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Conservation of Mutant Genetic Stocks of Silkworm (*Bombyx mori* L) Eggs by Long Term Preservation

M. Muthulakshmi* and C.K. Kamble
Central Sericultural Germplasm Resources Centre, Hosur - 635 109,Tamil Nadu, India.

Studies on longterm egg preservation schedule from 180 days to 300 days were taken up with 20 germplasm accessions of mutant silkworm genetic stocks of *Bombyx mori* L. Among 20 germplasm accessions 19 performed well in hatching trials (above 80%) and one accession (BBE-0313) showed less hatching (below 50%). Better hatching accessions were tested for rearing performance. Statistical analyses of the data collected in three trials revealed no significant changes in the quantitative characters (fecundity, hatching percentage, single cocoon weight and shell ratio and less significant changes in few accessions for some quantitative traits (larval weight, pupation rate and single shell weight of the genetic stocks between treatment (10 month egg preservation) and control (6 month egg preservation) except for total larval duration where there was no significant difference between control and treatment batches for all the 19 mutant accessions tested. The results indicate that extended schedule of 10 month egg preservation can safely be adopted for 19 accessions, which will reduce the cost of conservation and minimize the genetic erosion leading to reduced crop cycle.

Key words: Silkworm, *Bombyx mori,* mutants, genetic stocks, cold preservation, hibernation schedule, genetic erosion, conservation, crop cycles.

Systematic studies on preservation of eggs of multivoltine silkworm were undertaken by several workers (Higashi, 1971; Datta *et al*., 1972; Govindan and Narayanaswamy, 1986; Narayanasamy and Govindan, 1987; Tayade *et al*., 1987; Manjula and Hurkadli, 1993; 1995; Yu *et al*., 1993 and Meera Verma and Chauhan, 1996). Cold storing of diapause eggs at different temperatures is used usually for activating the diapause eggs and to preserve them for nearly 300 days. The hibernation schedules evolved in temperate sericulture for 4, 6 and 10 month have been evaluated for bivoltine egg preservation to suit tropical climate (Narasimhanna, 1988). Initially mutant genetic stocks were preserved under four month hibernation schedule and Muthulakshmi *et al*., (2005) reported that they may be preserved under six month preservation schedule and crop cycle can be reduced from three to two per year without affecting conservation protocols. Presently six month egg preservation schedule is followed in conserving the bivoltine mutant genetic stocks. Further in order to reduce the cost of conservation and to avoid the genetic erosion due to repeated conservation rearing, an attempt was made to develop and standardize 10 month egg preservation schedule for 20 mutant genetic stocks of *Bombyx mori* conserved at CSGRC, Hosur with an objective to minimize the number of crop cycles from two to one per year as practiced in the case of bivoltine genetic resources.

Preliminary evaluation trials on hatching with 10 month, 12 month and 14 month of presentation were conducted and the results were encouraging in 6 month and 10 month preservation where as 12 and 14 month results showed considerable reduction in hatching in most of the accessions. Accordingly, based on the results of preliminary studies, a detailed experimentation was undertaken with 10 month preservation schedule to study its effect of prolonged cold preservation on growth and reproductive traits on the mutant genetic stocks.

Materials and Methods

Nineteen bivoltine mutant genetic stocks of Japanese origin constituted the materials for the present study (Table1). Standard preservation schedules were followed for preserving the eggs under control and treatment (Manjula and Hurkadli, 1995). Eggs preserved under 6 month preservation schedule was kept as control, while eggs preserved under 10 month preservation schedule was considered as treatment (Table-2). After the completion of experimental cold preservation period, the eggs were incubated at 25 ± 1º C and 85 ± 5 % RH. Standard silkworm rearing technique was adopted throughout the rearing period using composited layings (Thangavelu *et al*., 2000), following completely randomised block design (CRBD) with two replications. From neonate to third moult all the larvae of composited layings were maintained as such and three hundred fourth instar

*Corresponding author email: lakshmicsgrc@yahoo.co.in

larvae were maintained in each replication for further data recording.

Important silkworm economic parameters *viz*., fecundity, hatching percentage, weight of 10 grown larvae, total larval duration, fifth age larval duration, cocoon yield (No.)/10000 larvae and cocoon yield (weight)/10000 larvae, pupation percentage, single cocoon weight, single shell weight and cocoon shell percentage were recorded during the experimentation. Confirmatory morphological characterization for larval, pupa, cocoon and moth stages were carried out based on the passport data. After cocoon assessment, live cocoons were maintained at 25± 1º C and 85 ± 5 % RH. Disease free layings (DFLs) produced from the control and treated batches were preserved for 6 and 10 months preservation following the standardized egg preservation schedules (Table 2) developed by Manjula and Hurkadli (1995) in order to confirm the earlier results. Three trials were conducted during the experimental period. The data recorded for three generations were compiled and statistically analysed using computer statistical packages of SPSS Inc., U.S.A. The data on two preservation schedules were compared using students 't' test.

Table 1. Traits of mutant silkworm genetic stock of *Bombyx mori* considered for egg preservation for 6 and 10 months preservation schedule

Acc.No.	Name	Trait (s) & linkage group
BBE-0320	TMS-2	striped larval body markings (pS,2:0.0)..
BBE-0306	TMS-12	zebra body markings (Ze, 3:20.8).
BBE-0307	TMS-14	red haemolymph (rb,21:0.0).
BBE-0321	TMS-17	lemon larval body colour (lem,3:0.0)..
BBE-0322	TMS-31	tubby larval body shape (tub,23:6.9)..
BBE-0308	TMS-32	stony larval body shape (st,8:0.0).
BBE-0309	TMS-33	blind larval body markings (bl,15:0.0), cheek & tail spots (cts, 18:4.6).
BBE-0331	TMS-34	egg colour (pe,5:0.0) and brown head & tail spots (bts, 17:30.1).
BBE-0310	TMS-35	white egg colour (w-2, 10:16.1) chocolate neonate colour (ch,13:9.6), sooty larval body colour (so, 26:0.0) and melanism larval body markings (mln, 18:41.5).
BBE-0311	TMS-38	ursa larval body colour (U-2, 14:40.5), extra-leg body shape (E,6:0.0) and wild wing spot (Ws, 17:14.7).
BBE-0312	TMS-61	brownish red egg colour (b-2, 6:8.0), red egg (re, 5:31.7), blind larval body mark (bl,15:0.0) and lustrous eyes in moths (lu, 16:0.0).
BBE-0314	TMS-64	chocolate neonate colour (la,9:22.1), lemon coloured larval body (lem, 3:0.0) and Chinese translucent skin (oc, 5:40.8).
BBE-0315	TMS-65	narrow-brest larval body shape (nb,19:31.2), moricaud larval marking (pM, 2:0.0) and r-translucent integument (or, 22:8.9).
BBE-0316	TMS-66	zebra faded larval marking (ZeF, 3:20.8) and wild wing spot on wings (Ws,17:14.7).
BBE-0317	TMS-67	yellow haemolymph colour (Y, 2:25.6) and pink and flesh coloured cocoons (Pk, 2:? ; F, 6:13.6) colour and shape.
BBE-0323	TMS-69	multi-lunar larval body markings (L,4:15.3).
BBE-0318	TMS-75	red egg colour (re, 5:31.7), elongated II & III abdominal segments (e,1:36.4), quail body markings (q, 7:0.0) and sex-linked translucent integument (os, 1:0.0).
BBE-0319	TMS-82	knobbed larval body shape (K, 11:23.2)
BBE-0333	ODT	translucent larval body cuticle

Table 2. Egg preservation schedule adopted for mutant genetic stocks of *Bombyx mori*

6 month (control)		10 month (Treatment)	
Temperature (°C)	Days	Temperature (°C)	Days
25	20	25	40
20	3	20	30
15	3	15	20
10	3	10	10
5	147	5	60
2.5	0	2.5	123
5	0	5	10
10	0	10	5
15	3	15	2
20	1	20	1
25	Release	25	Release
180		300	

Results and Discussion

The mean performance of control (6 month egg preservation schedule) and treatment batches (10 month egg preservation schedule) for eleven important economic parameters are presented in (Table 3). The data revealed highly significant variation among the mutant genetic stocks for all the traits in both the batches (Table 5). The purpose of the study is to compare the rearing performance of the experimental batch (10 month egg preservation schedule) with that of control (6 month egg preservation schedule) (Table-4). The results

Table 3. Mean performance for economic parameters of 19 mutant genetic stocks of *Bombyx mori* reared from 6 and 10 months egg preservation schedule

Name	Details	Fecundity (No.)		Hatching %		Larval weight (g)		Total larval duration (h)		V instar larval duration (h)		Yield/10,000 larvae (no.)		Yield/10,000 larvae (kg)		Pupation rate (%)		Cocoon weight (g)		Shell weight (g)		Shell ratio	
		Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
BBE-0306	6 M	479 ±	15.2	90.0 ±	1.75	30.7	± 0.84	500 ±	4.9	103 ±	0.9	9744 ±	58.9	12.4	± 0.14	93.1 ±	1.2	1.23 ±	0.06	0.18	± 0.01	13.9 ±	0.33
	10 M	429 ±	22.0	90.7 ±	2.47	28.7	± 0.68	507 ±	11	120 ±	4.4	9741 ±	34	12.9	± 0.41	91.9 ±	1.7	1.32 ±	0.05	0.19	± 0.006	14.7 ±	0.11
BBE-0307	6 M	455 ±	21.8	89.7 ±	2.07	27.9	± 0.48	520 ±	8.7	123 ±	6.6	9922 ±	15.9	12.3	± 0.25	93.2 ±	2.1	1.27 ±	0.05	0.16	± 0.01	12.8 ±	0.49
	10 M	380 ±	21.2	83.5 ±	0.92	25.7	± 0.47	513 ±	14	131 ±	5.5	9641 ±	93.7	9.8	± 0.58	91.6 ±	1.7	1.11 ±	0.01	0.14	± 0.007	12.9 ±	0.68
BBE-0308	6 M	318 ±	12.6	91.1 ±	1.49	20.6	± 0.44	501 ±	4.3	104 ±	1.7	9777 ±	86.1	9.45	± 0.31	82.4 ±	3.9	0.95 ±	0.04	0.11	± 0.01	12.5 ±	0.78
	10 M	281 ±	24.4	82.1 ±	2.1	20.2	± 0.67	504 ±	9.8	122 ±	1.1	9539 ±	124	8.4	± 0.3	86.6	± 2.32	0.93 ±	0.04	0.11	± 0.009	11.5 ±	0.66
BBE-0309	6 M	383 ±	26.8	89.0 ±	2.06	27.8	± 0.83	505 ±	4.5	108 ±	5.6	9686	± 90.78	11.2	± 0.35	90.1 ±	2.5	1.12 ±	0.03	0.14	± 0.01	13.0 ±	0.41
	10 M	409 ±	19.0	91.7 ±	1.48	25.2	± 0.91	514 ±	9.2	132 ±	12.1	9824 ±	50	11.1	± 0.46	96.1	± 0.99	1.06 ±	0.014	0.15	± 0.004	14.6 ±	0.38
BBE-0310	6 M	304 ±	5.9	85.2 ±	3.38	22.1	± 1.31	544 ±	7.6	132 ±	6.6	9594 ±	71.3	11.1	± 0.35	88.5 ±	2.0	1.04 ±	0.04	0.12	± 0.001	12.2 ±	0.49
	10 M	367 ±	20.6	85.9 ±	2.5	23.6	± 0.82	515 ±	14	132 ±	5.3	9752 ±	29	12.0	± 0.37	93.7	± 1.23	1.10 ±	0.03	0.15	± 0.005	13.6 ±	0.43
BBE-0311	6 M	326 ±	31.7	88.3 ±	1.98	28.3	± 1.8	505 ±	4.6	108 ±	5.6	9833 ±	27.2	11.5	± 0.27	93.2 ±	1.7	1.12 ±	0.03	0.14	± 0.004	12.8 ±	0.44
	10 M	392 ±	26.7	84.1 ±	2.6	27.9	± 0.68	509 ±	8.5	123 ±	1.0	9761 ±	39	12.5	± 0.32	91.9 ±	2.4	1.25 ±	0.02	0.16	± 0.004	13.2 ±	0.27
BBE-0312	6 M	338 ±	20.8	89.4 ±	1.43	20.0	± 0.53	507 ±	5.69	110 ±	7.6	9832 ±	84.3	9.4	± 0.65	89.2	± 2.78	0.84 ±	0.01	0.09	± 0.001	11.6 ±	0.12
	10 M	380 ±	5.7	81.8 ±	4.1	17.8	± 0.52	501 ±	14.6	119 ±	6.1	9649 ±	126	8.6	± 0.20	88.5 ±	4.1	0.87 ±	0.03	0.12	± 0.003	13.4 ±	0.20
BBE-0314	6M	397 ±	21.2	88.6 ±	1.58	21.06	± 0.75	526 ±	3.8	118 ±	3.4	9676 ±	49.1	10.0	± 0.51	87.0 ±	1.6	1.01 ±	0.01	0.12	± 0.003	11.7 ±	0.37
	10 M	435 ±	20.6	86.4 ±	1.9	21.4	± 0.24	508 ±	11	125 ±	2.2	9881 ±	18	9.87	± 0.28	96.7	± 0.88	0.94 ±	0.01	0.11	± 0.001	11.3 ±	0.04
BBE-315	6 M	401 ±	26.6	91.2 ±	1.39	23.4	± 0.86	514 ±	7.5	112 ±	8.1	9811 ±	57.8	10.9	± 0.30	91.9	± 1.48	1.02 ±	0.02	0.11	± 0.002	10.5 ±	0.46
	10 M	347 ±	19.5	87.5 ±	1.7	24.3	± 1.35	506 ±	9.7	122 ±	2.7	9647 ±	70	9.18	± 0.62	91.9 ±	1.4	1.12 ±	0.07	0.14	± 0.01	12.4 ±	0.37
BBE-0316	6 M	272 ±	24.3	79.07 ±	2.82	20.9	± 0.86	512 ±	7.5	123 ±	6.8	9925 ±	14.9	10.7	± 0.44	92.1	± 1.82	1.05 ±	0.02	0.09	± 0.003	9.28 ±	0.33
	10 M	308 ±	23.4	81.7 ±	3.4	23.8	± 0.51	501 ±	12	119 ±	3.04	9857 ±	28.6	11.1	± 0.52	93.5 ±	2.1	1.09 ±	0.03	0.11	± 0.003	10.3 ±	0.34
BBE-0317	6 M	297 ±	17.5	76.7 ±	1.67	19.7	± 0.51	496 ±	3.86	97 ±	2.2	9552 ±	95.6	9.1	± 0.39	89.9	± 2.87	0.86 ±	0.01	0.12	± 0.006	13.6 ±	0.67
	10 M	305 ±	30.5	74.7 ±	0.95	21.6	± 0.42	499 ±	10.4	118 ±	4.0	9603 ±	83	9.4	± 0.16	89.3 ±	2.0	1.05 ±	0.03	0.13	± 0.005	12.6 ±	0.54
BBE-0318	6 M	327 ±	31.0	91.1 ±	1.96	18.3	± 0.23	498 ±	4.33	100 ±	1.6	9876 ±	16.3	8.35	± 0.20	94.1 ±	1.07	0.78 ±	0.02	0.09	± 0.007	12.1 ±	0.67
	10 M	385 ±	17.2	85.2 ±	2.3	18.4	± 0.67	498 ±	15.5	116 ±	6.8	9840 ±	48	8.7	± 0.27	90.9 ±	2.3	0.87 ±	0.04	0.12	± 0.005	13.4 ±	0.38
BBE-0319	6 M	453 ±	34.4	86.7 ±	4.26	32.4	± 0.88	498 ±	4.7	101 ±	1.7	9791 ±	24.8	12.7	± 0.22	93.2 ±	0.68	1.19 ±	0.02	0.11	± 0.07	13.7 ±	0.63
	10 M	417 ±	27.8	87.9 ±	1.8	29.2	± 0.94	483 ±	18.2	118 ±	4.0	9703 ±	37	13.5	± 0.26	91.6 ±	1.85	1.35 ±	0.02	0.18	± 0.006	13.4 ±	0.37
BBE-0320	6 M	404 ±	28.1	93.2 ±	1.13	28.8	± 0.88	505 ±	2.7	108 ±	4.5	9862 ±	33.2	11.4	± 0.27	94.3 ±	0.96	1.11 ±	0.04	0.15	± 0.008	13.9 ±	0.52
	10 M	502 ±	14.2	88.6 ±	1.37	26.9	± 0.89	500 ±	14.6	119 ±	5.1	9853 ±	24.4	11.3	± 0.36	94.1 ±	0.93	1.18 ±	0.03	0.17	± 0.003	14.8 ±	0.27
BBE-0321	6 M	425 ±	27.5	93.1 ±	1.10	24.2	± 0.47	498 ±	4.7	101 ±	1.7	9515 ±	92	10.9	± 0.63	87.8 ±	1.39	1.06 ±	0.01	0.14	± 0.007	13.5 ±	0.64
	10M	425 ±	31.7	93.3 ±	2.7	26.4	± 1.38	498 ±	10.3	109 ±	4.4	9570 ±	67	11.6	± 0.7	86.3 ±	3.3	1.09 ±	0.03	0.16	± 0.005	14.4 ±	0.42
BBE-0322	6 M	368 ±	18.9	82.6 ±	3.39	22.9	± 0.65	529 ±	1.07	127 ±	5.2	9877 ±	19.7	9.23	± 0.36	90.6 ±	2.94	0.93 ±	0.02	0.12	± 0.003	13.3 ±	0.39
	10 M	336 ±	13.2	75.6 ±	5.9	21.7	± 0.64	513 ±	13.9	131 ±	5.1	9737 ±	65	10.3	± 0.73	91.6 ±	1.65	0.89 ±	0.02	0.12	± 0.003	13.8 ±	0.16
BBE-0323	6 M	435 ±	13.4	89.9 ±	1.78	30.3	± 1.92	508 ±	6.06	110 ±	8.2	9398 ±	118	12.9	± 0.37	81.9 ±	3.02	1.17 ±	0.02	0.15	± 0.004	13.3 ±	0.43
	10 M	482 ±	41.3	89.4 ±	0.44	27.0	± 1.21	501 ±	15.0	118 ±	6.5	9663 ±	78	12.3	± 0.48	90.3 ±	1.94	1.22 ±	0.03	0.17	± 0.007	13.6 ±	0.26
BBE-0331	6M	274 ±	33.2	74.2 ±	3.92	21.57	± 0.45	518 ±	6.1	118 ±	6.1	9773 ±	78.7	10.0	± 0.73	95.5 ±	0.92	0.92 ±	0.04	0.12	± 0.005	13.3 ±	0.53
	10 M	244 ±	11.5	77.1 ±	2.5	21.7	± 0.07	500 ±	15.4	118 ±	6.5	9722 ±	84	10.9	± 0.35	91.9 ±	3.05	0.98 ±	0.01	0.14	± 0.002	14.8 ±	0.18
BBE-0333	6M	432 ±	26.5	91.6 ±	1.42	28.46	± 1.22	498 ±	4.5	104 ±	1.5	9888 ±	35.3	11.6	± 0.17	96.8 ±	0.78	1.10 ±	0.02	0.15	± 0.007	14.0 ±	0.57
	10M	479 ±	16.3	83.8 ±	4.2	26.2	± 0.42	491 ±	13.50	109 ±	4.7	9820 ±	48	11.7	± 0.22	93.9 ±	1.9	1.16 ±	0.003	0.17	± 0.003	14.7 ±	0.19
CD at 5%	6 M	68.6		6.26		2.63		13.8		13.4		184		1.06		5.9		0.08		0.014		1.07	
	10 M	61.5		7.33		2.08		13.3		12.54		180.4		1.20		4.15		0.08		0.015		1.04	

6 M- Control 10 M- Treatment

showed no significant difference for most of the economic parameters in most of the accessions studied between treatment and control. However some mutant genetic stocks showed significant variation between treatment and control for some characters except BBE-0321 which showed no significant difference between control and treatment batches for all the eleven economic parameters followed by BBE-0322 showed significant difference for only cocoon yield (No.)/10000 larvae (nos.) and BBE-0323 for pupation rate (Table 4). Accessions showed significant changes were critically analysed and discussed characterwise under the following headings.

In the case of fecundity, there was no significant difference between control and treatment batches among 16 mutant accessions. Among three accessions, Acc.no BBE-307 showed lower value in treatment (380 eggs/dfl) than in control (455 eggs/ dfl) and showed significant 't' value (2.474) at 5 % level. At the same time Acc.no BBE-310 and BBE-320 showed negatively significant 't' value, in other words fecundity is more under treatment batch.

Four accessions showed significant difference in hatching percentage (BBE-307, BBE-308, BBE-318 and BBE-320) in which accessions BBE-307, BBE-308 were negatively significant at 5% level and showed higher hatching percentage under 10 month conservation (treatment). Remaining 15 mutant accessions did not exhibit any difference among them in hatching percentage.

In the case of weight of 10 larvae, 13 mutant accessions did not show any difference in larval weight, whereas there was significant difference between control and treatment in six accessions viz., BBE-307, BBE-309 BBE-312 BBE-316 BBE-317 and BBE-312.There was no significant difference in total larval duration (h) between control and treatment in all the 19 mutant accessions tested.

The fifth instar larval duration did not show any significant difference between control and treatment batches in 14 mutant accessions tested and five mutant accessions viz., BBE-306, BBE-308, BBE-311, BBE-317 and BBE-319 showed negatively significant 't' value, in other words fifth age larval duration is more under treatment batch which may

Table 4. Comparative performance (t-values) of 6 and 10 month egg preservation for economic parameters of 19 mutant genetic stocks of Bombyx mori

Name	Fecundity	Hatching %	Larval Weight (g)	Total larval duration (h)	V instar larval Duration (h)	Yield/10,000 larvae (No.)	Yield/10,000 larvae (kg.)	Pupation Rate (%)	Cocoon Weight (g)	Shell Weight (g)	Shell Ratio
BBE-306	1.900^{NS}	-0.230^{NS}	1.781^{NS}	-0.532^{NS}	-3.836**	0.037^{NS}	-1.359^{NS}	0.547^{NS}	-1.145^{NS}	1.657^{NS}	-2.365*
BBE-307	2.474*	-2.914*	2.129*	0.441^{NS}	-0.848^{NS}	2.958*	3.952**	0.583^{NS}	3.624**	1.778^{NS}	-0.194^{NS}
BBE-308	1.339^{NS}	-2.880*	0.481^{NS}	-0.281^{NS}	-2.880*	1.584^{NS}	2.429*	-0.922^{NS}	0.295^{NS}	0.849^{NS}	0.951^{NS}
BBE-309	-0.790^{NS}	-1.046^{NS}	2.086*	-0.849^{NS}	-1.795^{NS}	-1.327^{NS}	0.100^{NS}	-2.229*	1.657^{NS}	-1.418^{NS}	-2.800^{NS}
BBE-310	-2.914*	-0.154^{NS}	-0.930^{NS}	1.835^{NS}	0.000^{NS}	-2.057^{NS}	-1.813^{NS}	-2.225*	-1.203^{NS}	-4.341**	-2.112^{NS}
BBE-311	-1.601^{NS}	1.272^{NS}	0.207^{NS}	-0.330^{NS}	-2.557*	1.532^{NS}	-2.378^{NS}	0.408^{NS}	-3.370*	-1.543^{NS}	-0.548^{NS}
BBE-312	-1.938^{NS}	1.729^{NS}	3.024*	0.382^{NS}	-0.887^{NS}	1.206^{NS}	1.122^{NS}	0.138^{NS}	-0.918^{NS}	-5.268**	-7.474**
BBE-314	-1.296^{NS}	0.916^{NS}	-0.377^{NS}	1.572^{NS}	-1.808^{NS}	-3.921**	0.314^{NS}	-5.236**	4.554**	3.622*	1.231^{NS}
BBE-315	1.631^{NS}	1.681^{NS}	-0.566^{NS}	0.735^{NS}	-1.126^{NS}	1.819^{NS}	2.443*	-0.020^{NS}	-1.210^{NS}	-2.804*	-3.348**
BBE-316	1.339^{NS}	-0.604^{NS}	-2.880*	0.831^{NS}	0.553^{NS}	2.129*	-0.515^{NS}	-0.487^{NS}	-1.285^{NS}	-3.469**	-2.184*
BBE-317	-0.232^{NS}	1.081^{NS}	-2.961*	-0.269^{NS}	-4.435**	-0.401^{NS}	-0.622^{NS}	0.168^{NS}	-5.970**	-1.977^{NS}	1.157^{NS}
BBE-318	-1.656^{NS}	2.086*	-0.133^{NS}	-0.010^{NS}	-1.283^{NS}	0.727^{NS}	-0.984^{NS}	1.217^{NS}	-2.177*	2.529*	-1.661^{NS}
BBE-319	0.824^{NS}	-0.255^{NS}	2.472*	0.831^{NS}	-3.758**	1.960^{NS}	-2.497*	0.836^{NS}	-.5.811**	-2.016*	0.486^{NS}
BBE-320	-3.118*	2.629*	1.507^{NS}	0.370^{NS}	-1.534^{NS}	0.218^{NS}	0.074^{NS}	0.154^{NS}	-1.113^{NS}	-2.459*	-1.481^{NS}
BBE-321	0.000^{NS}	-0.077^{NS}	-1.524^{NS}	0.000^{NS}	-1.692^{NS}	-0.478^{NS}	-0.869^{NS}	0.412^{NS}	-1.056^{NS}	-1.750^{NS}	-1.166^{NS}
BBE-322	1.35^{NS}	1.020^{NS}	1.362^{NS}	1.153^{NS}	-0.436^{NS}	2.073*	-1.387^{NS}	-0.294^{NS}	1.652^{NS}	-0.238^{NS}	-1.311^{NS}
BBE-323	-1.088^{NS}	0.306^{NS}	1.491^{NS}	0.463^{NS}	-0.680^{NS}	-1.865^{NS}	1.130^{NS}	-2.313*	-1.608^{NS}	-1.657^{NS}	-0.568^{NS}
BBE-331	0.850^{NS}	-0.633^{NS}	-0.318^{NS}	1.139^{NS}	0.093^{NS}	0.448^{NS}	-1.052^{NS}	1.126^{NS}	-1.517^{NS}	-3.852**	-2.350*
BBE-333	-1.548^{NS}	1.785^{NS}	1.787^{NS}	0.526^{NS}	-0.907^{NS}	1.138^{NS}	-0.482^{NS}	1.426^{NS}	-2.533*	-2.109*	-1.152^{NS}

be due to extended preservation in low temperature.

Four mutant accessions, BBE-307, BBE-314, BBE-316 and BBE-322 showed significant difference between control and treatment batches, in which BBE-314 showed significantly higher ERR (9881) under 10 month schedule compared to control (9676) and the remaining fifteen accessions showed significantly no difference in cocoon yield / 10000 larvae(Nos).

There is no significant difference in Effective Rate of Rearing by weight/10000 larvae (kg) in control and treatment batches in fifteen accessions and four mutant accessions(BBE-307, BBE-308, BBE-315 and BBE-319) showed significant difference between control and treatment batches but accession number BBE-319 showed negatively significant ‘t’ value and the cocoon yield (weight) / 10000 larvae was more (13.5 kg) in treatment batch when compared to control where it was 12.7 kg only.

Pupation rate significantly differed from control (6 month preservation) and was high in four mutant accessions, BBE-309, BBE-310 BBE-314 and BBE-323 under (10 month preservation) but there was no significant difference in remaining fifteen accessions. There was no significant difference in single cocoon weight (g**)** between control and 12 mutant accessions (BBE-306, BBE-308, BBE-309, BBE-310, BBE-312, BBE-315, BBE-316, BBE-320, BBE-321, BBE-322, BBE-323 and BBE-331) however five tested mutant accessions BBE-311, BBE-317, BBE-318, BBE-319 and BBE-333 showed negatively significant ‘t’ value, ie., single cocoon weight was more under treated batch whereas, it was less in two mutant accessions, BBE-307 and BBE-314.

There was no significant difference in **s**ingle shell weight between control and nine mutant accessions(BBE-306,BBE-307,BBE-308,BBE-309, BBE-311, BBE-317, BBE-321, BBE-322 and BBE-323). Whereas, remaining ten accessions (BBE-310, BBE-312, BBE-314, BBE-315, BBE-316, BBE-318, BBE-319, BBE-320, BBE-331 and BBE-333) showed significant difference compared to control. Among these ten accessions higher single shell weight was observed in eight accessions under ten month preservation (treatment) whereas it was less in two accessions, BBE-314 and BBE-318.

Table 5. Variability on important economic characters of mutant genetic stocks of *Bombyx mori* reared from 6 and 10 month egg preservation schedule

Parameter	Control (6 month)		Treatment (10 month)	
	Mean sumof squares	F-Ratio	Mean sumof squares	F-Ratio
Fecundity (No.)	25335.35	7.07**	27007.07	9.39***
Hatching (%)	180.0	6.04***	271.9	6.65***
Larval weight (g)	114.5	21.76***	67.56	20.4***
Total larval duration (h)	990.7	6.82***	388.3	2.87***
V instar larval duration (h)	607.7	4.43***	277.8	2.32**
Effective rearing rate (No.)	132090.7	5.16***	63158.13	2.55**
Effective rearing rate (kg)	10.28	11.94***	14.04	12.77***
Pupation rate (%)	96.12	3.62***	45.25	3.45***
Cocoon weight (g)	0.107	20.09***	0.12	25.03***
Shell weight (g)	0.0034	24.31***	0.0042	23.89***
Shell ratio	9.27	10.67***	9.83	12.04***

**** significance at P<0.001 ** significance at P<0.01 NS- Non significant*

Shell ratio significantly differed from control (6 month preservation) and was high in five mutant accessions, BBE-306, BBE-312, BBE-315, BBE-316 and BBE-331 but there was no significant difference between control and treated batches in 14 mutant accessions (BBE-307, BBE-308, BBE-309, BBE-310, BBE-311, BBE-314, BBE-317, BBE-318, BBE-319, BBE-320, BBE-321, BBE-322, BBE-323 and BBE-333) tested

Studies on highly heritable morphological traits *viz*., larval markings, cocoon colour, cocoon shape and moth characteristics, moth emergence pattern and oviposition pattern revealed no significant change between the treated and control batches throughout the experimental period. This corroborates with the results obtained with multivoltine silkworm genetic resources, where extended egg preservation for 45 days against 30 days, did not show significant changes both in the qualitative and quantitative traits (Kumaresan *et al*., 2004). And also, utilisation of mutant silkworm is widely adopted by silkworm breeders. Some of the mutants for economical characters are directly utilized in silkworm breeding. The polyphagous mutation had been utilized to breed silkworm varieties adaptable to artificial diet to produce fine silk. The non-glutinous mutation was used to produce natural loose eggs. Some of the morphological characters have multiple functions, which also have positive effect on the economic characters. Therefore, it is possible to use mutant genetic stocks directly in silkworm breeding for evolving new races (Tzenov *et al*., 2002). Significant variation observed between treated and control for characters like larval duration cocoon yield (No.)/ 10,000 larvae, cocoon yield (weight)/10,000 larvae are mainly due to the influence of the environment. The variation observed for fecundity, shell weight, larval duration and pupation rate in few accessions over control batch did not show considerable deviation and also higher values under treated batch (10 month conservation) predisposes the fact that these accessions can safely be maintained in the gene bank without any adverse change in their genetic traits. Further, conservation following 10 month egg preservation helps to minimize the crop cycle cost and labour involved in rearing and grainage. This will help to reduce genetic depression/ genetic erosion and minimize the exposure to biotic and abiotic stress factors and it facilitates rearing of mutants in favorable seasons.

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