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Selection of the Silkworm *Bombyx mori* L. Breeding Resource Material

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A B S T R A C T

For success of any breeding programme, the selection of breeding resource material is of paramount importance. The selection of superior parents determines the degree of success of the breeding programme to a large extent. Therefore, it is highly pertinent to select and evaluate the suitable silkworm breeds before initiating any breeding programme. Accordingly in the present study eighteen silkworm breeds of diverse geographical origin were selected and evaluated with respect to eleven important yield attributing traits by employing multiple trait evaluation index (EI). Based on the overall evaluation index value only eight breeds *viz.,* A209, CSR4, 61N, NB18, CSR2, N4D2 and SBNP-1 scored mean EI values greater than 50 whereas other ten breeds could not hold the promise. The short-listed breeds could be utilized as breeding resource material for the development of new breeds / hybrids.

Introduction

Selection is the process of deciding superior quality animal to become the parents for next generation and is a basic tool for improving the genetic structure of any stock in the direction desired. Though the simplest form of selection is choosing parents based on the preferred phenotypic traits, the degree of improvement depends on variability among parents, extent of selection pressure induction, heritability of traits as the induced artificial selection acts only as additional force to enhance the natural processes of selection. Selection of initial breeding materials followed by their effective utilization in different combinations to create genetic variability (Roa, 2016). Therefore, it is of paramount importance that utmost care must be taken in verifying and analyzing the genetic worth of parents to be utilized as resource material (Kumar *et al.,* 2006). Selection of appropriate breeding resource materials for any improvement programme is very essential and aims at a derivation of better constellation of gene complex which suits to express good phenotypic values on a wide range of traits by amalgamating distinct and different gene pools. Conventional breeding methods are directed not only for the evolution of new breeds but also for the identification of the promising hybrid combinations for commercial exploitation based on the heterosis. Therefore it’s imperative to evaluate diverse genotypes and to identify the distinct and different gene pools to be utilized in breeding programme for development of robust breeds / hybrids.

Materials and Methods

Eighteen silkworm breeds *viz.*, CSR2, CSR4, CSR5, CSR6, CSR51, A209, SBNP1, H304, 61N, CSR18, Boropolo, NB7, NB18, KPGB, KA, P5, SH6 and NB4D2 were reared using standard rearing method (Anonymous, 2003). The experiments were laid out in Completely Randomized Designs (CRD) with three replications for each treatment comprised of 200 larvae (after third moult). The data pertaining to eleven metric traits *viz.*, number of eggs / laying, hatching percentage, ten mature larval weight, survival percentage, single cocoon weight, single shell weight, shell ratio filament length, denier, renditta and raw silk percentage were recorded, analyzed statistically and was also subjected to multiple trait evaluation (Mano *et al.*, 1993).

Results and Discussion

The silkworm breeds showed significant difference in economic traits presented in table 1. Highest number of eggs / laying were recorded in KPGB (627) and lowest in Boroplo (506). Maximum hatching % was recorded in NB_4D_2 (97.70) and lowest in CSR6 (88.45). Weight of ten mature larvae was highest in KPGPB (46.60g) and lowest in CSR6 (37.07g). Survival % was highest in CSR18 (93.83) and lower in case of CSR6 (61.83). The single cocoon weight (2.12g) and shell weight (0.42g) were highest in A209 and lowest (1.42g) and (0.25g) in CSR5 respectively. More shell ratio was obtained in H304 (21.06) and less in KPGB (16.22). Filament length (1125m) was recorded highest in 61N and lowest in CSR18 (712m). Fine (2.40) and coarse (3.25) denier were recorded in 61N and CSR5 respectively. In 61N renditta was 5.50 while in case of CSR18 the renditta (9.06) was recorded. The raw silk percentage ranged from 21.19-to 26.28 in NB7 and CSR5 respectively. Among the selected silkworm breeds no specific breed performed, except 61N which performed best for three, A202 and KPGB each performed best in two parameters out of eleven parameters studied (Table 2).

Data on the economically important traits was subjected to Multiple Trait Evaluation Index and ranking of the breeds was done as per Mano *et al.*, (1993). The ranking of these breeds was given on the basis of average evaluation index values obtained for ten positive traits where higher the value better the economic viability and in one negative trait *i.e.*, renditta less the value better the economic viability. The order of merit for ranking was recorded as A209 (56.86), CSR4 (54.12), 61N (52.42), NB18 (52.12), CSR2 (51.74), NB7 (51.04), NB4D2 (50.51), SBNP-1(50.02), CSR18 (49.91), H304 (49.78), P5 (49.26), CSR51 (48.67), Boropolo (48.12), SH6 (48.30), KPGB (47.71), KA (45.81), CSR5 (45.37) and CSR6 (45.16) (Table 3 and Fig. 1). Only eight silkworm breeds could scored more than average evaluation index (> 50) while other couldn't hold the promise to score greater than 50. Evaluation of genetic resources promotes effective and higher utilization of the germplasm, particularly in breeding and crop improvement programme. Improvement of silk productivity depends on the magnitude of genetic variability and the extent to which the associated traits are heritable in silkworm. The challenges in silkworm breeding are the selection of suitable parent lines to build heterotic combinations. Genetic divergence, one of the criteria for selection of parents is considered in most of the breeding experiments as means to generate crosses which segregate in later generations into genotypes transgressing the performance of better parents (Murthy and Arunachalam, 1967; Timoty, 1963).

Table.1 Performance of selected bivoltine silkworm breeds

Silkworm Breeds	No. of eggs / laying	Hatching (%)	Larval weight (g)	Survival %	Single cocoon weight (g)	Single shell weight (g)	Shell ratio	Filament length (m)	Denier	Renditta	Raw silk %
CSR2	536	93.50	41.30	88.66	1.72	0.33	19.52	838	2.68	7.18	23.63
CSR4	577	92.51	43.30	92.83	1.89	0.39	20.91	853	3.15	6.40	25.58
CSR5	523	90.27	40.36	89.33	1.42	0.25	17.92	934	2.96	6.78	26.28
CSR6	513	88.45	37.07	61.83	1.94	0.37	19.24	819	2.56	6.95	24.61
CSR51	566	96.79	37.86	87.66	1.63	0.31	19.34	868	3.00	6.14	24.48
A209	550	95.39	46.46	92.50	2.12	0.42	19.98	849	3.13	6.69	24.36
SBNP1	560	96.69	42.66	92.00	1.79	0.31	17.38	951	2.80	5.73	25.25
H304	533	92.80	41.50	82.66	1.85	0.39	21.06	839	2.90	6.82	26.00
61N	566	93.99	43.83	76.00	1.81	0.38	20.95	1125	2.40	5.50	24.17
CSR18	552	95.47	44.76	93.83	1.96	0.34	17.28	712	2.60	9.06	26.00
Boropolo	506	95.98	43.39	87.15	1.71	0.32	18.72	769	2.75	7.15	25.00
NB7	520	97.58	42.76	90.93	1.88	0.34	18.22	833	2.94	7.85	21.91
NB18	566	94.31	45.90	76.53	1.97	0.36	18.57	755	3.25	7.54	23.14
KPGB	627	94.52	46.60	82.00	1.66	0.27	16.22	847	2.66	6.89	26.28
KA	596	95.28	41.23	72.90	1.62	0.26	16.46	795	2.76	5.77	22.70
P5	573	97.45	44.40	75.73	1.76	0.32	18.66	681	2.77	7.20	24.70
SH6	570	96.90	40.70	65.46	1.83	0.33	18.17	748	2.85	7.03	25.55
NB4D2	517	97.70	42.33	71.00	1.74	0.33	19.17	952	2.85	6.31	24.55
CD@5%	62.5	4.4	3.62	11.87	0.18	0.03	1.99	95.03	0.032	0.59	1.51

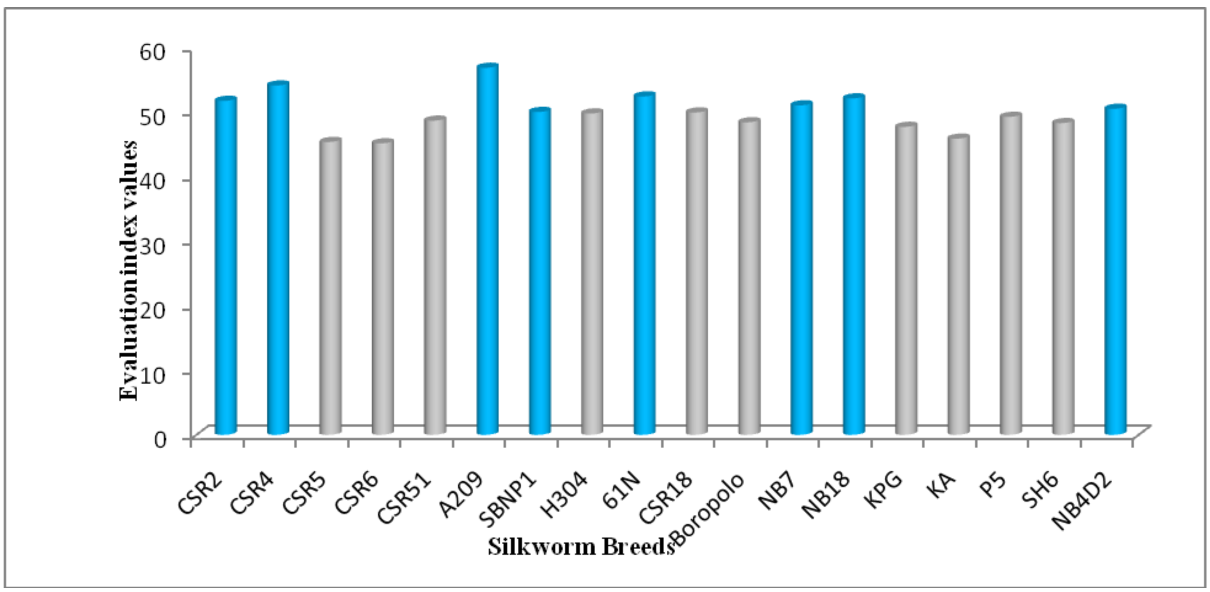
Table.2 Parameter-wise status of silkworm breeds

S. No	Silkworm breeds	Parameter	Trait status
1	KPGB	No. of eggs / laying	627
2	NB4D2	Hatching (%)	97.70
3	KPGB	Weight of ten mature larvae (g)	46.60
4	CSR18	Survival percentage	93.83
5	A209	Single cocoon weight (g)	2.12
6	A209	Single shell weight (g)	0.42
7	H304	Shell ratio (%)	21.06
8	61N	Filament length	1125
9	61N	Denier	2.06
10	61N	Renditta	5.50
11	CSR5	Raw silk percentage	26.28

Table.3 Evaluation index for eleven commercial traits of silkworm breeds

Silkworm Breeds	No. of eggs/ laying	Hatching	Averag e larval weight	Surviva l	Single cocoon weight	Single shell weight	Shell ratio	Filament length	Denier	Renditta	Raw silk	Average EI Values	Rank
CSR2	46.38	46.34	47.62	55.32	45.75	49.49	54.85	49.56	45.10	54.14	74.97	51.74	1
CSR4	55.96	43.50	52.29	58.75	55.33	62.26	63.10	50.96	56.38	46.14	50.65	54.12	1
CSR5	43.32	37.01	43.54	55.87	29.35	32.45	44.44	58.51	51.76	50.04	52.77	45.37	5
CSR6	40.88	31.77	33.72	33.29	57.72	57.29	52.66	47.79	42.02	51.85	47.73	45.16	5
CSR51	53.53	55.87	36.07	54.50	40.96	45.23	53.28	52.35	52.73	43.47	47.35	48.67	3
A209	49.60	51.82	61.74	58.47	67.67	67.23	57.29	50.58	55.90	49.11	56.03	56.86	1
SBNP1	51.96	55.57	50.40	58.06	49.43	43.81	41.07	60.15	47.86	39.26	52.69	50.02	1
H304	45.67	50.18	50.18	50.19	50.14	50.36	50.20	50.18	50.14	50.18	50.19	49.78	2
61N	53.45	47.76	53.88	44.92	50.72	58.71	63.37	76.31	38.12	36.90	52.44	52.42	1
CSR18	50.23	52.04	56.67	59.57	59.20	50.20	40.42	37.81	42.99	73.43	26.49	49.91	2
Boropolo	39.39	53.53	52.58	54.08	45.01	45.94	49.43	43.12	46.81	53.83	48.90	48.42	3
NB7	42.53	58.18	50.69	57.19	54.59	50.91	46.30	49.12	51.35	61.02	39.57	51.04	1
NB18	53.37	48.70	60.05	45.36	59.57	55.87	48.51	41.82	58.90	57.84	43.29	52.12	1
KPGB	67.74	49.31	62.14	49.85	42.52	35.29	33.37	50.40	29.85	51.17	52.78	47.71	4
KA	60.44	51.51	46.12	42.38	40.04	34.58	35.27	45.55	77.57	29.41	41.96	45.89	5
P5	55.10	57.77	55.58	44.70	47.96	47.36	49.05	34.92	47.13	54.35	48.00	49.26	2
SH6	54.31	56.19	44.53	36.27	51.83	48.78	45.97	41.17	49.08	52.60	50.58	48.30	3
NB4D2	41.98	58.50	49.41	40.87	46.47	48.78	52.07	60.25	49.16	45.21	62.71	50.51	1

Fig.1 Graphical representation of average evaluation index values of different economic characters



The breeding of silkworm since long has been aimed towards evolving of superior and hardy breeds either by means of selection alone or by combining out crossing or backcrossing with selection in the subsequent generations. Combining ability is the most widely used biometrical tool in determining the genetic worthness of the parent / hybrid, while detecting the magnitude of the variability present in the organism (Arunachalam, 1994). Parents possessing high general combining ability and general combining ability considered for population development and for initiation of pedigree breeding as it are heritable and can be fixed. The final aim of the breeder is primarily to evolve a breed which can give rise to stabilized crops (Tazima, 1984). The performance of breed mainly depends on the combined action of its hereditary potential and extent to which such potential is permitted to express in the environment (Roa, 2016). One of the objectives of the breeder is to recommend stable breeds to the farmers for rearing under different environmental conditions (Basavaraja *et al.*, 1995).

Eighteen silkworm breeds possessing important genetic potential for various economic traits were screened for their performance at Silkworm Breeding and Genetics Section of Temperate Sericulture Research Institute, Mirgund, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir to obtain fair and precise assessment of various yield attributing traits. Results of various economically important traits showed significant difference which revealed the genetic potential as well as variability among the breeds. Judging the superiority of the silkworm breed on the basis of its performance in individual traits cannot lead to fruitful conclusion, a common index method was found very much essential (Bhargava *et al.*, 1994). The present study clearly establishes the superiority of some breeds over the rest is due to the influence of environmental factors and interaction of allelles responsible for the expression of the traits. These breeds has immense potentiality as breeding material as they displayed variability for various economic traits, higher the variability more scope for selection for segregants. Cocoon yield being a complex trait is contributed by more than 21 components (Thaigrajan *et al.*, 1993). In present study the multiple trait evaluation index method developed by (Mano *et al.*, 1993) was employed giving equal weight-age to economic traits only eight breeds viz., A209, CSR4, 61N, NB18, CSR2, NB7, NB4D2 and SBNP-1 appeared to hold promise of scoring evaluation index above 50 which would be crossed in appropriate and desirable combinations for the development of hybrids / breeds suitable for the region.

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