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Yield and yield contributing traits in eri silkworm, *Samia ricini* (Donovan) in different combinations

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ABSTRACT

Six strains of eri silkworm were isolated from *Samia ricini* (Donovan) on the basis of larval colour and body markings, that is, Yellow plain (YP), Yellow spotted (YS), Yellow zebra (YZ), Greenish blue plain (GBP), Greenish blue spotted (GBS) and Greenish blue zebra (GBZ). The strains were maintained in the germplasm bank up to fifth generation to get the homozygous characters. Finally crossings were conducted among the six strains of eri silkworm based on combining ability test following dialell technique and observed the combining ability effect and heterosis of parental genotype for different character of the seven crosses, *viz*., YP × GBZ, YZ × GBS, GBZ × YS, YS × GBS, YZ × YS, GBZ × YP, and GBS × GBZ. The obtained data of the above crosses reflected that YZ × YS and GBS × GBZ cross combinations are superior in terms of fecundity, hatching (%), larval weight (g), larval period, cocoon weight (g), shell weight (g), pupal weight (g), shell ratio %, effective rate of rearing %, and absolute silk yield/dfls (g).

Keywords: Eri silkworm, strains, development, combination.

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INTRODUCTION

Southeast Asia is the apex of the natural home of silk producing insects and is richest in terms of silkworm biodiversity. The eri silkworm, *Samia ricini* (Donovan) is a domesticated multivoltine non - mulberry silkworm having six strains and one of the major component of wild (Vanya) silk of India (Sarmah et al., 2002, 2006). This insect has been exploited commercially for its silk since time immemorial (Choudhury, 1982). The silk produced by eri silkworm is considered economically the third most important silk in the world after mulberry and Tasar silks. There are two species of eri silkworms available in north east India, *viz*., the domesticated *Samia ricini* (Donovan) and its wild progenitor *Samia canningie* (Hutton) (Peigler and Naumann, 2002-03). The North eastern region of India is rich in genetic resources of eri silkworm and a number of ecoraces existing in nature. The rural tribes of North east region of India conduct eri rearing partly for the need of eri pupae as an alternative source of protein (Suryanarayan et al., 2004; Sarmah, 2011). The product of the eri silkworm pupae, is a natural health food, second most abundant biological polymer in nature, and the second largest renewable resource and wide distribution. Recent works on biodiversity in eri silk moths have indicated a massive growth potential for eri culture in north east India (Chakravorty et al., 2008). However, the conservative opinion of experts finds the industry dealing in international trade most often little cost saving. On the other hand, this culture holds promise for being a highly lucrative and employment oriented enterprise. The industry persisted in the region because traditional sericulture requires little equipment, less money and virtually no risks. Even if there is no market for the products, these are used at home. Now, with the winds of globalization and information technology revolution behind its sails, eri culture cannot afford to hold on to old ways for long. There is still scope for increasing eri silk production but to establish large scale industrial units, development of high yielding cross breed of eri like non-mulberry is very essential. Recently, a new eri silkworm C2 breed has been developed through conventional breeding (Sarmah et al., 2015). However, adverse climatic conditions e.g., high humidity coupled with high temperature causes mortality of the breed (Ahmed et al., 2014). Therefore, it is necessary to evolve breeds/

combinations of eri silkworm based on qualitative and quantitative traits.

MATERIALS AND METHODS

Germplasm conservation centre, Chenijan, CMER & TI, Lahdoigarh was selected as location of the experiments and six strains (YP = Yellow plain), (YS = Yellow spotted), (YZ = Yellow Zebra), (GBP = Greenish blue plain), (GBS = Greenish blue plain), (GBZ = Greenish blue plain) of eri silkworm were isolated from promising ecoraces (Figure 1). On the basis of body marking of 5^{th} instars larvae were isolated and reared on the primary food plants, that is, castor, *Ricinus communis* L. Five generation rearing (F1 to F5) of isolated six pure line strains were completed within the year through inbreed rearing to obtain homozygous population. Rearing was conducted following standard methodology (Sarmah et al., 2013) maintaining 300 worms in each treatment with 3 replications and the rearing data of each generation was calculated. On the basis of established methods, the combining ability was calculated at the institute (Singh et al., 2012) *viz*., YP, GBP, YZ, GBZ, YS and GBS were subjected to estimate their general combining ability in breeds and specific combining ability in the hybrids crossed in a 6 × 6 dialell fashion. The analysis of variance for combining ability of nine yield contributing traits manifested significant GCA variances in all the traits except absolute silk yield. Based on this established combining ability of inbreed lines of six strains of the eri silkworm crosses were made. The crosses *viz*. YP × GBZ, YZ × GBS, GBZ × YS, YS × GBS, YZ × YS, GBZ × YP and GBS × GBZ, were supplied to the seven farmers of Seri model village of Tamulisiga and Dadhara of Sivasagar and Golaghat district, respectively to evaluate the performance of the combinations at farmers level. The rearing data, that is, fecundity (no), hatching (%), larval weight (g), larval duration (days), cocoon weight (g), shell weight (g), SR%, ERR% and absolute silk yield were recorded.

Figure 1. Six strains of eri silkworm isolated from promising ecoraces.

RESULTS AND DISCUSSION

To get homozygous population the isolated strains of eri silkworm were maintained up to five generations on castor fed and the rearing data indicated that, in the first generation maximum average hatching (86%), cocoon weight (3.10 g) and fecundity (358 nos.) is observed in yellow plain strain. The maximum shell weight (0.54 g) was in yellow zebra strain and maximum average larval weight (7.10 g) in greenish blue zebra. In the second generation highest average hatching (88%), larval weight (7.10 g), cocoon wt. (3.10 g), shell weight (0.51 g) and fecundity (354 nos.) were observed in yellow zebra strain. In the third generation also highest average hatching (89 %), larval weight (7.20 g), cocoon weight (3.15 g), shell weight (0.51 g) and fecundity (358 nos.) is observed in yellow zebra strain. In the fourth generation highest average hatching (87%) was observed in the yellow zebra and greenish blue zebra. The larval weight (7.20 g), cocoon wt. (3.16 g), shell weight (0.52 g) and fecundity (358 nos.) were found in yellow zebra strain. In the 5^{th} generation highest average hatching (87%), cocoon weight (3.46 g) and fecundity (364 nos.) was observed in the yellow zebra. The highest larval weight (7.80 g) was found in yellow zebra and highest shell weight (0.56 g) in greenish blue zebra strain (Table 1).

The combining ability was calculated at the institute (Singh et al., 2012) *viz*., (YP), (GBP), (YZ), (GBZ), (YS) and (GBS) to estimate their general combining ability in breeds in a 6 × 6 dialell fashion. As the established

Table 1. Performance of generation wise rearing of isolated pure line strains in different period.

Strains	Hatching (%)	Larval wt. (g)	Cocoon wt. (g)	Shell wt. (g)	Fecundity (nos.)
1st generation (December, 2014 – February, 2015)					
YP	86	7.00	3.10	0.51	358
YS	82	6.80	2.95	0.46	349
YZ	89	7.40	3.20	0.54	360
GBP	83	6.90	2.88	0.43	349
GBS	80	6.70	2.75	0.44	344
GBZ	85	7.10	2.85	0.50	355
St. dev.	3.19	0.25	0.17	0.04	6.16
Confidence level (95.0%)	3.35	0.26	0.18	0.05	6.46
2nd generation (March, 2015 - April, 2015)					
YP	85	6.90	3.00	0.48	345
YS	83	6.60	2.85	0.43	335
YZ	88	7.10	3.10	0.51	354
GBP	82	6.40	2.78	0.42	336
GBS	80	6.30	2.79	0.42	333
GBZ	86	6.90	2.88	0.46	344
St. dev.	2.90	0.32	0.13	0.04	7.99
Confidence level (95.0%)	3.04	0.33	0.13	0.04	8.38
3rd generation (May, 2015 - June, 2015)					
YP	85	6.90	3.10	0.49	344
YS	83	6.80	2.98	0.44	334
YZ	89	7.20	3.15	0.51	358
GBP	82	6.40	2.78	0.42	336
GBS	81	6.70	2.95	0.45	337
GBZ	86	6.90	2.97	0.46	349
St. dev.	2.94	0.26	0.13	0.03	9.25
Confidence level (95.0%)	3.09	0.28	0.14	0.03	9.71
4th generation (July, 2015 - Aug, 2015)					
YP	83	7.00	3.10	0.50	351
YS	83	6.60	2.85	0.43	335
YZ	87	7.20	3.16	0.52	358
GBP	82	6.40	2.78	0.42	336
GBS	80	6.30	2.79	0.42	333
GBZ	87	6.90	2.99	0.48	348
St. dev.	3.33	0.36	0.16	0.04	10.25
Confidence Level (95.0%)	3.49	0.47	0.17	0.05	10.76
5th generation (Sept, 2015 - Nov, 2015)					
YP	83	7.80	3.45	0.52	361
YS	84	6.90	3.00	0.46	345
YZ	87	7.60	3.46	0.55	364
GBP	80	6.72	3.10	0.42	346
GBS	81	6.80	3.12	0.44	343
GBZ	85	7.20	3.30	0.56	358
St. dev.	2.58	0.45	0.19	0.06	9.20
Confidence Level (95.0%)	2.71	0.47	0.20	0.06	9.65

combining ability seven combinations were made *viz*, YP × GBZ, YZ × GBS, GBZ × YS, YS × GBS, YZ × YS, GBZ × YP and GBS × GBZ, and rearing performance were studied during the winter crop at seri model village as well as institute level. The overall rearing performance revealed that YZ × YS and GBS × GBZ combinations of eri silkworm are superior in terms of fecundity (nos.), hatching (%), larval weight (g), larval period, cocoon weight (g), shell weight, pupal weight (g), shell ratio %, effective rate of rearing %, and absolute silk yield / dfls (g). The rearing data at farmers' level revealed that the highest fecundity 356 nos. was observed in YZ × YS combination, equal highest hatching 85% was found in YZ × YS and GBS × GBZ. There after maximum larval weight 8.81 g was found in GBS × GBZ combination. Also highest cocoon yield per 260 dfls and cocoon weight 3.59 g found in GBS × GBZ. Highest shell weight 0.56 g and shell ratio15.59% were observed in GBS × GBZ. The effective rate of rearing 86.16 % and absolute silk yield / dfls 145.60 g also was found higher in case of GBS × GBZ combination (Table 2). The rearing data of

Table 2. Evaluation of seven combinations at farmers' level (Sample size: 5 dfls/combination).

Combinations	Fecundity (no.)	Hatching (%)	Larval wt. (g)	Larval (days)	Cocoon yield/dfls (no.)	Cocoon wt. (g)	Shell wt. (g)	Pupa wt. (g)	SR (%)	ERR (%)	Absolute silk yield/dfl (g)
YP × GBZ	354	80	8.5	24	240	3.47	0.51	2.96	14.69	84.74	122.4
YZ × GBS	347	81	8	23	238	3.36	0.53	2.83	15.77	78.56	126.14
GBZ × YS	349	81	8.1	22	242	3.47	0.48	2.99	13.83	85.6	116.16
YS × GBS	344	83	8.2	24	245	3.4	0.49	2.91	14.41	85.8	120.05
YZ × YS	356	85	8.7	24	258	3.58	0.55	3.03	15.36	85.26	141.9
GBZ × YP	348	82	8.2	23	241	3.4	0.49	3.1	14.41	84.45	118.09
GBS × GBZ	355	85	8.81	23	260	3.59	0.56	3.03	15.59	86.16	145.6
St. dev.	4.58	1.99	0.31	0.76	8.96	0.09	0.03	0.09	0.72	2.63	11.8
Confidence level (95.0%)	4.23	1.84	0.29	0.7	8.28	0.08	0.03	0.08	0.67	2.43	10.91

Table 3. Evaluation of seven combinations at Institute level (sample size: 5 dfls/ combination).

Combinations	Fecundity (no.)	Hatching (%)	Larval wt. (g)	Larval (days)	Cocoon yield/dfls (no.)	Cocoon wt. (g)	Shell wt. (g)	Pupa wt. (g)	SR (%)	ERR (%)	Absolute silk yield/dfl (g)
YP × GBZ	352	82	8.6	23	252	3.48	0.52	2.96	14.94	87.3	131.04
YZ × GBS	347	83	8.2	23	250	3.38	0.52	2.86	15.38	86.8	130
GBZ × YS	349	84	8.2	22	250	3.47	0.51	2.96	14.69	85.27	127.5
YS × GBS	344	83	8.4	24	251	3.42	0.5	2.92	14.61	87.9	125.5
YZ × YS	353	86	8.7	23	262	3.56	0.55	3.01	15.44	86.3	144.1
GBZ × YP	348	82	8.4	22	248	3.42	0.5	2.92	14.61	86.9	124
GBS × GBZ	358	86	8.7	24	255	3.58	0.57	3.01	15.92	82.82	145.35
St. dev.	4.6	1.7	0.21	0.82	4.69	0.07	0.03	0.05	0.51	1.7	8.7
Confidence level (95.0%)	4.25	1.58	0.2	0.76	4.33	0.07	0.02	0.05	0.47	1.57	8.05

institute level revealed that the highest fecundity 358 nos. was observed in GBS × GBZ combinations and almost equal hatching 86% and larval weight 8.7 g were found in GBS × GBZ and YZ × YS combinations. The highest cocoon yield per 262 dfls. observed in YZ × YS and cocoon weight 3.58 g found in GBS × GBZ. Highest shell weight 0.57 g and shell ratio 15.92% were also observed in GBS × GBZ. The highest effective rate of rearing (86.30%) was found in YZ × YS and absolute silk yield / dfls (145.35 g in GBS × GBZ combinations (Table 3). most of the characters are influenced by both environmental genetic factors and the contribution of which vary for different strains. The success of breeding is largely depending on the choice of parents, mating system in designing the breeding plane followed by appropriate selection procedure. Analysis of the growth, development and economic characters of cocoon of six strains of eri silkworm, revealed that combinations *viz*. YZ × YS and GBS × GBZ are the promising combinations. For commercial exploitation further study is essential.

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