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SELECTION OF PRODUCTIVE BIVOLTINE SILKWORM PURE BREEDS FOR THE PREPARATION OF PROMISING FOUNDATION CROSSES

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Abstract

The maintenance of silkworm breeds plays a vital role in retaining original breed characteristics and for the expression of high magnitude of hybrid vigour at commercial level. Maintenance of pure breed needs to be given utmost care as inbreeding causes deterioration of qualitative and quantitative traits in silkworm. Hence the breeders should maintain the purity of the breeds. Further, selection of suitable productive bivoltine breed is also important. While selecting the pure breeds, importance was given to select breeds showing good resistance without sacrificing the productivity traits. Keeping this in view, twenty different promising breeds were selected from CSGRC, Hosur and KSSRDI, Bangalore germplasm banks for the present study. Five plain larvae spinning oval cocoon breeds and five marked larvae spinning dumbbell cocoon breeds were selected from CSGRC, Hosur. Parallelly, five plain oval spinning cocoon and five marked dumbbell spinning cocoon breeds were selected from KSSRDI. These breeds were reared twice in a year in three replicates during favourable seasons along with controls CSR2 and CSR27 for oval and CSR6 and CSR26 for dumbbell breeds. The data pertaining to quantitative and qualitative traits were collected for these breeds. The data was statistically analysed and the breeds were ranked by adopting Mano's evaluation index method. Out of the twenty breeds six bivoltine breeds spinning oval cocoons and six bivoltine breeds spinning dumbbell cocoons were selected for the preparation of foundation crosses based on the rearing performance and ranking.

Key words: Pure breeds, productive, quantitative traits.

Introduction

The success of any sericulture industry mainly depends on the systemic maintenance and multiplication of the silkworm breeds which are developed with great caution by the breeders and can be successfully utilized for the commercial exploitation. Maintenance of breeds plays a vital role in retaining original breed characteristics and for the expression of high magnitude of hybrid vigour at commercial level.

Sericultural advanced countries like China, Japan, have achieved a remarkable progress in increasing the production of silk by evolving highly productive bivoltine silkworm races (Yokoyama, 1979) However some of Indian breeders attempted to evolve bivoltine races suitable to local conditions and achieved very little success.

Earlier attempts to rear bivoltine hybrids result in only a sporadic success (Datta,1997) and confined to favourable seasons of the year. Among various factors that are attributed to poor performance of the bivoltine strains under tropical conditions, temperature serves as a critical factor in the expression of many quantitative characters such as viability and cocoon traits when it is in excess of 28^0C. As a result, the bivoltine hybrids such as KA x NB4D2 and NB7 x NB18 were introduced for commercial exploitation (Krishnaswami, 1978) and were evaluated under favourable season but they failed to compete with multi x bi hybrids in yield parameters, thus declining the demand from the farmers for rearing. Further, the success of breeding depends

on the initial selection of parents and their effective utilization in desirable combinations. In the present study, efforts have been made to select the potential pure breeds for the preparation of foundation crosses under favourable season by adopting Mono's evaluation method which is being used for evaluation of hybrids by many researchers.

Materials and Methods

Five plain larvae spinning oval cocoon and five marked larvae spinning dumbbell cocoon pure bivoltine breeds were collected from CSGRC, Hosur. Simultaneously five plain larvae spinning oval cocoon and five marked larvae spinning dumbbell cocoons were selected from KSSRDI, Silkworm breeding section T. G pura.

In total twenty races were reared twice in the favourable season in three replicates each by adopting standard rearing procedure**s**. The oval pure breeds were compared with the control CSR2 and CSR27 and dumbbell breeds were compared with the control CSR6and CSR26. The rearing data for the traits fecundity (Fec), brushing (B) %, larval duration (Ld), larval weight (Lw), yield/10000 by number (Y/No.), yield/10000 larvae by weight (Y/w) (Kg), single cocoon weight (SCW), single shell weight (SSW), cocoon shell ratio (SR) % and pupation rate (PR) % were collected and tabulated. The data generated was subjected to statistical methods ANOVA (One way) and analysed along with the control. Further by adopting Mono's multiple trait evaluation index method (1993, 1994) evaluation index values for all the traits were calculated and ranked. The details of the breeds along with their code numbers and general characters were presented in Table-1 and Table-2 for oval and dumbbell breeds respectively.

The average rearing performance of pure oval cocoon spinning breeds and dumbbell cocoon spinning breeds was statistically analysed and presented in table-3 and table-4 respectively. Besides, evaluation index values for all the traits of oval and dumbbell cocoon breeds along with average index values were presented in table-5 and table-6 respectively.

Results and discussions

The average data of rearing performance for 10 oval breeds and 10 dumbbell breeds were presented in the table-3 and table-4 respectively. The performance of the breeds along with control breeds such as CSR2, CSR27 and CSR6, CSR26 for different traits were collected and statistically analysed. The data of oval breeds reveals that the data pertaining to quantitative traits showed highly significant difference among oval breeds for all the traits except larval duration 627-630 hrs. Fecundity which is ranged for 488-503, Brushing percentage 95.500-97.500, 10 Larval weight 36.700-39.867gm, Yield/number8706-9250, Yield/weight13.10-14.64Kgs, Single cocoon weight 1.457-1.517gm, Shell weight 0.290-0.320 gm, cocoon shell ratio 20.07-21.25 % and pupation rate 86.33-90.67%.

Among oval breeds KDR, KCR, BRF, BBE-389 BBE-379 and KNK exhibited higher significant difference for the traits such as Y/No, Y/w, PR% over the control CSR2(86.77%) and CSR27(86.33%).

The selected oval breeds were tested against the control CSR2 and CSR27 through t test and the results were discussed as follows.

The p value for **fecundity** is shown significant difference for most of the breeds and non-significant for BBE-389 highly significant (<0.001) for KNK over CSR2, whereas the values shown non-significant for four breeds except BRF and KNK show significant difference (<0.05) over the CSR27.

Brushing %: the values regarding these traits were non-significant for four breeds except KNK and BRF which were significant difference over CSR2.Similarly non-significant for all the six breeds over the CSR27.

Larval duration: The p values for these traits have exhibited non-significant for both CSR2 and CSR27except for BRF was significant difference over CSR27(0.04)

Larval weight: the values shown non-significant for all the breeds except the BBE-389 over both the controls CSR2 and CSR27.

Yield/no: The values for this trait shown is highly significant difference for all the breeds over both the controls.

Yield/weight: The values were exhibited highly significant difference except KDR which shown non-significant over the CSR2 and Highly significant for BRF, BBE-389 significant difference for KNK over CSR27.

Single cocoon weight: p values for this trait shown significant difference except BRF and KNK which is non-significant over CSR2 and CSR27.

Single shell weight: highly significant difference for KCR, BRF, BBE-389 and KNK and significant for KDR, BBE-379 over the CSR2 shows significant difference for KNK, BBE-379 over CSR27

Shell ratio: KDR, KCR exhibited significant difference and highly significant for KNK over CSR2 whereas non-significant over CSR27

Pupation rate: highly significant difference for KCR, BBE-389 and significant difference for BRF, BBE-379 and KNK over CSR2. Similarly, KDR, KCR shown HS and significant for other breeds over the CSR27.

In table-4, The average rearing performance data for dumbbell breeds were presented. The data showed highly significant for all the traits. Fecundity 486-499, Brushing % 94.37-97.83, Larval duration 622-629hrs, Larval weight 35.60- 39.890gm, Y/No. 8361-9640, Y/wt12.79 -14.073Kgs, SCW-1.410-1.503gm, Shell weight 0.289-0.325gm, Cocoon shell ratio 20.54-21.24 % and Pupation rate 80.83-93.23 %. From the result it is clear that Among dumbbell breeds all the breeds showed highly significant for all the traits. Among dumbbell breeds T1, BBE-368, BBE-374, BBE-382 have recorded higher yield of above 9640 when compared to control CSR6 (9016) and CSR26 (8856). Similarly, T1, BBE-374, BBE-368 recorded higher yield per 10000 larvae of above 13.820 Kg over the control CSR6 (13.383Kg and CSR26 (13.057Kg). With regard to pupation rate T1, BBE-374, BBE-368, BBE-364 have showed higher pupation rate of above 90%over the control CSR6(86.9%) and CSR26 (84.73%).

The analysed data subjected to evaluation by Mono's evaluation method. The breeds scored average values of above 50 were selected Based on the cumulative index values the breeds were ranked excluding larval duration. Six dumbbell breeds T1, BBE-374, FCR, BBE-382, BBE-368 and BBE-364 were selected. Further the selected dumbbell breeds were subjected to t-test to verify the performance of the breeds over both CSR6 and CSR26 controls.

Fecundity The p value for is shown significant difference and highly significant difference for the breeds exceptBBE-364 (<0.001) over CSR6, similarly, the values shown non-significant for BBE-368 and BBE-382 and significant difference (<0.05) over the CSR26.

Brushing %: The values regarding this trait were non-significant for four breeds except BBE-364 and BBE-374 which were significant difference over CSR6.Similarlynon significant for two breeds and significant forT1, FCR, BBE-364, BBE-374 over the CSR26.

Larval duration: The P values for these traits have exhibited non-significant for three breeds and significant for FCR, BBE-364, BBE-374 over CSR6 and non-significant BBE-368 and BBE-382 over CSR26 except for four breeds which shows significant difference.)

Larval weight: The values shown significant and highly significant for all the breeds except the BBE-382 over CSR6 and significant for the four breeds except FCR, T1 over the controls CSR26.

Yield/no: The values for this trait shown is non-significant BBE-368, BBE-382 and significant for other four breeds over the CSR6. significant difference for all the breeds except BBE-382 over CSR26.

Yield/weight: The values were exhibited significant difference except BBE-364 which shown non-significant over the CSR6 and significant for all the breeds except BBE-364over CSR26.

Single cocoon weight: p values for this trait shown highly significant for T1, BBE-364, BBE-368, BBE-374 except FCR and BBE-382 which is non-significant over CSR6 and significant difference for T1 and non-significant for all the breeds over CSR26.

Single shell weight: The values recorded significant difference forT1, FCR, BBE-364, BBE-368, BBE-374 except BBE-382 over the CSR6 and highly significant for T1, FCR, BBE-368 and shows significant difference for BBE-364, BBE-368, BBE-374 over CSR26

Shell ratio: There is a non-significant value for this trait for all the selected breeds over CSR6but there is significant difference for FCR, BBE-368, BBE-374 over CSR26.

Pupation rate: highly significant difference for T1, BBE-382, BBE-364, BBE-368 and BBE-374 and significant difference for FCR over CSR6. Similarly, T1, FCR, BBE-368 and BBE-374 shows highly significant and significant for other breeds over the CSR26.

Conclusion: Based on the above results the selected oval breeds and dumbbell breeds which recorded highly significant for most of the traits such as yield/number and pupation rate over both the controls were selected for the preparation of oval x oval and dumbbell x dumbbell breeds foundation cross

Six oval KDR, KCR, BBE389, BBE-379, KNK and BRF and among oval and Six dumbbell breeds T1, BBE-374, FCR, BBE- 382 BBE-368 and BBE-364 were selected for hybrid performance studies. This study was an effort to identify the parental breeds for the effective utilization of pure breeds from the different germplasm centres as resource materials. Many breeders (Mono *et.al.*, 1993) have developed the breeds by adopting this method. Generally, the superiority of the race is judged by the phenotypic manifestation of more than twenty characters. (Mono *et al.,1993*).

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Table-1: List of pure bivoltine oval breeds and characteristics

Sl. No.	Name of the Breed	Code	larval marking	cocoon shape	cocoon colour
1	BBE-364	HO1	Plain	Oval	white
2	BBE-366	HO2	Plain	Oval	white
3	BBE-368	HO3	Plain	Oval	white
4	BBE-374	HO4	Plain	Oval	white
5	BBE-389	HO5	Plain	Oval	white
6	KCR	KO1	Plain	Oval	white
7	KDR	KO2	Plain	Oval	white
8	BRF	KO3	Plain	Oval	white
9	KNK	KO4	Plain	Oval	white
10	JKDB	KO5	Plain	Oval	white

Table-2: List of pure bivoltine dumbbell breeds and characteristics

Sl. No.	Name of the Breed	Code	larval marking	cocoon shape	cocoon colour
1	BBE-347	HD1	Marked	Dumbbell	white
2	BBE-363	HD2	Marked	Dumbbell	white
3	BBE-378	HD3	Marked	Dumbbell	white
4	BBE-379	HD4	Marked	Dumbbell	white
5	BBE-382	HD5	Marked	Dumbbell	white
6	T1	KD1	Marked	Dumbbell	white
7	T6	KD2	Marked	Dumbbell	white
8	APS46	KD3	Marked	Dumbbell	white
9	FCR	KD4	Marked	Dumbbell	white
10	K9D	KD5	Marked	Dumbbell	white

Table-3: Rearing performance of oval pure breeds										
Breeds	Fec	B%	Ld (hrs)	Lw (gm)	Y/No.	Y/w (Kg)	SCW	SSW	SR %	PR%
KO1(KCR)	502.667	96.333	627.333	39.333	9216.67	14.127	1.513	0.320	21.02	90.67
KO2(BRF)	502.333	96.300	629.667	37.167	9011.00	13.277	1.483	0.310	21.06	89.93
KO3(KNK)	501.667	95.500	627.000	37.633	9160.00	13.680	1.483	0.310	21.08	88.50
KO4(JKDB)	503.333	97.500	629.333	38.633	9250.00	13.917	1.457	0.300	20.91	88.07
KO5(KDR)	501.000	96.167	628.333	39.867	9243.33	14.645	1.513	0.310	20.87	90.23
HO1(347)	488.000	95.710	627.000	36.700	8706.67	12.343	1.434	0.290	20.41	83.03
HO2(368)	500.667	97.500	628.000	37.100	9203.33	13.692	1.496	0.300	20.27	90.00
HO3(378)	493.000	96.200	629.333	37.333	8736.00	12.887	1.492	0.300	20.07	85.33
HO4(379)	500.000	97.333	626.667	38.167	9110.00	13.667	1.517	0.310	20.47	89.27
HO5(382)	499.000	97.033	628.667	39.600	9030.00	13.710	1.500	0.310	20.66	89.60
CSR2	497.333	97.467	627.667	37.567	8830.00	13.107	1.479	0.310	21.25	86.77
CSR27	498.333	96.000	628.333	37.113	8750.00	13.113	1.480	0.310	21.03	86.33
Mean	498.944	96.587	628.111	38.018	9020.58	13.514	1.487	0.310	20.76	88.14
SD±	4.610	0.953	1.260	1.101	208.11	0.596	0.024	0.007	0.382	2.300
CD @ .05	1.182	0.468	0.589	0.233	26.20	0.053	0.005	0.001	0.086	0.275
CD @ .01	1.822	0.721	0.907	0.359	40.38	0.082	0.008	0.002	0.132	0.424
P Value	0.000	0.017	0.007	0.000	0.00	0.000	0.000	1.59	7.42	0.000
Significance	HS	NS	NS	HS	HS	HS	HS	HS	HS	HS
STAR	**			**	**	**	**	**	**	**

Table-4: Rearing performance of dumbbell pure breeds										
Breeds	Fec	B%	Ld(hrs)	Lw (gm)	Y/no	Y/w (Kg)	SCW	SSW	SR%	PR%
KD1(T1)	495.000	95.77	625.000	39.890	9220.0	13.783	1.503	0.323	21.11	89.47
KD2(T6)	486.444	96.47	628.333	37.200	8361.7	12.793	1.410	0.289	20.54	80.83
KD3(APS46)	491.333	96.97	629.000	36.667	9290.0	13.413	1.450	0.300	20.69	89.50
KD4(FCR)	493.000	97.04	622.333	38.233	9275.3	13.627	1.502	0.321	21.39	89.33
KD5(K9D)	490.667	96.67	623.333	37.233	9290.0	13.393	1.459	0.303	20.76	89.50
HD1 364Md	499.000	97.83	624.333	36.567	9123.3	13.537	1.459	0.313	21.34	90.27
HD2 366Md	490.667	96.43	625.000	38.067	9083.3	13.610	1.480	0.315	20.72	86.50
HD3 368Md	490.667	97.27	626.000	35.600	9640.0	14.073	1.467	0.325	21.08	91.77
HD4 374Md	493.333	94.37	624.667	36.967	9528.3	14.033	1.475	0.313	21.24	93.23
HD5382Md	488.667	97.27	627.667	39.300	9343.7	13.623	1.477	0.315	21.22	89.67
CSR6	486.333	97.20	627.000	38.600	9016.7	13.383	1.496	0.317	21.16	86.90
CSR26	487.667	96.70	628.000	38.367	8856.7	13.053	1.483	0.317	21.19	84.73
Mean	491.065	96.614	625.889	37.724	9169.1	13.527	1.472	0.3126	21.037	88.48
SD±	3.729	0.948	2.252	1.223	325.163	0.400	0.026	0.0104	0.316	3.252
CD @ .05	0.792	0.231	0.688	0.177	35.657	0.139	0.005	0.0015	0.116	0.356
CD @ .01	1.221	0.357	1.060	0.274	54.955	0.215	0.007	0.0023	0.179	0.549
P Value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.0899	0.000	0.000
Significance	HS	HS	HS	HS	HS	HS	HS	HS	HS	HS
STAR	**	**	**	**	**	**	**	**	**	**

Table-5: Evaluation index values for oval pure breeds

	Fec	B%	Lw	Y/n	Y/w	SCW	SSW	SR%	PR	CI	Rank (ex ld)*
KO1(KCR)	60.966	60.966	61.950	59.422	60.287	60.676	64.356	56.93	60.97	60.72	1
KO2(BRF)	57.778	57.778	42.269	49.540	46.025	48.384	56.346	57.76	57.78	52.63	6
KO3(KNK)	51.546	51.546	46.508	56.699	52.792	48.384	56.817	58.37	51.55	52.69	5
KO4(JKDB)	49.676	49.676	55.591	61.024	56.763	37.458	43.623	54.03	49.68	50.84	8
KO5(KDR)	59.082	59.082	66.795	60.703	68.979	60.676	51.634	52.98	59.08	59.89	2
HO1(347)	27.763	27.763	38.030	34.916	30.364	28.034	28.591	40.99	27.76	31.58	12
HO2(368)	58.068	58.068	41.663	58.781	52.988	53.574	43.623	37.20	58.07	51.34	7
HO3(378)	37.778	37.778	43.783	36.326	39.481	51.798	37.968	31.89	37.78	39.40	11
HO4(379)	54.879	54.879	51.352	54.297	52.568	62.041	49.277	42.35	54.88	52.95	4
HO5(382)	56.329	56.329	64.372	50.452	53.296	55.213	53.518	47.40	56.33	54.80	3
CSR2	44.010	44.010	45.902	40.842	43.172	46.745	59.314	62.93	44.01	47.88	9
CSR27	42.126	42.126	41.784	36.998	43.284	47.018	54.932	57.17	42.13	45.28	10

*Excluding larval duration

Table-6: Evaluation index values for dumbbell

	Fec	B%	Lw	Y/n	Y/w	SCW	SSW	SR%	PR %	CI	Rank (ex ld)*
KD1(T1)	60.554	41.062	67.706	51.566	56.402	62.145	62.674	57.46	53.05	56.96	1
KD2(T6)	37.609	50.115	45.715	25.169	31.681	26.223	27.816	45.41	26.50	35.14	12
KD3(APS46)	50.720	53.718	41.355	53.719	47.163	41.618	43.573	50.45	53.15	48.39	10
KD4(FCR)	55.190	54.456	54.163	53.268	52.490	61.760	58.520	54.44	52.64	55.21	2
KD5(K9D)	48.932	50.554	45.987	53.719	46.664	45.210	52.885	52.92	53.15	50.00	8
HD1 364Md	71.281	62.858	40.537	48.593	50.243	53.165	46.439	48.34	55.51	53.00	4
HD2 366Md	48.932	48.093	52.800	47.363	52.074	53.165	40.708	30.97	43.93	46.45	11
HD3 368Md	48.932	56.882	32.635	64.482	63.644	55.730	45.006	44.47	60.12	52.43	5
HD4 374Md	56.084	26.296	43.807	61.048	62.645	51.112	51.691	49.98	64.63	51.92	6
HD5382Md	43.569	56.882	62.883	55.369	52.407	51.882	53.124	53.15	53.66	53.66	3
CSR6	37.311	56.179	57.160	45.313	46.414	59.323	57.278	50.57	45.16	50.52	7
CSR26	40.887	50.905	55.253	40.392	38.173	54.447	60.286	61.84	38.49	48.96	9

*Excluding larval duration