Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2017; 5(5): 1346-1348
© 2017 JEZS
Received: 22-07-2017
Accepted: 23-08-2017

Shabir A Bhat
Temperate Sericulture Research Institute Mirgund, SKUAST-Kashmir, Post Box No. 674, GPO- Srinagar Kashmir, India

Malik Farooq IL Khan
Temperate Sericulture Research Institute Mirgund, SKUAST-Kashmir, Post Box No. 674, GPO- Srinagar Kashmir, India

KA Sahaf
Temperate Sericulture Research Institute Mirgund, SKUAST-Kashmir, Post Box No. 674, GPO- Srinagar Kashmir, India

Correspondence
Shabir A Bhat
Temperate Sericulture Research Institute Mirgund, SKUAST-Kashmir, Post Box No. 674, GPO- Srinagar Kashmir, India

Studies on the performance of some silkworm, *Bombyx mori* L, hybrids during summer season in Kashmir

Shabir A Bhat, Malik Farooq IL Khan and KA Sahaf

Abstract
Eight newly evolved silkworm, *Bombyx mori* L, hybrids were evaluated for their performance in eight metric traits viz., fecundity, hatching, larval weight, yield per 10,000 larvae by number and by weight, single cocoon weight, single shell weight and shell ratio (%). The data generated were analyzed statistically and subjected to multiple trait evaluation index. Four hybrids viz., $SK_{28} \times SBNP_1$, $SK_6 \times SBNP_1$, $NB_4D_2 \times SH_6$ and $SK_{30} \times SBNP_1$, exhibited better performance during summer season.

Keywords: *Bombyx mori*, evaluation, hybrid, silkworm, summer and trait

Introduction
Kashmir is the temperate sericulture belt bestowed with climate suited for production of bivoltine silk of international standard. Though there is scope for taking two to three crops per year on a large scale, but mainly one major crop is taken commercially during spring whereas during summer 10-15 percent farmers take up sericulture [19]. Production is below the production potential in both seasons especially during summer. Attempts have been made to popularize the second silkworm rearing on a commercial scale [4, 11] but the non-availability of season specific hybrids, shortage of quality mulberry leaf, disease prevalence *etc* come in way the of achieving the targets. Although a good number of silkworm breeds / hybrids have been developed for rearing during the spring season under Kashmir climatic conditions [23, 7, 10, 12] yet limited work has been carried out for evolution / identification of silkworm hybrids for summer season under Kashmir climatic conditions [16]. The present study is an attempt towards identification of silkworm hybrids suitable for rearing during summer season in Kashmir. Identification and rearing of summer specific silkworm hybrids will ensure cocoon crop stability and generate more income to sericultural farmers. The introduction of multiple cocoon crop will make sericulture viable and sustainable in the region.

Material and Methods
Eight silkworm crosses viz., $SK_{28} \times SBNP_1$, $SK_{30} \times SBNP_1$, $SK_6 \times SBNP_1$, $SH_6 \times KA$, $SH6 \times NB_7$, $NB_{18} \times KA$, $NB_4D_2 \times SH_6$ and $SH_6 \times NB_4D_2$ were prepared and the disease free layings of these crosses were reared at the Temperate Sericulture Research Institute (TSRI), Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir (SKUAST-K) Mirgund. The experiment was laid down in a Completely Randomized Design (CRD) with three replications of 300 larvae following the standard rearing procedure [1]. The data for eight metric traits *viz.*, number of eggs/ laying, hatching percentage, ten mature larval weight, yield per 10,000 larvae by number and by weight, single cocoon weight, single shell weight and shell ratio were recorded, analyzed statistically and also subjected to Multiple Trait Evaluation Index (EI) [14] to identify with top ranking hybrids for exploitation in the field during summer under Kashmir climatic conditions.

Evaluation and Index
Evaluation index value (EI) for silkworm hybrid performance was calculated by using the following formula

$$\text{Evaluation index} = \frac{A - B}{C} \times 10 + 50$$

Where,
A= Value obtained for a particular trait of particular hybrid combination
B= Mean value of particular trait of all the hybrid combinations
C= Standard Deviation
10= Standard Unit
50= Fixed Value
The average index value fixed for the selection of a combination is >50. The hybrid combinations with the relatively higher value of >50 were only considered to have greater economic value.

Results and Discussion
The results on eight metric traits are presented in table -1. Highest fecundity (622) was recorded in NB_{18} × KA and found significantly superior to other hybrids. Maximum hatching percentage (97.37) was recorded in SH_6 × NB_4D_2 significantly superior to SK_{30} × $SBNP_1$ (86.82) but at par with other hybrids. Weight of ten mature larvae was recorded (40.30g) in NB_{18} × KA which was significantly superior to SK_6 × $SBNP_1$ (34.30), SH_6 × NB_4D_2 (31.59), and SH_6 × KA (24.04) but was at par with SK_{28} × $SBNP_1$ (39.78), SK_{30} × $SBNP_1$ (39.01), SH_6 × NB_7 (37.23), NB_{18} × KA (40.30) and NB_4D_2 × SH_6 (37.79). Highest yield per 10,000 larvae by number was obtained in SK_6 × $SBNP_1$ (8050) and lowest in SH_6 × NB_7 (5666), however the yield per 10,000 larvae by weight (Kg) was highest in SK_{28} × $SBNP_1$ (15.00) and lowest (8.50) in SH_6 × KA. Single cocoon weight was recorded in the range of 1.45 to 1.63g being highest in SK_{28} × $SBNP_1$ followed by NB_4D_2 × SH_6 and SK_{30} × $SBNP_1$ with values of 1.61 and 1.59, respectively. Highest single cocoon shell weight of 0.35g was recorded in SK_{30} × $SBNP_1$ followed by SK_{28} × $SBNP_1$ and SK_6 × $SBNP_1$ with value of 0.34 and 0.33g respectively. The highest shell ratio percentage (21.61) was recorded in SK_{30} × $SBNP_1$ followed by SK_6 × $SBNP_1$ (21.47) and SK_{28} × $SBNP_1$ (21.25). The data in respect of important commercial characters viz., number of eggs / laying, hatching percentage, larval weight, yield per 10,000 larvae by number and by weight, cocoon weight, shell weight and shell ratio were subjected to multiple trait evaluation index (EI) as per Mano *et al*. (1993) and is presented in table 2. On the basis of evaluation index only four silkworm hybrids viz., SK_{28} × $SBNP_1$ (57.66), SK_6 × $SBNP_1$ (55.15), NB_4D_2 × SH_6 (53.29), and SK_{30} × $SBNP_1$ (52.25) scored values greater than 50 (Table 2 and Fig.1).
The manifestation of heterosis described in terms of superiority through F_1 hybrid performance over the parental performance is well established in biological kingdom. It is well documented that parental stock undergo some deterioration in performance due to continuous inbreeding therefore, evolution of new breeds / hybrid is must so that week and low yielding breeds are replaced with new productive ones. Fusion of new gene combinations by genetic manipulation is one of the powerful tools in improving the commercial traits of plants and animals. As per available literature manifestation of heterosis in silkworm has been demonstrated by many breeders [2, 7, 9, 8, 21, 13, 6]. The F_1 hybrids are robust, productive, tolerant to biotic and abiotic stress [5] and can be reared easily by adopting appropriate rearing technology [3]. The high levels of production and productivity is mainly attributed to use of highly productive silkworm hybrids for commercial cocoon production. In earlier studies silk productivity was regarded to be one of the important characteristics for evaluation of silkworm hybrid / breeds [24, 20] but cocoon yield being a complex trait is contributed by more than 21-components traits [22]. Hence the identification of new and productive hybrids call for consideration of the cumulative effects of all the component traits on cocoon silk yield so multiple trait evaluation index method developed by [14] has been utilized for short-listing silkworm breeds / hybrids by various breeders [17, 18, 10, 12, 15]. In this method equal weight-age is given to yield components and has been employed in the present investigation as well. Based on the values obtained for eight metric traits, only four top ranking hybrids viz., SK_{28} × $SBNP_1$ (57.660), SK_6 × $SBNP_1$ (55.15), NB_4D_2 × SH_6 (53.29), and SK_{30} × $SBNP_1$ (52.25) were identified / short listed based on higher index value (>50). These short listed hybrids are recommended for rearing during summer season to boost the cocoon production in the region.

Table 1: Performance of silkworm hybrids with respect to rearing parameters.

Silkworm Hybrids	Fecundity (No)	Hatching (%)	Larval Weight (g)	Yield / 10000 Larvae		Cocoon Wt. (g)	Shell Wt (g)	Shell ratio (%)
				By No.	By Wt.			
SK_{28} ×$SBNP_1$	571	95.67	39.78	7500	15.00	1.63	0.34	21.25
SK_{30}× $SBNP_1$	342	86.82	39.01	7100	13.90	1.59	0.35	21.61
SK_6 × $SBNP_1$	560	97.36	34.30	8050	12.83	1.56	0.33	21.47
SH_6×KA	553	93.66	24.04	5950	8.50	1.48	0.28	19.27
SH_6×NB_7	570	95.41	37.23	5666	10.21	1.55	0.29	18.89
NB_{18}×KA	622	97.06	40.30	7366	10.16	1.45	0.28	19.52
$NB4D_2$ × SH_6	491	95.97	37.79	6650	14.16	1.61	0.33	20.72
SH_6 × $NB4D_2$	503	97.37	31.59	6716	11.66	1.54	0.30	19.43
CD@5%	10	5.8	4.99	1276	1.66	0.82	0.227	1.63

Table 2: Evaluation index for eight different commercial characters of silkworm hybrids.

Hybrid	Fecundity	Hatching	Larval Weight	Yield/10000 larvae		Cocoon weight	Shell weight	Shell ratio	Mean EI	Rank
				By No.	By Wt.					
SK_{28} ×$SBNP_1$	53	51.42	57.34	56.15	62.51	60.35	60.07	56.58	57.66	1
SK_{30}× $SBNP_1$	34	34.69	56.01	52.67	57.83	55.70	61.17	59.02	52.25	1
SK_6 × $SBNP_1$	52	54.62	47.92	61.63	53.30	51.51	56.76	58.08	55.15	1
SH_6×KA	52	47.63	30.32	40.73	43.88	40.34	40.20	43.28	40.52	3
SH_6×NB_7	53	50.93	52.95	73.91	42.18	50.11	42.40	40.68	45.07	3
NB_{18}×KA	57	54.05	58.24	54.83	41.96	35.68	39.09	44.96	48.30	2
$NB4D_2$ × SH_6	47	51.99	53.92	47.69	58.97	57.56	55.65	53.04	53.29	1
SH_6 × $NB4D_2$	48	54.63	43.26	48.36	48.34	48.72	44.61	44.31	47.73	2

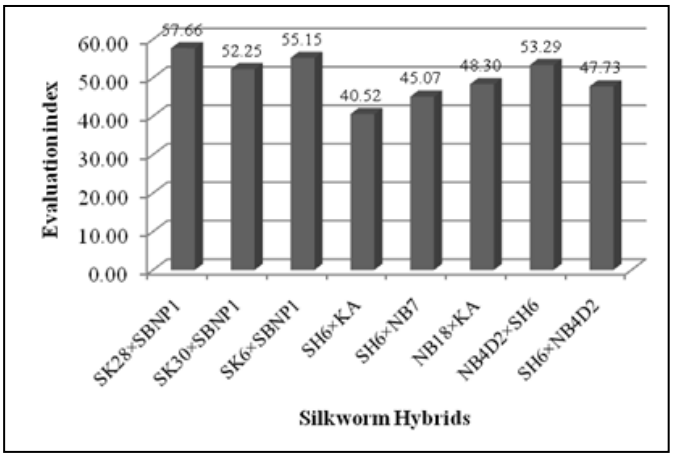

Fig 1: Graphical representation of mean evaluation index of different economic characters of silkworm hybrids.

Acknowledgment
Authors are thankful to all Silkworm Breeding and Genetics Laboratory scientific and technical staff for their help and encouragement during the course of experiment.

References

1. Annomyous. Package of practices for silkworm rearing and mulberry cultivation in Kashmir. Technical Document. Directorate of Extension Education, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, 2003, 5-6.
2. Basavaraja HK, Nirmal Kumar S, Suresh Kumar N, Mal Reddy N, Kashama Giridhar, Ahsan MM *et al*. New productive bivoltine hybrids, India Silk. 1995; 34:5-9.
3. Datta RK, Raghavendra RD, Jayaswal KP, Premalatha V, Ravindra S, Kariappa BK. Heterosis in relation to combining ability in multix bi strains of silkworm *Bombyx mori* L. Indian J Seric. 2001; 40:1-6.
4. Farooq M, Singh TP, Noor-ud-Din, Rufaie ZH, Baqual M, Dar HU. Second commercial crop to make sericulture a more profitable in Kashmir. Proceedings of regional Seminar on Prospects and Problems of Sericulture as are economic enterprise in North west India. 2006, 275-276.
5. Gamo T, Hirabayshi, Hirabayashi T. Genetic analysis of grwth rate, pupation rate and some quantative charactyers by diallel croses in silkworm Bombyx mori L. Jpn. J Breed. 1983; 33:178-190.
6. Gowda V, Kalpana GV, Ashwat SK. Evaluation and identification of potential bivoltine silkworm hybrids of *Bombyx mori* L. J of Entomology and Zoology studies. 2013; 1(6):39-43.
7. Kamilli AS. New bivoltine silkworm breeds and their hybrids (SKAU-HR-1) Technical Document. Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir (J & K), 1996.
8. Malik GN, Kamilli AS, Wani SA, Munshi NA, Raja TA. Performance of some bivoltine silkworm, *Bombyx mori* L. hybrids. Oriental Science. 2001; 2:105-111.
9. Malik GN, Masoodi MA, Kamilli AS, Sofi MA. Studies on hetrosis in some bivoltine silkworm, *Bombyx mori* L. crosses. Journal of Sericulture. 1998; 6:47-49.
10. Malik GN, Rufaie SZ, Baqual MF, Kamilli AS, Dar HU. Comparative performance of some bivoltine silkworm, *Bombyx mori* L. hybrids. Entomon. 2006; 1:61-64.
11. Malik MA, Kamili AS, Sofi AM, Malik GN, Sabahat A, Bhat SA *et al*. Second commercial silkworm rearing in Kashmir – A ray of hope, Indian Silk. 2009; 9:10-11.
12. Malik MA, Kamilli AS, Sofi AM, Malik GN, Sabahat A, Malik FA. Evaluation and identification of region / season specific bivoltine hybrids of the silkworm, *Bombyx mori* L. suitable for Kashmir climatic conditions. J. Expt. Zool. India. 2010; 13:171-176.
13. Malik MA, Sofi AM, Malik GN, Kamilli AS, Sabahat A, Malik FA. Identification of autumn specific breeding resource material of *Bombyx mori* L. suitable for second commercial rearing under Kashmir climatic conditions. J. Expt. Zool. India. 2010a; 13:139-142.
14. Mano Y, Nirmal Kumar S, Basavaraju HK, Mal Reddy N, Datta RK. A new method to select the promosing silkworm breeds / combinations. Indian silk. 1993; 13:5.
15. Nissar M, Chishti MZ, Khan MA. Studies on the identification of summer specific silkworm *Bombyx mori* L hybrids under temperate climatic conditions of Jammu and Kashmir, India JIARM. 2013; 1(3):1-10.
16. Nooruldin S, Bhat SA, Malik MA, Khan IL, Sahaf KA. Comparative performance of some silkworm, L., hybrids during different seasons under Kashmir climatic conditions. Green Farming. 2015; 6(6):1392-1395.
17. Rajalakshami E, Chauhan TP, Kamble CK, Srinavas BT, Mahadevaiah BM. Evaluation of newly evolved bivoltine hybrids of *Bombyx mori* L. for silk yield contributing traits under hill conditions. Indian J. Seric. 2000; 1:21-23.
18. Rameshbabu M, Chandraskekhekhariah LH, Presad J. Evaluation and identification of bivoltine hybrids of silkworm *Bombyx mori* L for tropical conditions. I: Abstracts and Souvenier on national Symposium on Recent Trends in Applied Biology, Depts. Of life Sciences and Higher Education for Women. Deemed University. Coimbatore India. 2004, 46.
19. Sahaf KA, Bhat SA, Mir Nissar. Sericulture in North-west India with special refence to temperate region-problems and prospects. Nationa seminar on sericulture development in temperate region- problems and prospects. 2016, 34-38.
20. Singh T. Studies on the silk productivity in some three way crosses of the silkworm *Bombyx mori* L. Bulletin of Indian Academy of sericulture. 2002; 1:96-98.
21. Suresh Kumar N, Basavaraja HK, Kishor Kumar CM, Mal Reddy N, Datta RK. On the breeding of "CSR18×CSR19" A robust bivoltine hybrid of silkworm, *Bombyx mori* L. for the tropics. International Journal of Indusrial Entomology. 2002; 2:153-162.
22. Thaigrajan Y, Bhargaya SK, Rameshbabu M, Nagraju B. Differences in seasonal performance of twenty six strains of silkworm, *Bombyx mori* L (*Bombycidae*). J. Lepidopt. Soc. 1993; 47:331-337.
23. Trag AR, Kamili AS, Malik GN, Kukiloo FA. Evolution of high yielding bivoltine silkworm, *Bombyx mori* genotypes. Sericologia. 1992; 32:321-324.
24. Udupa SM, Gowda VBL. Heterotic expression in silk productivity of different crosses of silkworm, *Bombyx mori* L. Sericologia. 1988; 3:395-400.