FINAL REPORT

Development of high yielding mulberry varieties using physiological growth parameters as markers for selection

PIB-3479

MULBERRY BREEDING AND GENETICS SECTION

CENTRAL SERICULTURAL RESEARCH AND TRAINING INSTITUTE
CENTRAL SILK BOARD
(Ministry of Textiles: Govt. of India)
Berhampore-742101, Murshidabad, West Bengal

FINAL REPORT

FINAL REPORT ON CONCLUDED RESEARCH PROJECT

PROJECT CODE: PIB-3479

Development of high yielding mulberry varieties using physiological growth parameters as markers for selection

SCIENTIST ASSOCIATED:

Dr. B.B. Bindroo
Dr. S. Nirmal Kumar
Dr. Kanika Trivedy
Dr. Jalaja S.Kumar
Mr. Suresh, K.
Dr. M. K.Ghosh
Dr. P.K Ghosh
Dr. A.K. Mishra

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RESEARCH PROJECT
PART – 10 FINAL REPORT
Format for Submission of Final Report

1. Institute Code No.	:	02
2. Name and Address of Research Institute / Centre	:	Central Sericultural Research and Training Institute, Berhampore – 742 101, Murshidabad, West Bengal.
3. Project Title	:	Development of high yielding mulberry varieties using physiological growth parameters as markers for selection.
4. Project Cost	:	Rs.00.80 Lakhs
5. Project Period	:	**2012 – 2016**
a) Date of Start		**Oct. 2012**
b) Date of Termination		**Sept. 2016**
6. Particulars of Investigators	:	

Name (s) and Designation (s) of Project Leader & Project Scientists together with Time Spent.

Investigator	Name	Designation	Time Spent (%)
Co-ordinator	Dr. B.B. Bindroo (up to 22.04.2013)	Director	10
	Dr. S. Nirmal Kumar (22.4.13-31.7.15)		10
	Dr. K. Trivedy (w.e.f. 02.11.2015)		10
Principal Investigator	Dr. Jalaja S. Kumar (up to 31.05.2016)	Scientist-D	40
	Mr. Suresh, K. (w.e.f. 01-06-2016)	Scientist-B	20
Co-Investigator	1. Dr. M. K.Ghosh (up to 31.3.2016)	Scientist-D	10
	2. Dr. P.K Ghosh	Scientist-D	10
	3. Dr. A.K. Misra(upto 31.9.2013)	Scientist-C	10

7.Location of Research Project with complete Address Division / Section / Sub-Station	:	**Moriculture-II Division Mulberry Breeding and Genetics Section CSR&TI, Berhampore**
8. Objective	:	**To develop mulberry varieties with superior quality and with 10% higher leaf yield over the ruling variety.**

9. Final Report on the Project:

9.1 Introduction

Development of high yielding mulberry varieties through various breeding methods is a continuous process and is mainly based on indirect selection for yield and growth characters. Recent studies confirm the expectation that varieties differ extensively in the physiological process determining yield. Identification of these physiological components of yield and planned crosses to maximize segregation of genotypes possessing the physiological complementation and balance required for high yield, thereby leading to more rapid and predictable yield improvement.

In this project six female and eleven male parents were selected from germplasm bank at CSR&TI Berhhampore were hybridized to produce 57 cross combinations and about 1.45 lakh Nos. seeds were collected. After primary screening in the nursery by rejection, a total of 1024 seedlings were transplanted in Progeny Row Trial (PRT) plot with 60×60 cm spacing along with check variety, S-1635. Growth, leaf yield, physiological growth parameters and propagation data of selected genotypes was recorded for two years and analyzed results were presented below.

9.2 Details of activity wise results.

E01: Hybridization of Selected Parents and preliminary screening in Nursery.

Jalaja S Kumar and P.K.Ghosh

After screening the germplasm, six female and eleven male parents were short listed and the same was utilized for crossing to produce 57 cross combinations with about 1.45 lakh Nos. seeds.

Table.1 :List of cross combinations and number of seedlings selected for PRT trial

Sl. No.	Cross combination	No of seeds (Approx.)	Seedlings selected for PRT trial
1	M.Indica (HP) × Nagaland	963	15
2	M.Indica (HP) × MS-7	1060	1
3	M.Indica (HP) × Bishnupur-10	278	2
4	M.Indica (HP) × KPG-1	107	3
5	M.Indica (HP) ×Berhampore	354	21
6	M.Indica (HP) × English Black	485	8
7	M.Indica (HP) × Almora Local	350	21
8	M.Indica (HP) × Kosen	1977	31
9	M.Indica (HP) × V-1	2377	0
10	M.Indica (HP) × C-776	404	24
11	China White × V1	656	31
12	China White × Kosen	11783	31
13	China White × C-776	3505	44
14	China White × Almora Local	1148	6
15	China White × English Black	3971	20

16	China White ×Berhampore	1898	8
17	China White × Bishnupur-10	1334	15
18	China White × Nagaland	266	6
19	China White × MS-7	811	9
20	China White ×KPG-1	105	12
21	China White × Chaitul	1124	12
22	Chinese F-1 10 × C776	1035	12
23	Chinese F-1 10 × Bishnupur-10	260	25
24	Chinese F-1 10 × Berhampore	2318	31
25	Chinese F-1 10 × English Black	4743	30
26	Chinese F-1 10 × Almora Local	1988	31
27	Chinese F-1 10 × V-1	1440	20
28	Chinese F-1 10 × Kosen	371	16
29	MS-30 × C-776	4123	10
30	MS-30 × Kosen	1778	13
31	MS-30 × V-1	1957	10
32	MS-30 × Almora Local	663	2
33	MS-30 × English Black	1455	48
34	MS-30 × Berhampore	1066	29
35	MS--30 × Bishnupur-10	674	37
36	M.Multucaulis × MS-7	2108	20
37	M.Multucaulis × English Black	2171	25
38	M.Multucaulis × Chaitul	2563	32
39	M.Multucaulis X Bishnupur-10	3423	29
40	M.Multucaulis X Berhampore	3282	20
41	M.Multucaulis × Acc.No. 1190	1963	31
42	M.Multucaulis × V-1	3021	29
43	M.Multucaulis × C-776	1150	25
44	M.Multucaulis × Kosen	1414	28
45	M.Multucaulis ×KPG-1	2641	32
46	M.Multucaulis × Almora Local	3004	21
47	Kajli OPH × V-1	9924	15
48	Kajli OPH × Nagaland	3584	19
49	Kajli OPH × KPG-1	4905	8
50	Kajli OPH ×MS-7	2598	4
51	Kajli OPH × English Black	6202	1
52	Kajli OPH × Bishnupur-10	2306	4
53	Kajli OPH × Chaitul	2873	5
54	Kajli OPH × Acc.No.1190	1963	10
55	Kajli OPH × Kosen	5250	6
56	Kajli OPH × Almora Local	6615	10
57	Kajli OPH × C-776	12946	16
Total		**1,44,730**	1024

1.44 lakhs seeds of 57 cross combinations were sown in Nursery bed during October 2013. Visual screenings of genotypes in nursery bed was done based of entire leaf and erect branching. Finally 1024 seedlings were selected for PRT trial.

E02: Evaluation of genotypes/Seedlings for morphological and yield contributing traits.

Jalaja S. Kumar, Suresh, K. and P.K.Ghosh

After primary screening in the nursery, a total of 1024 seedlings from 57 cross combinations along with ruling check variety, S-1635 were transplanted in Progeny Row Trial plot with 60×60 cm spacing.

During 2014-15, evaluation was done during two non-rainy seasons *viz.*, March and May crop with only one life saving irrigation after pruning. Data was recorded from individual plant for 3 yield contributing traits namely, total shoot length (TSL), number of branches length of the longest shoot and leaf yield. Mean values of these two crops on growth and leaf yield was statistically and presented below.

Table.2 : Frequency analysis of mean leaf yield (g/plant) under moisture stress

	Range of leaf yield (g/plant)			Frequency	% age
>(x+2s)	>452.60			3	0.31
(x+1s) to (x+2s)	383.76	to	452.60	16	1.63
(x) to (x+1s)	314.92	to	383.76	42	4.28
<x		<	314.92	65	6.62
			Total	126	12.83

Mean ± SD= 314.92 ± 68.84

Table 3: Frequency analysis of mean values of growth traits under moisture stress

Parameter	Population Mean	Standard Deviation	No. of plants >Mean + 1 S.D.	No. of plants above Mean + 2 S.D.
Total Shoot Length (cm)	353.4	203.6	126	34
No of branch	4.49	1.83	118	25
Longest Shoot Length (cm)	88.7	24.41	132	23

Frequency analysis of mean data during 2014-15 indicated that ~2.00 % of the total population (=19 genotypes) genotypes recorded mean leaf yield higher than mean + 1SD of the population.

During 2015-16, evaluation was done under irrigated conditions for growth and leaf yield related traits; data was recorded from individual plants on physiological, growth and yield contributing traits. Annual leaf yield of 5 crops were computed for to assess the genetic parameters and yield potential of genotypes.

Table 4: Frequency analysis of annual leaf yield (kg/plant) during 2015-16

	Range of leaf yield (kg/plant/y)			Frequency	% age
>(x+3s)	> 2.341			13	1.32
(x+2s)·to (x+3s)	1.844	to	2.341	30	3.05
(x+1s) to (x+2s)	1.346	to	1.844	93	9.47
(x) to (x+1s)	0.849	to	1.346	282	28.72
<x		<	0.849	564	57.43
			Total	982	100.00

Frequency analysis of mean data during 2015-16 revealed that 43 genotypes provided mean leaf yield higher than mean + 2SD representing 4.37 % of the total population. Out of 982 seedlings in PRT, 140 genotypes recorded significantly higher yield over the ruling check S-1635 representing 13.70% of population. Finally 24 genotypes were shortlisted based on propagation, physiological parameters and significantly higher leaf yield over C-2038.

Table 5: Estimates of genetic parameters for physiological, growth and yield traits

	Leaf yield (kg/ plant)	Chloro phyll content ($\mu g\ cm^{-2}$)	SLA (cm^2g^{-1})	Moisture content (%)	Single leaf area (cm^2)	Single leaf weight (g)	Total shoot length (cm)	Shoot per plant	Nodal distance (cm)
PCV	58.29	26.60	14.49	5.51	38.96	43.74	39.35	32.41	22.51
GCV	51.19	25.74	13.84	5.15	37.04	39.79	37.97	30.31	4.59
ECV	27.88	6.69	4.30	1.96	12.09	18.17	10.32	11.46	22.04
h^2(BS)	77.12	93.68	91.18	87.32	90.37	82.74	93.12	87.49	4.17
GA	225.7	7.95	71.19	7.68	80.18	1.46	509.4	3.84	0.07
GAM	92.60	51.33	27.22	9.91	72.53	74.56	75.49	58.41	1.93

CCMR- Chlorophyll concentration index units is converted into total chlorophyll content (μgcm^{-2}) based on conversion formulae Chl. conent (μg cm-2) = (117.1 CCI)/ (148.84 - CCI) at a determinant coefficient of R^2=0.88 (Cerovic *et al.*, 2012).

SLA-Specific leaf area

High genetic advance coupled with high heritability estimates offers the most suitable condition for selection as it indicates proportion of heritable variation that is due to genetic. In the present study higher GCV coupled with high heritability was observed for most of the traits. Moreover, the physiological parameters CCMR, SLA, single leaf area also recorded high heritability (>90%). Jhansilakshmi et al., 2014 and Doss, et al., 2006 also reported significant positive association of these parameters with foliage yield. Therefore selection of genotypes based on these traits would be useful for mulberry improvement programme.

E03: Evaluation of selected genotypes/Seedlings for Physiological growth analysis parameters.

Suresh, K.

Plant growth analysis is an integrative approach to interpreting plant form and function using simple primary data in the form of weights, areas, volumes and contents of plant components to investigate processes within and involving the whole plant (Evans, 1972; Causton and Venus, 1981; Hunt, 1990). The calculation of the growth parameters done by either classical approach (one harvest-interval *ie.*, period of time between two successive harvests), functional or dynamic approach, involving the use of many harvests and fitted curves, which can be either parametric (Hunt, 1982) or form-free (Shipley and Hunt, 1996), and also contrasts with the combined approach involving curves fitted to classically derived values (Poorter, 1989).

In the present investigation 140 selected genotypes were analysed for some Physiological growth analysis parameters based on individual plant data. Out of 140 genotypes studied, 24 below mentioned genotypes recorded higher values for all the growth parameters studied and moderate leaf area ratio. In the present investigation large amount of variability among the progenies was also observed and similar observations was also

reported by earlier worker Ralebhat et al.(2015) in soybean and Bueno (2006) in sorghum.

Table 6: Physiological growth analysis parameters of promising genotypes under PRT

Genotype No.	Chlorophyll content ($\mu g\ cm^{-2}$)	Specific leaf area (cm^2g^{-1})	Total leaf area (m^2)	Leaf area ratio (m^2g^{-1})	Leaf area index	Leaf weight ratio	Leaf area duration (m^2day^{-1})	Absolute growth rate ($g\ day^{-1}$)
350	14.10	223.55	472.27	21.43	13.12	0.48	7.27	33.91
359	12.54	237.55	470.16	25.65	13.06	0.54	7.23	28.20
319	16.93	254.75	474.68	22.53	13.19	0.46	7.30	32.42
490	13.61	215.03	369.86	18.16	10.27	0.46	5.69	31.33
986	11.49	272.28	419.53	23.58	11.65	0.46	6.45	27.37
642	15.91	260.55	381.18	22.60	10.59	0.44	5.86	25.94
362	17.76	228.10	314.48	21.40	8.74	0.50	4.84	22.60
245	16.42	246.68	352.97	22.66	9.80	0.47	5.43	23.97
838	30.43	185.30	211.71	14.45	5.88	0.49	3.26	22.53
343	15.50	243.30	306.14	21.78	8.50	0.49	4.71	21.62
570	17.34	270.74	306.42	19.76	8.51	0.44	4.71	23.85
768	12.06	323.00	304.55	19.45	8.46	0.44	4.69	24.08
400	17.34	270.00	400.68	23.76	11.13	0.40	6.16	25.95
936	11.78	274.91	277.15	19.00	7.70	0.46	4.26	22.44
52	17.24	226.52	202.05	17.12	5.61	0.56	3.11	18.15
616	16.93	200.23	227.13	14.75	6.31	0.43	3.49	23.70
313	18.92	248.98	297.43	21.60	8.26	0.48	4.58	21.19
836	16.52	372.13	388.73	27.56	10.80	0.47	5.98	21.70
413	15.91	205.05	269.85	22.22	7.50	0.53	4.15	18.68
1016	11.11	279.14	349.28	26.46	9.70	0.49	5.37	20.31
1019	13.22	233.35	278.42	19.09	7.73	0.43	4.28	22.44
790	14.40	242.93	191.02	12.95	5.31	0.42	2.94	22.70
716	23.75	217.93	205.57	14.09	5.71	0.41	3.16	22.45
S-1635	17.1	254.4	203.4	14.86	4.92	0.38	3.34	18.24
Min.	4.58	142.4	75.0	8.4	2.1	0.4	1.2	10.5
Max.	32.07	409.3	474.7	37.6	13.2	0.6	7.3	33.9
Avg.	13.60	254.8	226.9	21.1	6.3	0.5	3.5	16.8
CD@5%	2.1	60.1	191.0	13.3	5.3	0.12	2.9	11.9

E03: Evaluation of Promising genotypes/Seedlings for propagation efficiency.

Suresh, K.

Out of 4 parameters studied, significant variation was observed for all traits studied. Highest survival % was recorded in genotype no. 343 (82.04%) and other genotypes had propagation parameters at par with check S-1635.

Table 7. Survivability of cutting and propagation traits of newly developed promising mulberry genotypes

Genotype No.	Survivability (%)	Shoot length(cm)	Shoot fresh mass (g)	Root length(cm)
350	79.80	54.0	25.60	24.60
359	68.29	62.5	31.10	20.00
319	64.42	63.0	30.60	22.20
490	62.40	57.5	33.40	24.00
986	79.60	51.0	23.40	20.40
642	73.60	54.0	33.30	21.60
362	81.20	91.0	32.20	26.40
245	71.62	58.0	16.40	23.20
838	66.70	52.0	19.00	21.80
343	82.40	45.0	26.00	18.00
570	74.24	64.0	33.50	22.60
768	76.40	64.0	36.00	23.60
400	72.10	70.5	26.10	28.20
936	75.80	69.6	32.70	23.84
52	79.60	44.0	20.20	16.60
616	58.40	33.0	20.50	13.20
313	76.40	40.0	22.20	14.00
836	78.64	42.0	19.90	16.20
413	79.98	66.0	27.20	22.40
1016	78.20	60.0	23.00	23.00
1019	52.60	35.0	18.90	15.00
790	72.60	61.5	26.60	21.60
716	69.40	61.0	29.00	20.40
721	58.60	66.0	36.00	22.40
S-1635	**76.80**	**49.8**	**24.60**	**19.92**
CD@ 5%	17.53	27.89	12.85	8.24

From this investigation, it has been observed that the physiological traits possesses higher heritability and genetic advance as percent of mean, indicating their utility in breeding programme for evolving high yielding varieties. It is also observed that segregant with better physiological efficiency was high yielding.

Table 8: Promising newly evolved genotypes based on leaf yield and growth traits.

S.N.	G. No.	Parentage	Total shoot length (cm)	Shoot (no/ plant)	Mois ture (%)	Nodal Dist ance (cm)	Leaf yield (kg/y)	Gain over S-1635	Gain over C-2038
1	350	Chinese F_1 10 x Bishnupur-10	1348	9	77.81	4.5	2.561	58.11	29.36
2	359	Chinese F_1 10 x Bishnupur-10	1410	11	78.10	5.0	2.559	57.95	29.23
3	319	China White x Charitul	1435	10	78.08	4.0	2.546	57.14	28.57
4	490	MS-30 x C-776	1845	12	76.74	5.5	2.538	56.65	28.17
5	986	Kajli OPH x Bishnupur-10	1534	12	81.83	4.0	2.526	55.93	27.58
6	642	*M.multicaulis* x MS-7	1322	9	78.85	4.0	2.518	55.40	27.14
7	362	Chinese F_1 10 x Berhampore-B	1366	12	76.07	3.0	2.512	55.03	26.84
8	245	China White x English Black	1566	11	78.39	4.5	2.504	54.57	26.47
9	838	*M.multicaulis* xC-776	1108	7	74.58	4.5	2.499	54.28	26.23
10	343	Chinese F_1 10 x Bishnupur-10	1176	9	78.68	3.5	2.425	49.67	22.46
11	570	MS-30 x English Black	1561	11	81.33	4.5	2.409	48.72	21.68
12	768	*M.multicaulis* x English Black	1425	10	79.85	4.5	2.389	47.49	20.68
13	400	Chinese F_1 10 x English Black	1760	11	85.03	4.5	2.367	46.13	19.56
14	936	*M.multicaulis* x Almora local	1386	11	81.44	4.5	2.325	43.52	17.42
15	52	*M.indica* HP x Almora Local	957	8	75.57	5.0	2.318	43.09	17.07
16	616	MS-30 x Bishnupur-10	1415	11	78.73	4.0	2.316	42.96	16.96
17	313	China White x Charitul	1107	9	76.84	4.5	2.315	42.87	16.89
18	836	*M.multicaulis* xC-776	1175	9	88.80	5.0	2.306	42.35	16.47
19	413	Chinese F_1 10 x English Black	960	8	74.11	5.2	2.256	39.26	13.94
20	1016	Kajli OPH x Almora local	1145	9	82.16	5.0	2.256	39.26	13.94
21	1019	Kajli OPH x Almora local	1234	9	78.55	5.5	2.179	34.49	10.03
22	790	*M.multicaulis* xAc.No.1190	1345	9	78.40	3.5	2.171	33.99	9.63
23	716	*M.multicaulis* x Charitul	1466	11	76.34	3.5	2.115	30.55	6.82
24	721	*M.multicaulis* xBishnupur-10	779	6	76.33	7.00	2.104	29.84	6.23
Check		**S-1635**	1018	8	79.23	4.80	1.620		

10. DISCUSSION

Development of high yielding mulberry varieties through various breeding methods is a continuous process. The present study envisages utilizing the physiological growth parameters as markers for selecting high yielding varieties. The continuing pressure to produce higher yielding cultivars has simulated interest in physiological factors contributing to final yield and in possibilities for using such factors for selection (Buttery and Buzzell, 1972).

In the long run, the most effective approach would seem to be to identify physiological components causing varietal differences in economic yield and require understanding of genetic control thereby leading to more rapid and predictable yield improvement (Wallace *et al.*, 1972). Genetic behaviour and dry matter accumulation studies have long been in vogue to assess the physiological basis of yield in crop plants (Evans, 1975). Growth determinants such as Crop growth rate (CGR), Relative growth rate (RGR), Net assimilation rate (NAR), Leaf area duration (LAD), Biomass duration (BMD and Leaf area index (LAI) have been analyzed in various crop plants and marked variability was observed. Growth analysis also plays an important role in comparison of genotypes of a species as a part of breeding programme (Wilson and Cooper, 1969; Tollenaar, 1991). Analysis of physiological basis of yield improvement may provide insight into avenues for future yield improvement combining the physiological trait with other desired morphological traits that have been accumulated in elite varietal selections. In present investigation, physiological traits possesses higher heritability and genetic advance which may had complementary interaction resulted in high yielding segregants/progenies. Out of 982 genotypes screened under moisture-stress during non-rainy season , 2.00 %(19 genotypes) recorded mean leaf yield higher than mean + 1SD of the population. Frequency analysis of annual data during 2015-16 revealed that 43 genotypes provided mean leaf yield higher than mean + 2SD representing 4.37 % of the total population. Out of 982 seedlings in PRT, 140 genotypes recorded significantly higher yield over the ruling check S-1635 representing 13.70% of population. These 140 selected genotypes were assessed for physiological growth analysis parameters based on single plant leaf yield. Large amount of variation was observed for these traits viz., chlorophyll content(μg cm^{-2}), specific leaf area (cm^2g^{-1}), total leaf area (m^2), leaf area ratio (m^2g^{-1}), leaf area index, leaf weight ratio, leaf area duration (m^2day^{-1}) and absolute growth rate (g day^{-1}) provide scope for selection of genotypes based on these traits. Further these 140genotypes was tested for propagation parameters. Out of 4 parameters studied, significant variation was observed for all traits studied and all genotypes had propagation parameters at par with check S-1635. Finally 24 genotypes were shortlisted based on propagation, physiological parameters and significantly higher leaf yield over C-2038.

10.1 CONCLUSION:

- ✓ After evaluation newly evolved genotypes under PRT trial for 2014-15 and 2015-16, 140 genotypes had significantly higher leaf yield over ruling check, S-1635 and 24 genotypes over C-2038.
- ✓ The leaf yield potential of newly evolved genotypes ranged from 2.104 to 2.561 kg/plant/year compared to check S-1635 (1.620 kg/plant/y) and C-2038(1.980 kg/plant/y).
- ✓ Then newly evolved twenty four genotypes not only having higher leaf yield potentiality but also possess good physiological efficiency and propagation characters indicating their utility from point of climate resilient sericulture.
- ✓ These 24 promising genotypes need to be be evaluated under Primary yield trial (PYT) to identify 7-8 promising genotypes for FYT cum MLT for further utilization.

11. Inference / Recommendations of Principal Investigator regarding **a)** Need for Additional Research **b)** Plan of Future work	 Screening for isotopic discrimination, measure of intrinsic physiological efficiency will help in identification of physiologically efficient climate resilient stable genotypes. Future research can be taken up on this aspect. The identified 24 promising genotypes need to be evaluated under Primary yield trial (PYT) to identify 7-8 promising genotypes for FYT cum MLT for further utilization.
12. Patenting/ Commercialization if any. a) Material developed such as new varieties of crops or breeds implements, products which need patenting should be discussed in some detail. This should be a summary of results presented in column 9 above. Action initiated, if any, for Patenting / TOT also to be indicated separately.	 The 24 newly evolved genotypes were developed utilizing germplasm of CSR&TI, Berhampore. These genotypes need to be evaluated in PYT for further utilization.
b)New Techniques / Technology / Products developed	Total of 24 newly evolved genotypes have been identified with significantly superior for leaf yield, growth parameters over check S-1635and C-2038.
c) Any Procedures modified with sufficient details to enable other scientists to follow	Not applicable
d) Equipment fabricated / designed /modified (give detailed description with drawings)	Not applicable

13. REFERENCE

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14. PUBLICATIONS AND MATERIAL:	
a) Research Papers	To be communicated shortly after presenting the concluded report before RAC.
b) Popular Articles	Very shortly it will be communicated.
c) Reports	Reported in Annual report of the Institute *w.e.f.* 2013-2016.
d) Seminar and workshops (Relevant to the Project) in which the scientists have participa	National conference at CSGRC, Hosur, scientist was participated and published one abstract.

15. SUMMARY

1. Six female and eleven male parents were selected from germplasm bank at CSR&TI Berhampore were hybridized to produce 57 cross combinations.

2. About 1.45 lakh Nos. seeds were collected and sowed in nursery.

3. After visual rejection, a total of 1024 seedlings were transplanted in Progeny Row Trial plot with 60×60 cm spacing along with check variety, S-1635.

4. After establishment in main field, evaluation was done during non-rainy season under moisture stress (March and May-2016) for growth and yield parameters and tagged 120 progenies.

5. During 2015-16, evaluation for yield and growth parameters was done under irrigated condition for 5 crops. Finally 140 genotypes were short listed/tagged to study propagation and physiological growth parameters.

6. Out of 1024 progenies derived from 57 crosses, 24 genotypes recorded significantly higher yield over check C-2038 with better physiological growth and propagation parameters.

17. Budget Utilization	Allocation (Rs. In Lakhs)	Actual Expenditure (Rs. In Lakhs)	Remarks
I. RECURRING COST a) Salaries (APPORTIONED COST)	-	-	The work completed within the budget provision
b)Fellowship/Wages (APPORTIONED COST)	-	-	
c)Contingencies (APPORTIONED COST)	0.80	0.80	
II.NON-RECURRING COST (APPORTIONED COST)	-	-	
Grand Total of I +II	**0.80**	**0.80**	

Certified that the Project work has been carried out and financial expenditure incurred for executing the Project are in accordance with the declaration / certification submitted at the time of submission of the Project Proposal and sanction obtained from time to time thereafter as per the revision made.

XVI. Signature of the Principal Investigator	**(MR. SURESH K.)** **Scientist-B** MBG SECTION
Co-Investigator	**(Dr. P. K. GHOSH)** **Scientist-D** MBG SECTION

13. Signature (with comments, if any) of Head of Division	**(Dr. S. K. DUTTA)** **Scientist-D** **Moriculture-II division**
14. Signature (with comments, if any) of Director / Co-ordinator	21/11/16 **(Dr. KANIKA TRIVEDY)** **Director** Central Sericultural Research and Training Institute Berhampore-742 101

FOR CENTRAL OFFICE USE

1. To what extent objectives are achieved :	
2. Deviations noticed if any & comments a) Physical : b) Scientists : c) Financial : d) Equipment :	
3. Overall observations :	

Place:
Date:

DIRECTOR
CENTRAL SILK BOARD