULTS AND DISCUSSION

The data indicate that among oval lines, highest pupation was observed in S8N (76.4%) and lowest in CSR50N (36.4%), where as in dumbbell lines highest pupation was observed in CSR16N (68.4%) and lowest in CSR51N (41.9%) (Table 1) .The mean performance of parents and their F1is presented in Tables 2 and 3, respectively. The pupation in hybrids ranged from 94.2 (S8N x CSR6N to 96.9 % (CSR52N x CSR26N), cocoon yield /100000 larvae from 18.0 (CSR52N x CSR16N) to 19.3 kg (CSR52N x CSR26N) cocoon weight from 1.925 (CSR52 N x CSR6N) to 1.992 g (CSR52N x CSR26N), shell weight from 0.437 (CSR52N x CSR26) to 0.474 g (CSR52N x CSR26N), shell percentage from 22.4 S8N x CSR26N to 23.8 % (CSR52N x CSR26N), reelability from 85 (S8N x CSR6N) to 89 % (CSR52N x CSR26N), filament length from 1025 (CSR52N x CSR6N) to 1145 m CSR52N x CSR26N) and raw silk percentage from 18.1 (S8N x CSR6N) to 19.8% (CSR52N x CSR26N). The neatness ranged from 94.0 to 96.0 points.

Table 1: Survival of breeding lines exposed to BmNPV inoculation of $2x10^6$ spores/ml NPV

Sl No.	Breed	Survival (%)
1	CSR2N	43.2
2	CSR17N	44.0
3	CSR27N	42.2
4	CSR50N	36.4
5	CSR52N	71.0
6	S8N	76.4
7	CSR4N	43.2
8	CSR6N	60.9
9	CSR16N	68.4
10	CSR26N	67.2
11	CSR51N	41.9
12	CSR53N	42.6

Table 2: Performance of parental breeds

Breeds	Pupa-tion	Cocoon yield	Cocoon weight	Shell weight	Shell	Reelabi-lity	Fila-ment lengt	Raw silk	Fila-ment-size	Neat-ness
	(%)	(kg)	(g)	(g)	(%)	(%)	(m)	(%)	(d)	(p)
CSR52N	94.5	17.15	1.815	0.427	23.5	85	92	17.5	2.95	94
S8N	95.5	17.43	1.825	0.436	23.9	86	98	18.2	2.88	94
CSR6N	94.2	15.93	1.768	0.396	22.4	83	86	17.2	2.89	92
CSR16N	94.3	16.55	1.750	0.390	22.3	84	87	15.9	2.87	94
CSR26N	93.3	15.92	1.706	0.379	22.2	82	82	15.7	2.93	93

Table 2: Performance of F1 hybrids

Hybrids	Pupation	Cocoon yield	Cocoon weight	Shell weight	Shell	Reela-bility	Fila-ment length	Raw silk	Filam ent size	Neat-ness	Evalua-tion index	Cocoon Uni-formity
	(%)	(kg)	(g)	(g)	(%)	(%)	(m)	(%)	(d)	(p)		(SD±)
CSR52N x CSR6N	94.1	18.3	1.942	0.443	22.8	86	1025	17.7	2.78	94	43.3	7.45
CSR52N x CSR16N	93.2	18.0	1.935	0.437	22.6	88	1042	18.6	2.99	94	43.7	7.46
CSR52N x CSR26N	96.9	19.3	1.992	0.474	23.8	89	1145	19.8	2.89	96	64.5	6.75
S8N x CSR6N	94.2	18.1	1.925	0.439	22.8	85	1045	18.1	2.79	95	42.7	7.75
S8N x CSR16N	96.5	19.1	1.982	0.468	23.6	88	1045	18.8	2.78	94	55.7	7.80
S8N x CSR26N	95.2	18.6	1.956	0.438	22.4	88	1125	19.3	2.98	96	52.6	7.35
CSR2 x CSR4 ©	95.2	18.4	1.932	0.448	23.2	86	1005	18.6	2.79	95	47.5	8.52
Mean	95	18.6	2.0	0.4	23.0	87	1062	18.7	2.86	95		
SD±	1.3	0.5	0.03	0.02	0.5	2.0	52.4	0.7	0.10	0.9		
CD at 5%	1.6	1.34	0.08	0.026	1.00	ns	65	1.1	ns	ns		

C- Control hybrid

The multiple trait evaluation index indicated that one hybrid have scored index > 50. The maximum index of 64.5 was obtained for the hybrid, CSR52N x CSR26N followed by the hybrid S8N x CSR16 (55.7). The cocoon uniformity in terms of standard deviation (SD±) calculated based on the length and breadth ranged from 6.75 CSR52N x CSR26N) to 8.52 (CSR2 x CSR4). The cocoon uniformity (SD**±)** less than 8, which is a target for selection of hybrid for commercial purpose.

In India, realizing the need for high cocoon shell percentage and high raw silk percentage as thrust areas, many viable single hybrids were evolved and authorized for commercial exploitation [1,2,3]. Of late, much emphasis is also being given for bivoltine silkworm rearing to boost up the quality silk production matching international standards. The ultimate results in silkworm breeding are judged by the excellency of commercial traits that appear in the hybrids. Therefore, in silkworms, a large number of hybrids are tested and promising ones are selected based on the economic traits. Evaluation of different hybrids is undoubtedly the most important method to identify their superiority. Moreover, hybridization coupled with selection has been exploited as an important tool by many silkworm breeders for the improvement of silkworm for their maximum gains. In India, attempts have also been made various crossing systems like diallel, line x tester, three- way and double crosses by various workers to study the gene action and utilize the hybrid vigour as such at commercial level [7, 8, 9,10, 11, 12].

In silkworm, large number of hybrids are tested and promising ones are selected based on the economic traits. Important traits on pre-cocoon, cocoon and post cocoon areas in the present study is certainly, aimed in this direction. The new superior hybrid developed from this study viz., CSR52N x CSR26N is clearly directed towards this goal and are expected to fare under tropical conditions. Even though, the rearing of silkworm is conducted under indoor locations throughout the year; the cocoon yield contributing parameters are greatly affected in different seasons/locations due to rearing management. The difference in the cocoon yield of these hybrid parallels the earlier findings of Ueda *et al*. [13] and Thiagrajan *et al*. (1993) who opined that the same hybrid performs differently in different seasons and locations.

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