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Short Communication

Selection of parents from multivoltine silkworm (*Bombyx mori* L.) germplasm through principal component analysis

P. Kumaresan, R. K. Sinha, F. R. Rayaradder and K. Thangavelu

Central Sericultural Germplasm Resources Centre, Hosur 635 109

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There are about 21 characters which contribute to silk yield in silkworm, *Bombyx mori* L., it is more challenging to the breeders to put together all the desired characters in a single variety/race. Hence, it is essential to eliminate certain environmentally sensitive variables before deciding to select the desirable traits for improvement. In statistical practices, the method of principal component analysis is used to find the linear combinations with large variance. Since there is very limited work available on this aspect in silkworm, *B. mori*, the present investigation was undertaken to study the principal component analysis for 13 economically important characters in 63 multivoltine silkworm accessions.

The experiment was conducted in 5 seasons during 2001 in randomized block design with two replication of 300 larvae each after third moult and observations were recorded on 7 quantitative traits of commercial value viz., single cocoon weight (g), single shell weight (g), shell ratio (%), cocoon yield (kg)/10,000 larvae, fecundity (number), pupation rate (%), and fifth age larval duration (h). The standard silkworm rearing technique was followed [1]. For the reeling study, the standard silk reeling technology package was followed [2]. The cocoons harvested from rearing (300 cocoons/replication from each accession) were utilized for the evaluation of 6 reeling parameters of economic importance viz., filament length (m), non-broken filament length (m), denier, reelability (%), renditta (Kg) and raw silk percentage. The reeled silk yarn was tested for quality parameters at Silk Conditioning & Testing House (SCTH), Bangalore under standard temperature of 25°C and 65 % relative humidity. The data were subjected to ANOVA, correlation coefficient analysis and principal component analysis (PCA) using the computer packages developed by Indostat Service Pvt. Ltd., Hyderabad, India. The selected variables from PCA were further subjected to Evaluation Index (EI) method [3], which was arrived at by the following formula: Evaluation Index (EI) = A–B/C × 10 + 50. Where, A = Mean of the particular trait for a breed, B = Overall mean of the particular trait (the experimental mean), C = Standard deviation, 10=Standard and 50=Constant. The breeds that score index value above 50 are considered to have greater economic value.

The variations among the sixty-three multivoltine silkworm accessions for all the 13 parameters are presented in Table 1. The results of correlation coefficient analysis indicate that, single cocoon weight has significant positive correlation with many parameters *viz.*, single shell weight (r=+0.914), shell ratio (r=+0.596), cocoon yield (kg)/10,000 larvae (r=+0.749), fecundity (r=+0.515), fifth age larval duration (r=+0.317) and filament length (r=+0.254). This finding corroborates the earlier observation [4]. Likewise, the filament length is positively correlated with non-broken filament length (r=+0.815) and raw silk % (r=+0.527), but it has negative correlation with denier (r=-0.278) and renditta (r=-0.532). Further, the denier is found to have significant negative correlation with filament length (r=-0.278), non-broken filament length (r=-0.368), reelability (r=-0.288) and renditta (r=-0.338). Similar significant negative correlation was observed for renditta with shell ratio (r=-0.270), filament length (r=-0.532), non-broken filament length (r=-0.399) and denier (r=-0.338). These observations are in agreement with the earlier report [5].

The principal component analysis (PCA) was carried out considering all the 13 evaluation parameters, the character which explained eigen values (total variance) lower than 1.865 in the principal component was rejected according to the criteria proposed by Joliffe [6]. The first three principal components representing 66.36% of the total variance were extracted. The highest coefficient values obtained for single shell weight (0.446) in PC1, raw silk % (0.439) in PC2 and denier (0.580) in PC3 respectively were found to have either positive or negative correlation with maximum number of selected parameters.

Table 1. Variability in 63 multivoltine silkworm races for rearing and post cocoon parameters

Variables	Mean	SD	Minimum	Maximum	CV%	Anova (F-value)
Single cocoon wt.(g)	1.20	0.11	0.94	1.40	8.77	16.38**
Single shell wt.(g)	0.18	0.03	0.11	0.23	14.39	27.37**
Shell ratio (%)	14.77	1.11	11.19	17.45	7.52	20.29**
Cocoon yield(kg)/10,000 larvae	10.65	1.14	8.06	12.79	10.66	4.94**
Fecundity (No.)	445.79	52.93	292.10	570.20	11.87	3.88**
Pupation rate (%)	80.03	5.58	60.94	88.63	6.97	2.10**
Fifth age larval duration (H)	141.29	12.80	120.00	201.20	9.06	9.42**
Avg. Filament length (m)	432.32	106.12	245.75	698.50	6.67	26.28**
Non-broken filament length (m)	302.90	94.81	138.50	578.00	7.15	37.58**
Denier	2.24	0.44	1.14	2.91	6.04	19.68**
Reelability (%)	69.25	11.41	40.25	86.50	5.09	20.09**
Renditta (kg)	12.69	2.70	7.86	18.80	4.81	38.30**
Raw silk (%)	8.22	1.66	5.12	12.73	5.05	31.03**

**Significance at P<0.01 level

Table 2. Evaluation index values (EI) for selected characters based on principal component analysis

Sl. No.	Race name	Single shell wt.	Denier	Raw silk %	Average
1.	GNM	59.60	63.47	77.24	66.77
2.	AP12	67.20	60.48	60.77	62.82
3.	PA12	56.40	62.32	66.76	61.83
4.	MW13	58.80	51.29	70.41	60.17
5.	O	52.80	58.64	67.84	59.76
6.	A4E	70.00	58.87	43.25	57.37
7.	MU303	59.20	65.20	45.97	56.79
8.	MHMP(Y)	62.00	53.59	54.43	56.67
9.	Cambodg	52.80	52.32	62.89	56.00
10.	BL24	66.80	65.20	35.49	55.83
11.	MU520	58.00	57.38	51.35	55.58
12.	DMR	45.60	57.95	62.56	55.37
13.	PMS2	53.60	62.78	49.60	55.33
14.	M2	53.20	58.41	54.13	55.25
15.	Al 4DY	50.80	55.89	58.96	55.22
16.	BL23	71.20	56.92	35.76	54.63
17.	Oval	48.40	57.49	57.96	54.62
18.	WAI-4	46.40	54.51	62.80	54.57
19.	PM(SL)	46.40	62.78	54.43	54.54
20.	Pure Mysore	57.20	54.39	50.95	54.18
21.	Hosa Mysore	55.20	48.18	58.66	54.01
22.	MU11	58.00	51.29	50.50	53.26
23.	PMX	60.40	61.29	37.90	53.20
24.	MY1 (SL)	58.00	49.79	51.11	52.97
25.	MU10	63.60	50.83	44.16	52.86

The three economic parameters derived from principal component analysis *viz.*, single shell weight, denier and raw silk% were analysed to score the index values based on Mano's evaluation index method and assigned overall rank based on cumulative superiority of the traits (Table 2). The highest EI values obtained for first 10 silkworm accessions *viz.*, GNM, AP12, PA12, MW13, O, A4E, MU303, MHMP (Y), Cambodg and BL24 are promising parents for evolving superior multivoltine breeds/hybrids in silkworm breeding programme.

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References

1. **Krishnaswamy S.** 1978. New technology of silkworm rearing., Bulletin No. 2., CSR&TI, Mysore, India : 1-23.
2. **Sonwalkar T. N.** 1992. Review of research work in post cocoon harvest technology in India. Sericologia, **32(1)**.
3. **Mano Y., Nirmal Kumar S., Basavaraja H.K., Mal Reddy N. and Datta R.K.** 1993. A new method to select promising silkworm breeds/combination. Indian silk, **31**: 53.
4. **Kumaresan P., Sinha R. K., Sahni N.K. and Sekar S.** 2000. Genetic variability and selection indices for economic quantitative traits of multivoltine mulberry silkworm (*Bombyx mori* L.) genotypes. Sericologia, **40**: 595-605.
5. **Hariraj G., Ramesha Y.S., Divakar Y., Bhat and Kiram B Malani.** 1993. Cocoon characteristics and silk quality. The Indian Text. J., September : 22-24.
6. **Jolliffe I.T.** 1973. Discarding variable in a principal component analysis : I. Reel data. Applied Statistics, London, **22**: 21-31.