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Short Communication

Evaluation of genetic potential of inbred pure lines of silkworm for breeding and cocoon production in Pakistan

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The fundamental aim of silkworm breeding is to get robust and sturdy silkworm larvae for easy rearing and production of best cocoons in quality and quantity for a high yielding cocoon crop. In Pakistan, efforts are being made continuously to give boost to the sericulture industry by developing pure parental silkworm lines suitable for rearing for commercial purposes. The study was carried out to evaluate genetic potential of the eleven pure silkworm lines (PAK-1, PAK-2, PAK-3, PAK-4, M-101, M-103, M-104, M-107, S-1, PFI-1 and PFI-2) for breeding and cocoon production during 2006 - 2008 at Sericulture Research Laboratory, Lahore. On the basis of the index values ranking M-101 (57.55), PAK-3 (52.22), PFI-2 (52.04), PFI-1 (51.14) and PAK-4 (50.52) were identified as good performer for various economically important traits and were selected for field trials, hybridization and other breeding programmes.

Key words: Inbred lines, genetic potential, Pakistan.

INTRODUCTION

Silkworm is not only a commercially important insect, it is also found to be an important laboratory tool. It is estimated that more than 3000 silkworm strains are available all over the world due to various ongoing breeding programmes (Nagaraju, 2002; Thangavelu et al., 2003). The maintenance of pure silkworm genetic resources has become very important for meeting the desired objectives of the breeder for immediate or long-term utilization in silkworm seed production. For race improvement, a good stock of parental races or lines is necessary because the principal objective of silkworm breeding is the improvement of the gene pool in various characters useful in practical sericulture. It is necessary to maintain the genetic resources in their original form for their rational use in different breeding and other research purposes (Mukarjee et al., 1999; Basavaraja et al., 2003; Thangavelu et al., 2003; Yamaguchi, 2003). In addition to maintenance, systematic study of resource, material is also very important, not only for classification and characterization of varieties but also for the selection of promising parents to initiate various breeding programmes to ensure silkworm seed production on sustainable basis. Evaluation of genetic material also helps in identification of lines with special characters like longer filament length, fine denier, stress resistance, disease resistance, etc. (Li et al., 2001). Availability of diverse genetic stock gives ample choice for the breeder in selection of initial parents of his desire. Even half of a good silkworm egg layings from a good genetic stock can potentially transform the sericulture scenario to a greater extent (Chandrashekaraiah and Ramesh, 2003). Most of the damage to sericulture can be attributed directly to silk-worm diseases, unfavorable weather conditions and poor harvest of mulberry leaves. Therefore, prevention of silk-worm diseases and breeding of a silkworm variety with high productivity are important commercial aspects of sericulture.

Silkworm pure lines used in this experiment were the outcome of inbreeding of parent silkworm varieties of indigenous and exotic origin at sericulture research laboratories and research centers in Pakistan. Therefore, maintenance of resource material and their effective utilization has become very important. Most of the quantitative traits of commercial importance in silkworm are under complicated polygenic control under the influence of the environment. For synthesizing the potential

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Table 1. Mean performance of inbred parent silkworm lines.

Silkworm lines	Fecundity (eggs per moth)	Pupation rate (%)	Yield (kg/10000 larvae)	Cocoon weight (g)	Shell weight (g)	Cocoon shell ratio (%)	Filament length (m)	Hatchability (%)	Raw silk (%)	Mortality (%)
PAK-1	485	89.73	11.831	1.370	0.276	20.14	786	86	10.67	5.66
PAK-2	462	88.17	10.270	1.473	0.304	20.63	850	79	11.77	6.71
PAK-3	479	90.43	10.822	1.448	0.307	21.20	735	83	11.95	5.16
M-101	448	88.11	11.583	1.483	0.309	20.83	756	78	10.88	6.92
PAK-4	501	79.84	12.318	1.471	0.299	20.32	955	91	12.38	4.29
M-103	498	87.77	11.922	1.519	0.321	21.13	915	89	12.17	2.94
M-104	456	85.84	10.823	1.494	0.309	20.68	816	78	11.35	7.16
PFI-2	464	86.85	10.429	1.381	0.286	20.71	826	75	10.86	6.19
S-1	481	84.90	10.288	1.461	0.303	20.74	876	76	10.63	6.62
PFI-1	506	87.64	12.314	1.513	0.312	20.62	982	93	12.65	3.16
M-107	502	88.56	11.982	1.573	0.316	20.90	964	84	12.34	2.70
Mean	480	87.08	11.325	1.471	0.303	20.72	860	83	11.60	5.23
Standard Deviation	20.32	2.86	0.726	0.041	0.009	0.219	85.51	6.24	127.65	1.69

polyvoltine cross breeds, usually, the high yielding polygeneic traits of bivoltine varieties and fitness traits of polygeneic nature are hybridized as proper selection of potential and homozygous parents is very important. Effective utilization of selected germplasm also plays an important role in saving the time of the breeder in the synthesis of new hybrids.

In the present study, an attempt was made to evaluate and characterize inbred lines for cocoon production on the basis of evaluation index method, frequently used for evaluating breeds/ hybrids (Rao et al., 2006).

Germplasm evaluation was conducted to ascertain the genetic potential of various inbred pure lines of silkworm for commercial exploitation. Since sericulture is practiced in diverse agro-climatic zones, systematic evaluation is needed for the proper utilization of the available lines. The information generated in this study would be useful for future breeding programmes and commercial rearing.

MATERIALS AND METHODS

The selected lines (PAK-1, PAK-2, PAK-3, PAK-4, M-101, M-103, M-104, M-107, S-1, PFI-1 and PFI-2) (Table 1) were reared under standard rearing conditions (Krishnaswami, 1975, 1983) for six generations in spring and autumn seasons during 2006 - 2008. The young larvae (1^{st} - 3^{rd} instars) were reared at 27 - 28°C with 85% - 90% relative humidity and the late age larvae (4^{th} and 5^{th} instars) were maintained at 24 - 26°C with a relative humidity of 70% - 80%. The experiment was carried out in completely randomized design. Each breed was maintained in three replications. At the beginning of 4^{th} instar, 300 larvae were counted from each line and retained for further studies. Rearing was carried out under hygienic conditions. At the end of 5^{th} instar, the spinning larvae were collected manually and mounted in plastic collapsible mountages. During the rearing period, larvae and cocoons were assessed for the yield parameters like fecundity, cocoon yield, pupation rate, cocoon weight, shell weight, shell ratio, filament length, raw silk (%) and neatness using the following Rao et al., 2006.

These data were analyzed further by using the evaluation index method. Based on these values obtained, ranks were given for each breed accordingly. Evaluation index value (EI) for silkworm breed performance was calculated by using the following formula (Mano et al., 1993).

$$EI = (A - B)/ C \times 10 + 50$$

where, A is mean of the particular trait; B is overall mean of particular trait; C is standard deviation; 50 is constant.

RESULTS AND DISCUSSION

Among all the tested eleven silkworm lines, the fecundity was maximum in PFI-1 (506) and minimum in M-10 (448), while the average fecundity was 480.

In all the lines, pupation rate was noted above 80% except in PAK-4(79.84%) and maximum in PAK-3 (90.43%), while the average pupation rate was 87%. Single cocoon weight was found highest in M-107 (1.573 g) and lowest in PAK-1(1.37 g) with an average of 1.471 g. Maximum in Pak-2 (10.27 kg) while the average cocoon yield was found (11.32 kg). Raw silk was maximum in PFI-1 (12.65%) while minimum in S-1(10.63%).

Table 2. EI values for different traits of inbred parent silkworm lines and their ranking based on mean EI value.

Silkworm lines	Fecundity (eggs per moth)	Pupation (%)	Yield (kg/ 100 larvae)	Cocoon weight (gms)	Shell weight (gms)	Cocoon shell ratio (%)	Filament length (m)	Hatchability (%)	Raw silk (%)	Mortality (%)	Mean value	Rank
PAK-1	52.37	59.30	56.96	25.69	19.89	23.61	58	41.23	54.97	52.52	44.75	9
PAK-2	41.05	53.84	35.54	50.73	50.21	45.99	50	48.81	43.73	58.70	47.86	8
PAK-3	49.41	61.74	43.07	44.63	53.22	71.92	62.85	35.36	50.16	49.88	52.22	2
M-101	34.16	53.63	53.55	53.17	55.37	55.45	59.97	37.82	42.13	59.94	50.52	5
PAK-4	60.24	35.80	63.67	50.24	44.82	31.42	61.47	61.10	63	48.49	57.55	1
M-103	58.76	52.44	58.22	61.95	68.48	69.10	61.26	56.42	59.79	36.32	38.27	11
M-104	38.10	45.69	44.09	55.35	55.58	48.27	60.44	44.84	42.13	61.35	49.63	6
PFI-2	42.03	49.23	37.65	28.29	30.86	49.64	59.95	46.01	37.31	55.64	43.66	10
S-1	50.40	42.41	35.71	47.30	49.13	51	59.72	51.86	38.92	58.17	48.51	7
PFI-1	62.70	51.99	63.62	60.48	58.81	45.54	61.74	64.25	66.21	37.82	51.14	4
M-107	60.73	52.20	59.04	75.12	63.11	58.28	61.43	62.15	51.76	35.08	52.04	3

Filament length was found maximum in M-107 (982 m) and minimum was measured in PAK-3(735 m) with mean value of 960 m.

Hatchability was also recorded during the rearing which was highest in M-107(90.43%) and lowest in PFI-2 (75%).The mortality of silkworm lines was recorded maximum in M-104 (7.16%) while minimum in M-107 (2.7%) (Table 2).

Table 2 presents EI values for different traits of inbred parent silkworm lines and their ranking based on mean EI value. On the basis of evaluation index method PAK-4(57.55), PAK-3(52.22), M-107 (52.04), PFI-1 (51.14) and PAK-4 (50.52) were identified as potentially better performers and were selected for further breeding programmes (Table 2).

This study was an effort to ensure the effective utilization of the pure inbred silkworm lines and the maintenance of the resource material. Keeping the importance of hybrids in view, the silkworm lines were reared consecutively for six generations and their quantitative traits were evaluated using reliable statistical method, that is, evaluation index method to assess the performance of the inbred lines. Earlier many breeders (Mano et al., 1993; Gower, 1971; Ramesh et al., 2001; Rao et al., 2004; Rao et al., 2006) analyzed their breeds by adopting the above methods either individually or together. The lines which have been selected through this method could be effectively used in further breeding programmes as potential parents for synthesizing superior silkworm hybrids that are suitable for culture under sub-tropical climatic conditions.

REFERNCES

Basavaraja HK, Kumar S, Kariappa N (2003). Constraints, Present Status and Prospects of Silkworm Breeding. Proceeding of Mulberry Silkworm Breeders Summit; Hindupur, India. pp. 24-40.

Chandrashekaraiah M, Babu R (2003). Breeding in India during the Last Five Decades and What Next? Proceeding of Mulberry Silkworm Breeders Summit; Hindupur, India. pp. 6-13.

Gower JC (1971). A general coefficient of similarity and some of its properties. Biometrics, 27: 857-871.

Krishnaswami S (1975). New technology of silkworm rearing. CSRTI, Mysore Bull., 2: 23.

Krishnaswami S (1983). Evolution of new bivoltine race for traditionally multivoltine areas of south India. Indian Silk, 22: 3-11

Li M W, Yao Q, Hou CX, Lin C Q, Chen KP (2001). Studies of some special characters in the silkworm (*Bombyx mori* L.) germplasm in China. Sericologia, 41: 527-535.

Mano Y, Kumar N, Basavaraja S, Mal HK, Reddy N, Datta RK (1993). A new method to select promising silkworm breeds/combinations. Indian Silk, 31: 53.

Mukarjee P, Mukharjee S, Kumarsan P (1999). An analysis of genetic divergence in Indian (multivoltine silkworm, *Bombyx mori*) germplasm. Sericologia, 39: 337-347.

Nagaraju J (2002). Application of genetic principles for improving silk production. Curr. Sci., 83: 409-414.

Ramesh B, Chandrashekaraiah M, Lakshmi H, Prasad J (2001). Silkworm (*Bombyx mori* L.) genetic stocks–an evolutionary analysis. Bull. Ind. Acad. Seri., 5: 9-17.

Rao CGP, Ramesh C, Chandrashekaraiah M, Ibrahim H, Basha K, Seshagiri S V, Nagaraju H (2004). Evaluation of polyvoltine hybrids based on silk productivity in silkworm, *Bombyx mori* L. Int. J. Indust. Entomol., 8(2): 181-187.

Rao, CGP, Seshagiri SV, Ramesh C, Basha K, Ibrahim H, Nagaraju J, Chandrashekaraiah M (2006). Evaluation of genetic potential of the polyvoltine silkworm (*Bombyx mori* L.) germplasm and identification of parents for breeding programme. J. Zhejiang Univ. Sci., 7(3): 215-220.

Thangavelu K, Sinha R, Mohan RK (2003) Silkworm Germplasm and their Potential Use. Proceeding of Mulberry Silkworm Breeders Summit; Hindupur, India. pp. 14-23.

Yamaguchi A (2003) Maintenance of Bivoltine Silkworm Races at Breeders Level. Proceeding of Mulberry Silkworm Breeders Summit; Hindupur, India. pp. 4-5.