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RESEARCH ARTICLE

SELECTION OF POTENTIAL PARENTAL BREEDS OF BIVOLTINE SILKWORM *BOMBYX MORI* L. FOR TROPICAL CLIMATE

***1Veeranna Gowda, 2Kalpana, G. V. and 3Ashwath, S. K.**

[1]Central Sericultural Germplasm Resources Centre, Hosur-635 109, Tamil NaduIndia
[2]P4 Basic Seed Farm, CSR&TI, Hassan-573 217, Karnataka, India
[3]Central Sericultural Research and Training Institute, Mysore-570 008, Karnataka, India

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ABSTRACT

With the objective of selecting suitable parental breeds for silkworm breeding program, a total of twenty (10 oval and 10 dumb-bell) bivoltine silkworm genetic stocks maintained at CSR&TI, Mysore and CSGRC, Hosur were evaluated in three replications during three seasons of the year. Data was collected and assessed for twelve traits of economic importance, viz., fecundity, cocoon yield/10000 larvae by number and weight, cocoon weight, shell weight, cocoon shell ratio, filament length and size, raw silk percentage, renditta, neatness and boil-off loss through multiple trait evaluation index method. Significant variations among the breeds were observed and based on highest Evaluation Index values for 10 economic parameters, JPN8, CSR27, CSR17, S5 (oval) and S9, D13, CSR26, CSR16 (dumb-bell) were identified as potential breeds for future breeding program aiming at developing promising bivoltine breeds/hybrids for tropical conditions.

INTRODUCTION

Indian sericulture industry dominated by multibivoltine silk is on the threshold of vitalizing the industry with greater emphasis on improvement of quality through adoption of bivoltine sericulture suitable to the tropical conditions. The methods applied for evaluation and identification of potential breeds are of vital importance in achieving the objective of developing parental strains. Therefore, progress in breeding, regardless of seasons or environment, revolves around the efficiency of selecting the promising parental breeds (Basavaraja *et al.*, 1995; Datta *et al*., 2000). The breeding progress as measured by the genetic gain in the yield in a particular environment cannot be considered as a smooth progression. In addition, recognizing the existence of favorable recombination in low frequency during the course of breeding is of vital importance to achieve the planned objectives. Clear understanding of the variability in the expression of the economic traits of the breeds is an important step for selection of suitable parental breed. Currently, despite numerous theoretical and empirical studies (Tokoyama, 1973), no consensus is found among the silkworm breeders in selection of parental breeds. Selection of breeding material depends on the objective of the breeder to satisfy the need of the industry. In view of this, development of a strategy to meet the required goal in breeding program is very essential in order to lay hands on the suitable parental breeds having the potential of producing variability in yield parameters when crossed in different combinations. The methods of parental breeds' selection and their predicted performance can be divided into two major groups. The first one consists of methods to choose the parental breeds on the basis of their performance (Murphy *et al.,* 1986). The second one includes the methods of evaluating the parental breeds on the basis of the performance of the progeny (Cox and Frey, 1984).

In addition to analysis of data obtained on the performance of different breeds, multiple trait evaluation indexes (Mano *et al.*, 1993) has been used to evaluate and identify the parental breeds on the basis of pooled values from the twelve quantitative traits considered for the current study. In this direction, an attempt has been made in the present study to evaluate resource material and identify promising bivoltine silkworm accessions for utilizing in breeding program to achieve the objective of synthesizing bivoltine parental breeds suitable for tropical region.

MATERIALS AND METHODS

Twenty bivoltine silkworm breeds *viz*., CSR2, CSR3, CSR12, CSR17, CSR27, JPN8, JPN7, S5, BBE226, BBI276 (Oval) and CSR4, CSR6, CSR16, CSR26, S1, S9, D13, 5HT, BBE246, BBE267 (Dumb-bell) from CSR&TI, Mysore and CSGRC,

***Corresponding author: Veeranna Gowda**
Central Sericultural Germplasm Resources Centre, Hosur, Tamil Nadu, India.

Hosur were selected for this evaluation study. All the twenty bivoltine breeds were analyzed by conducting cellular rearing in three replications of one disease free laying each during three different seasons (summer, rainy and winter) by following standard rearing techniques (Krishnaswami, 1978; Datta, 1984). Mulberry leaves of V1 variety formed as source of food. The performance of silkworm oval and dumb-bell breeds in respect of the morpho-metric traits (from egg incubation till cocoon reeling) were recorded. Observations with reference to pre-cocoon, cocoon and post-cocoon parameters were recorded. Results in respect of the traits *viz*., fecundity, yield / 10000 larvae by number and weight, cocoon weight, shell weight, cocoon shell ratio, filament length and size, raw silk percentage, renditta, neatness and boil-off loss parameters were recorded. Analysis of variance was calculated for results on 12 important economic traits by utilizing multiple trait evaluation index (Mano *et al*., 1993).

$$\text{Evaluation Index (E.I.)} = \frac{A-B}{C} \times 10 + 50$$

Where,
A= Value obtained for a trait in a breed,
B= Mean value of a particular trait of all the breeds,
C= Standard deviation of a trait of all the breeds,
10 = Standard unit,
50 = Fixed value.

RESULTS

Mean performance values of 12 quantitative traits analyzed for 10 each of oval and dumb-bell breeds reared in three replications during different seasons of the year is presented in Tables 1 and 2.

The data obtained is analyzed and the mean values of the results, trait-wise, evaluation index (E.I.) in both oval and dumb-bell breeds during different seasons are presented in Table 3 and 4. The oval breeds JPN8, CSR27, CSR17, S5 and dumb-bell breeds S9, D13, CSR26 and CSR16 were found to be superior in most of the quantitative traits studied.

Bivoltine oval breeds

The scrutiny of the data among the oval breeds indicated JPN8 toped the list (543) with higher value of fecundity and CSR3 observed to exhibit poor fecundity of 515; cocoon yield/10000 larvae by number JPN8 possess the highest of 9253 and BBE226 exhibited the lowest (8740); cocoon yield/10000 larvae by weight JPN8 tops the list with 16.200kg and BBI276 showed lowest of 12.645kg. Similarly, highest cocoon weight of 1.915g in JPN8; shell weight of 0.455g in CSR27; cocoon shell ratio of 25.01% (CSR27); filament length of 1,203m (JPN8); filament size of 3.16d (CSR3); raw silk of 19.36% (JPN8); renditta of 5.45 (BBI276); neatness 93.00p (JPN8) and boil-off loss 25.50% (CSR3) was evidenced. Mean values of the combined trait evaluation index (E. I.) in the oval breeds showed maximum value in JPN8 (53.23) followed by CSR27 (52.89), CSR17 (52.04) and S5 (51.76) whereas the least E.I. was recorded by BBE226 (44.26). Further, out of 10 studied 7 oval breeds have scored E. I. value of >50.

Bivoltine dumb-bell breeds

The dumb-bell breeds exhibited higher fecundity of 562 (D13); yield/10000 larvae by number in CSR16 (9,754); yield/10000 larvae by weight by D13 (18.429kg); cocoon weight 1.910g (CSR26); shell weight of 0.442g (S9); shell ratio of 22.59% (CSR26); filament length of 1112m (S9); filament size of 3.16d

Table 1. Performance of bivoltine oval breeds during different seasons

(Mean values of 3 seasons)

Breed	Fecundity	Yield/10000 larvae No.	Yield/10000 larvae Wt. (kg)	Cocoon Wt. (g)	Shell Wt. (g)	Cocoon Shell %	Filament length (m)	Filament Size (d)	Raw Silk (%)	Renditta	Neatness (p)	Boil-off loss (%)

Table 2. Performance of bivoltine dumb-bell breeds during different seasons

(Mean values of 3 seasons)

Breed	Fecundity	Yield/10000 larvae No.	Yield/10000 larvae Wt. (kg)	Cocoon Wt. (g)	Shell Wt. (g)	Cocoon Shell %	Filament length (m)	Filament Size (d)	Raw Silk (%)	Renditta	Neatness (p)	Boil-off loss (%)

Table 3. Mean Evaluation Index (E. I.) values of oval breeds during different seasons

Breed	Fecundity	Yield/10000 larvae No.	Yield/10000 larvae Wt.	Cocoon Wt.	Shell Wt.	Cocoon Shell	Filament length	Filament Size	Raw Silk	Renditta	Neatness	Boil-off loss

Table 4. Mean Evaluation Index (E. I.) values of dumb-bell breeds during different seasons

Breed	Fecundity	Yield/10000 larvae No.	Yield/10000 larvae Wt.	Cocoon Wt.	Shell Wt.	Cocoon Shell	Filament length	Filament Size	Raw Silk	Renditta	Neatness	Boil-off loss

(BBE267); raw silk 19.32% (CSR26); 6.55 renditta (BBE247); neatness of 92.67p (S9) and boil-off loss of 25.50% (BBE267) was recorded. In dumb-bell breeds, mean values of the combined trait evaluation index (E. I.) recorded maximum E.I. value in S9 (55.28) followed by D13 (52.30), CSR26 (52.20) and CSR16 (52.01) whereas BBE267 recorded a minimum of 43.88. Also, out of 10 breeds studied 5 dumb-bell breeds have scored E. I. value of >50.

The oval and dumb-bell breeds studied exhibited significant variation with respect to major economic parameters indicating considerable genetic variations among them. Evaluation of the overall performance and multiple trait evaluation index calculations confirmed the superiority of four each of oval (JPN8, CSR27, CSR17 and S5) and dumb-bell breeds (S9, D13, CSR26 and CSR16) over multiple traits. The above said oval and dumb-bell breeds scoring higher E.I. values in respect of the quantitative traits are adjudicated as the potential breeding resource materials.

DISCUSSION

In the present study the mulberry bivoltine silkworm breeds collected from CSR&TI, Mysore and CSGRC, Hosur were assessed for evaluation of mulberry genotypes and silkworm breeds. In the current study all the bivoltine breeds were tested under different environmental conditions. Variations in different quantitative traits among the selected oval and dumb-bell breeds were observed, may be due to racial differences among the breeds, which forms a genetic resource for evolving new breeds. Selection of parental breeds is of vital importance for the success of breeding apart from the mating systems and selection procedures (Ueda and Lizuka, 1962; Perkings and Jinks, 1968; Nirmal Kumar, 1995). Therefore, it is essential to measure the degree of phenotypic variability of the traits of economic importance.

Significant variations observed in the phenotypic manifestation of both oval and dumb-bell breeds for the parameters analyzed can be attributed to the genetic endowment of the breeds and their degree of response to the ambient environmental conditions prevailed during rearing (Suresh Kumar *et al*., 2002). The highly significant variation in the cocoon shell ratio and raw silk percentage indicate the responsiveness of the genetic constitution to changing environmental conditions (Murakami and Ohtsuki, 1989). Further, varied degree of responses observed in both oval and dumb-bell breeds for different traits in more than one dimension reflect their hereditary potential which is agreement with the findings of Harada (1961). Among the oval breeds, JPN8, CSR27, CSR17 and S5 can be projected as breeds with high viability besides possessing productive merit in quantitative parameters. Similarly the dumb-bell breeds S9, D13, CSR26, CSR16 were also observed to exhibit superiority for most of the economic characters analyzed. In view of the above results, the above said oval and dumb-bell breeds identified are recommended as potential parental breeds on the basis of having higher E. I. values, economic merit of their performance components and equal potential use for augmenting production of superior quality silk.

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