

# PROJECT

Development of multivoltine silkworm  
(*Bombyx mori L.*) breeds with high Shell  
percentage and high neatness of silk  
filament

**(DURATION OF PROJECT: 3 YEARS)**

**SUBMITTED TO**

**CENTRAL SILK BOARD  
MINISTRY OF TEXTILES (GOVT. OF INDIA)  
BTM LAYOUT, MADIVALA  
BANGALORE-560068**

**BY  
DR. A. K. VERMA  
(SCIENTIST-C)**



**SILKWORM BREEDING AND GENETICS LABORATORY  
CENTRAL SERICULTURAL RESEARCH AND TRAINING INSTITUTE  
CENTRAL SILK BOARD, MINISTRY OF TEXTILES (GOVT. OF INDIA)  
BERHAMPORE-742101, MURSHIDABAD, WEST BENGAL**

india

# **PROJECT**

## **Development of multivoltine silkworm (*Bombyx mori* L.) breeds with high Shell percentage and high neatness of silk filament**

**DURATION OF PROJECT: 3 YEARS  
(FROM JULY, 2013-JUNE, 2016)**

*Submitted to*

**Central Silk Board  
Ministry of Textiles (Government of India)  
BTM Layout, Madivala  
Bangalore – 560 068**

**By**

**Dr. A. K. Verma  
(Scientist - C)**

**Silkworm Breeding, Genetics Laboratory  
Central Sericultural Research & Training Institute  
Central Silk Board: Ministry of Textiles: Govt. of India  
Berhampore – 742 101, Murshidabad, West Bengal,**

**INDIA**

## PROFORMA FOR COLLECTION OF DATA OF RESEARCH PROJECTS IN SERICULTURE

### PART-I : GENERAL INFORMATION

1. **Name of the Institute / University / Organization submitting the Project Proposal** : Central Sericultural Research and Training Institute, Berhampore, West Bengal
2. **Status of the Institute (s)** : N.A.
3. **Name (s) and designation(s) Of the Executive Authority Of the institute / University Forwarding the application** : Dr.B.B.Bindroo, Director
4. **Project Title** : **Development of Multivoltine silkworm (*Bombyx mori* L.) Breeds with high Shell Percentage and high neatness of silk filament.**
5. **Category of the Project** : Animal (A)
6. **Specific Area** : Silkworm Improvement
7. **Duration** : 3 years
8. **Total Cost** : 1.50 lakh
9. **Is the Project single Institutional or multi-institutional** : Single institutional
10. **If the Project is multi-institutional, please furnish the following : Name , Designation and Address of the Project Co-Ordinator.** : N.A.

### 11. (a) Project Summary:

Genetic resources of multivoltine breeds with higher values of shell content and neatness in silk filament will form the material for the study. The designated breeds conforming to these values shall be retrieved from CSGRC Hosur, CSR&TI, Mysore and APSSRDI, Hindupur and KSSRDI, Bangalore. Multivoltine breeds with high shell percentage (20.56% - 15.03%) from CSGRC,Hosur includes BMI-0001, BMI-0065, BMI-0023, BMI-0074, BMI-0072, BMI-0069, BMI-0066, BMI-0070, BMI-0043, BME-0048, while as the breeds with high neatness (93.00 -88.5P) include BMI-0004, BMI-0008, BME-0015, BMI-0011, BMI-0038, BMI-0014, BMI-0003, BMI-0016, BMI-0007, BMI-0042. Three breeds namely BL67, ND7, NDV6 and L14 from CSRTI, Mysore and two breeds namely APM1, APM3 and APDR15 from APSSRDI, Hindupur will also be collected. Based on the high shell percentage and high neatness values along with the

high survival rate, these breeds will be selected initially. Directional selection will be followed and after fixing the desired traits, the selected breeds with higher shell content and neatness in filament will be crossed with testers, which include the breeds viz. M6DPC, M.Con.4 and M.Con.1 following line x tester mating design. Hybrid evaluation will be conducted during all the commercial crop seasons of West Bengal and after the Compilation and evaluation of the data obtained, depending upon the performance, suitable hybrids will be identified for further exploitation.

#### **11. (b) Aims and Objectives:.**

The main aim and objective of the project is to develop multivoltine breeds with higher shell content (16-18%), high neatness (80-85points), reelability, filament length and raw silk recovery % of filament to suit the adverse climatic conditions of West Bengal.

#### **PART-II: PARTICULARS OF INVESTIGATORS**

12. a) Name: : Dr. Anil Kumar Verma

Date of Birth : 28.12.1960

Sex: : Male

Indicate whether Principal Investigator/ : Principal Investigator

Co-investigator

Designation : Scientist-C

Department : Silkworm Pathology Section,

Institute/University: Address CSRTI, Berhampore

b) Name: : Dr.N.Suresh Kumar

Date of Birth : 01-06-1956

Sex: : Male

Indicate whether Principal Investigator/ : Co-Investigator

Co-investigator

Designation : Scientist-C

Department : Silkworm Breeding and Genetics,

Institute/University: Address CSRTI, Berhampore

c) Name: : Shri.N.B.Kar

Date of Birth : 04-01-1959

Sex: : Male

Indicate whether Principal Investigator/ : Co- Investigator

Co-investigator

Designation : Scientist-C

Department : Reeling and Spinning Section,

Institute/University: Address CSRTI, Berhampore

d) Name: : Dr.Gautum Kumar Chatopadhyay  
Date of Birth : 27.10.1954  
Sex: : Male  
Indicate whether Principal Investigator/  
Co-investigator : Co-investigator  
Designation : Scientist-C  
Department : Silkworm Breeding and Genetics  
Institute/University:Address CSRTI, Berhampore

e) Name: : Dr.A.K.Saha  
Date of Birth : 27.08.1957  
Sex: : Male  
Indicate whether Principal Investigator/  
Co-investigator : Co- Investigator  
Designation : Scientist-D  
Department : Silkworm Breeding and Genetics,  
Institute/University: Address CSRTI, Berhampore

13. No. of Projects being handled by : Principal investigators: Two project as CI  
Each investigator at present Co-investigator:1-Project/Programme as  
PI/CI-5  
Co-investigator:2-Project/Programme as  
PI/CI-4  
Co-investigator:3-Project/Programme as  
PI/CI-5  
Co-investigator:4-Project/Programme as  
PI/CI-5

14. Proposed Research Fellows: N.A. [Detailed justification with work sharing is a must]

### **PART-III: TECHNICAL DETAILS OF THE PROJECT**

#### **15. Introduction**

The Indian sericulture industry is beset with many problems. One of the main problems is the inability to produce quality silk of international grade. The quality silk can be produced only from bivoltines. The bulk of silk produced in India is from Multivoltines which are of inferior quality. Therefore, it is highly pertinent to have more productive multivoltine silkworm breeds capable of producing quality silk. In India, mulberry leaves are available throughout the year including the summer months.

However, during summer the rearing of bivoltines are very difficult with frequent crop losses. Therefore, the farmers are forced to switch over to multivoltine x bivoltine hybrids which are comparatively more stable under such environmental conditions.

### **15.1 Definition of the Problem**

#### **(a) Origin of the project**

Indian sericulture industry is multivoltine oriented and hence the quality of silk is of low grade. Quality silk can be produced only through bivoltines. However, the hot climatic conditions prevailing in India is not conducive to rear the bivoltines already available. Therefore, there is an urgent need to develop multivoltine breeds which can produce high quality silk under the adverse climatic conditions of the tropics.

#### **b) Expected outcome**

The successful completion of the project is expected to come out with the development of multivoltine breeds which can produce high quality silk having higher shell content and higher neatness of filament..

### **15.2 Origin of the Proposal / Rationale of the Study**

Eastern India, especially the state of West Bengal experiences extreme variation in temperature, relative humidity and rainfall. According to climatic conditions, the commercial seasons are broadly divided into two, favourable and unfavourable. During unfavourable season, because of prevalence of high temperature and humidity as well as rainfall, most of the rearers rear indigenous multivoltine breed, Nistari during the period, which is low productive. Keeping the prevalence of variable climatic condition in mind and realizing the importance of season specific multivoltine x bivoltine hybrids as well as advantage of rearing of F1 hybrids during different commercial season will be reared in three commercial seasons. From these hybrids, selection of season specific better performing multivoltine hybrids will be made.

### **15.3 Relevance to the current issues and expected outcome**

In West Bengal, Silkworm rearing for commercial purpose is practiced five times in a year at farms and farmer's level due to availability of huge mulberry leaves for high rainfall and fertility of soil. The climatic situation of West Bengal is broadly categorized into two i.e., the favourable (November to March) and unfavourable (May to September). Therefore, farmers are forced to restrict their rearing only with Nistari, the indigenous multivoltine strain having

horizontal tolerant potentiality both as P<sub>1</sub> and in commercial level during the adverse month. Even though Nistari is used for rearing in adverse climatic conditions, the quantitative and qualitative characters are very low. Hence, an attempt is made to find out the alternative multivoltine breed with high shell percentage and neatness, so that both the farmers and the reelers will be benefitted.

#### 15.4 Objective

To develop multivoltine breeds with higher shell content (16-18%), high neatness (80-85points), reelability, filament length and raw silk recovery % of filament to suit the adverse climatic conditions of West Bengal.

### 16. Review of status of Research and Development on the subject.

#### 16.1 International Status

In Japan seasonal studies have been carried out in mulberry silkworm. The different breeds have expressed that differently during different climatic conditions (Watanabe, 1928; Ueda *et al.*, 1969). Commercial utilization of high degree of heterosis was first advocated by Toyama (1906). Since then utilization of hybrids progressed very rapidly in Japan, reaching almost 100% in 1930. Due to the superiority of hybrids to their parental strains in terms of higher tolerance to disease, higher adaptability to unfavourable abiotic conditions, they produce more stable crops due to hybrid vigour (Hirobe, 1956). Japanese and Chinese silkworm breeders extensively utilized different aboriginal races to evolve silkworm breeds of distinct characters for commercial exploitation and genetical studies (Yakoyama, 1959). The differences in fitness of silkworms in different seasons and regions have long been recognized by the sericulturists in other countries like Japan and China and the outcome being development of season/region specific breeds/hybrids to achieve sustainable cocoon yield (Hirobe and Ohi, 1954; Yokoyama, 1976; Xu Meng Kui *et al.*, 1990; He Yi *et al.*, 1991). Overseas research are mainly based on development of season and region specific bivoltine breeds and their hybrid with some work on univoltine but work on multivoltines and their hybrids are mainly restricted to tropics like India..

**16.2 National Status:** Indian silk industry was almost multivoltine oriented till 1970s and only indigenous multivoltine races and their hybrids were reared for commercial silk production (Chandrasekaraiah and Jolly, 1986). Earlier to 1920, only indigenous multivoltine races such as Pure Mysore in South India, Nistari and Chotapolu in Bengal and Sarupat and Moria in Assam were utilized in silk production (Kariappa & Rajan,

2004). A number of attempts were made to improve indigenous races through hybridization with exotic races resulting development of breeds like Nistid and Nismo (Ghosh, 1949).

Since 1960s, a number of breeding plans were initiated both at Mysore and Berhampore. Narayanan *et al.*(1967) developed several high yielding white multivoltine breeds like Mysore princess, Kollegal Jawan and Kolar Gold from double hybrid (PM x NN6D) x (Shungetsu x Hosho). Berhampore too has developed improved multivoltine breeds like MBD4, NBD5, D14b,L-yellow, O-yellow, A4e etc. In 1975, Tamil Nadu developed Tamil Nadu white from PM J122 hybrid. During 1990s, Mysore developed BL series for irrigated and rain fed areas. During 2000, Hindupur developed APM1 and popularized in the field. Besides Sex-limited multivoltine breeds like MY1 (SL) and PM(SL) were developed by Mysore, SL-KMS and MH1 by KSSRDI (Sadananda and Mundukar, 1990) and Nistari (SL) and M12W(SL), both in larval markings and cocoon colour by Berhampore ( Biswas *et al.*, 2008, 2010). Besides hybridization, variability was also attained through induced mutation and breeds like CB2 and CB5 were developed by Berhampore (Datta *et al.*, 1978, 1981) MU1, MU11 and MU303 by Mysore University (Kalpana *et al.*, 1998) through mutation breeding.

Prior to 1970, only indigenous breeds and their hybrids were reared for commercial silk production. The first hybrid in India is known to PM x C. Nichi. However the real improvement of productivity came with the introduction of NB4D2 as male component and its combination with Pure Mysore in the south and Nistari in the east became instantly popular due to higher hybrid vigour and virtually rules the industry over 3 decades. But with the development of highly improved bivoltine breeds CSR2 and CSR4 through JICA assisted Project (1992-2001), a number of multi x bi hybrids with graded silk like ND7 x CSR2, APM1 x CSR2 were developed. But these breeds are highly susceptible to diseases and their utilization was confined to elite farmers. However the combination of CSR2 with indigenous breed Pure Mysore has given improved result ( Dandin *et al.*,2004).

Quite a good number of multivoltine × bivoltine hybrids and bivoltine hybrids have been developed by research institute of Central Silk Board and have been authorized for commercial exploitation in different regions in India. Seasonal studies made both in mulberry and non-mulberry silkworm revealed that different hybrid expressed differently when tested under varied climatic conditions (Krishnaswami and Narasimhanna, 1974).



Although, there is scope for summer and autumn rearing, no adequate efforts have been made to identify season and region specific hybrids suitable to specific region. Since the climatic condition of North East is hot and humid particularly during summer (June to August) having 28-38°C and 90-98% relative humidity together with rainfall that sometimes cause the failure of commercial cocoon crops during the period, which makes it different from rest of the country and so the existing hybrids are unable to satisfy the demands of the local farmers. The proposed work is the first attempt at the CSRTI, Berhampore in the identification of promising multivoltine breeds with better quality silk suited to different agro-climatic conditions.

### **16.3 Importance of the proposed project in the context of current status:**

Now a day's multivoltine hybrid is being widely reared at commercial level in West Bengal during adverse seasons. However, all the multivoltine breeds so far developed for this region are capable of producing inferior quality silk and the neatness of filament is not up to the desirable limits.

It is a challenge to overcome the problem by raising a sustainable multivoltine breed with high quality silk with genetic plasticity having high shell content and high neatness of filament to buffer against the adverse seasons (June, August and September) in West Bengal. Such breeds are urgently required to increase the Crossbreed cocoon production for the production of hybrids to increase the productivity as well as quality of silk.

### **16.4 Anticipated Products, processes/Technology, Packages/ Information or other outcome from the project and their expected utility:**

The successful completion of the project will lead to the development of robust multivoltine breeds with better quality silk having higher shell content and neatness of filament suitable to the West Bengal Conditions and can be effectively utilized for the production of multivoltine x bivoltine hybrids throughout the year without any difficulty.

### **16.5 Expertise available with proposed investigation group/institution on the subject of the project:**

Name of the Scientists	Designation	Experience
Dr. A. K. Verma	Scientist-C	More than 14 years of experience in silkworm breeding

Dr.N.Suresh Kumar	Scientist-C	More than 22 years of experience in silkworm breeding
Shri.N.B.Kar	Scientist-C	More than 20 years of experience in silk reeling and spinning
Dr.G.K.Chattopadhyay	Scientist-C	More than 26 years of experience in silkworm breeding
Dr.A.K.Saha	Scientist-D	More than 20 years of experience in Silkworm cocoon production

#### 16.6 List of Five Experts in India in Proposed Subject Area:

Sl. No.	Name	Designation	Address
1	Dr.R.K.Datta	Director (Rtd)	Silver Oak, Srirampura II stage, Mysore
2	Dr.H.K.Basavaraja	Scientist-E(Rtd)	APSSRDI, Hindupur
3	Dr.P.J.Raju	Director	APSSRDI, Hindupur
4	Dr. K.C.Narayanaswamy	Professor	UAS, Bangalore
5	Dr.G.Subramanya	Professor	University of Mysore, Mysore

#### 17. Work Plan:

##### 17.1 Methodology:

##### 1. Collection of breeding resource material

A total number of twenty breeds from CSGRC Hosur, three breeds from CSR&TI, Mysore and two multivoltine breeds from APSSRDI, Hindupur and Sarupat from KSSRDI, Bangalore will be considered. The breeds M6DPC, M.Con.4 and M.Con.1 from CSR&TI, Berhampore will be used as recipients. Multivoltine breeds with high shell percentage (20.56% - 15.03%) viz., BMI-0001, BMI-0065, BMI-0023, BMI-0074, BMI-0072, BMI-0069, BMI-0066, BMI-0070, BMI-0043, BME-0048; Multivoltine breeds high neatness (93.00 -88.5P) BMI-0004, BMI-0008, BME-0015, BMI-0011, BMI-0038, BMI-0014, BMI-0003, BMI-0016, BMI-0007, BMI-0042 from CSGRC, Hosur; the breeds viz, BL67, ND7, NDV6, L-14 from CSRTI, Mysore and breeds APM1, APM3 and APDR15 from APSSRDI, Hindupur will be utilized as breeding resource materials

## **2. Screening and selection breeding resource materials**

Based on the passport data and initial screening, 12 breeds will be selected as breeding resource materials

## **3. Initial crossing, evaluation and selection**

The selected breeds will be crossed with the recipients from CSR&TI, Berhampore (Annexure – 1) and will be evaluated in all the seasons. . Selection for neatness character will be carried out from the early generation itself . Cross breeding techniques by utilizing multivoltine parent with high shell percentage (>17.0%) and high neatness (>80 P) will be employed to incorporate the targeted trait shell percentage and neatness to the resultant breed followed by recurrent back crossing (BC1 to BC5) to enhance the scope for selection of the desirable trait. From F<sub>2</sub> generation, directional selection for both the traits high shell percentage and high neatness will be initiated. The cocoons will be randomly picked from each sub-line and after assessing the shell percentage, the silk will be subjected for assessment of neatness trait, the sub-line with both the high shell percentage and high neatness will be selected for raising the next generation. Care also will be taken for selection of uniform cocoon colour, egg colour along with other qualitative parameters The same method will be repeated from F<sub>4</sub> to F<sub>9</sub> generation till the fixation of the trait.

## **4. Short listing of lines**

Instead of continuing with all the lines four promising lines only will be short listed

## **5. Hybrid evaluation**

After fixation, hybrids will be prepared by using the ongoing Multivoltine breed which are already in the field and will be tested along with the control N x M12 (W) and subjected for evaluation covering all the seasons of the year.

## **7. Selection of hybrids**

Promising hybrids will be identified by using Evaluation Index method (Mano *et al.*, 1993)

**BREEDING PLAN**

Breeds of CSRTI,  
Berhampore

X Collected Breeds  
(with desired traits)

F<sub>1</sub> X Breed with desired traits

BC1 X Breed with desired traits

BC2 X Breed with desired traits

BC3 X Breed with desired traits

BC4 X Breed with desired traits

BC5 X Breed with desired traits

INTROGRESSION

F<sub>1</sub>

F<sub>2</sub>

⋮

F<sub>5</sub>

Inbreeding  
under  
selection  
pressure  
for targeted  
traits

**Developed New Breed  
(With High Shell % and Neatness).**

**17.2 Organization of Work Elements:**

<b>Name of Scientists</b>	<b>Designation</b>	<b>Time</b>	<b>Organization of work elements.</b>
Dr. A. K. Verma	Scientist-C	50%	Principal Investigator will carry out the Planning and execution of the project such as collection of breeding resource materials, initial screening, rearing, data compilation, assessment and selection of lines, preparation of reports.
Dr.N.Suresh Kumar Co.I-1.	Scientist-C	10%	Assist in initial screening of the breeds and data compilation.
Shri.N.B.Kar. Co.I -2.	Scientist-C	30%	Assessment of post cocoon parameters with special emphasis on <b>neatness</b> .
Dr.G.K.Chattopadhyay Co.I- 3	Scientist-C	05%	Assist in initial screening of breeds based of rearing performance, assessment and help in report preparation.
Dr. A. K. Saha. Co.I- 4	Scientist-D	05%	Assist in rearing of different breeds and help to prepare reports.

**17.3 Proprietary / Patented items, if any, expected to be used for this Project: NA****17.4 Suggested plan of action for utilization of the expected outcome from the project:**

Developed new multivoltine breeds having high silk percentage with neatness will be utilized as the multivoltine parent in the preparation of multi x bi hybrid which will provide better silk percentage with neatness at commercial level.

**17.5 Time Schedule of activities giving milestones:**

<b>Sl. No.</b>	<b>Milestone/ Activity</b>	<b>Expected Date (After approval)</b>	
		<b>Starting</b>	<b>Completion</b>
1.	Collection of Breeding resource material	July2013	August2013
2.	Rearing of Breeding resource material	September 2013	October 2013
3.	Initial cross making	November 2013	December 2013
4	Rearing of crosses and evaluation & Short listing of lines		
	BC1 rearing	January 2014	February 2014
	BC2 rearing	March 2014	April 2014
	BC3 rearing	May 2014	June 2014

	BC4 rearing	July 2014	August 2014
	BC5 rearing	September 2014	October 2014
	F1-F5 generations	November 2014	October 2015
5	Hybrid preparation & Data Evaluation	November 2015	April 2016
6	Identification of promising hybrids	May 2016	June 2016

#### 17.6 Project Implementing Agency /Agencies :

Name of the agency	Address of the agency	Proposed Research Aspects	Proposed Amount	Cost Sharing %
CSB	CSB, Bangalore Pin-560068			

#### PART-IV: BUDGET PARTICULARS

18. **BUDGET** (in Lakhs ) : [ In case of multi-institutional projects, the budget details should be provided separately for each of the Institute ]

ITEM	YEAR 1	YEAR 2	YEAR 3	Total
<b>A. RECURRING</b>				
<b>SALARIES</b> [APPORTIONED COST ]	--	--	--	-
<b>1. SCIENTIFIC STAFF</b>	--	--	--	-
<b>2. TECHNICAL STAFF</b>				
<b>WAGES/FELLOWSHIPS</b> [AC]	--	--	--	-
<b>3. SUPPORTING COST</b>	--	--	--	--
<b>4. LABOURERS</b>	--	--	--	-
<b>5. TRANSPORT &amp; TRAVEL</b>	<b>0.100</b>	<b>0.100</b>	<b>0.100</b>	<b>0.300</b>
<b>CONTINGENCIES</b> [APPORTIONED COST]	<b>0.100</b>	<b>0.100</b>	<b>0.100</b>	<b>0.300</b>
<b>6.COST OF MATERIALS &amp; SUPPLY</b>	<b>0.300</b>	<b>0.300</b>	<b>0.300</b>	<b>0.900</b>
<b>7. OTHER COSTS</b>	--	--	--	
<b>B. NON-RECURRING</b> [APP. COST]	<b>0.000</b>	<b>0.000</b>	<b>0.000</b>	<b>0.00</b>
<b>GRAND TOTAL (in lakhs)</b>	<b>0.500</b>	<b>0.500</b>	<b>0.500</b>	<b>1.500</b>

## PART-VI : REFERENCES

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- C.K. (2008). Strategies for improving fibre quality in polyvoltine X bivoltine silkworm hybrids., *Mulberry Silkworm Breeder's Meet*, Central Sericultural Research & Training Institute, Mysore. Pp.20-24.
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- Sengupta, A.K., Ghosh, B., Rao, P.R.T. and Das, N.K. (2001). Phenotypic stability in *Bombyx mori* L., *Perspectives in Cytology and Genetics*, 10): 693-700,
- Sowmyashree, T.S., Sudhakara Rao, P., Nataraju, B. and Qadri, S.M.H. (2011). Effect of high temperature on the incidence of Nuclear Polyhedrosis in silkworm *Bombyx mori* L. *Journal of Sericulture and Technology*, NASSI, 2(1): 56-60.
- Singh, Ravindra., Vemananda Reddy, G., Rajanna, K. L. and Sivaprasad, V. (2012). Salient features of a tropical univoltine race "Barpat" *Munis Entomology & Zoology*, 7 (2): 1278-1279.
- Sudha, V.N., Umadevi, K., Ramamohan Rao, P., Singh, R., Raghavendra Rao, D., Basavaraha H.K., Kariappa, B.K., Premalatha, V., Dandin, S.B. and Kamble, C.K. (2007). Evaluation of a new multivoltine x bivoltine hybrid "ND7 x CSR2"(Jayalaxmi) of the silkworm, *Bombyx mori* L. *Indian J. Seric.*, 42(2): 173-176.
- Toyoma (1906). Breeding method of silkworm (Jap.). *Sangyo-Shimpo*, 158: 283-286
- Yokoyama T. (1959). *Silkworm Genetics illustrated*. Japan Society for Promotion of Science Pub., Japan.
- Yokoyama T. (1976). Breeding silkworm. *Science and Technology in Sericulture*, 15(4): 58-61.
- Xu Meng Kui, Song Cui-e, Wang Zhang-e, Wang Yun-qin, Sun Yu-wu and Xu Wei-hua (1990). Breeding of silkworm varieties 'Suhua', 'Chunhui' and their hybrids for spring rearing. *Canye Kexue*, 16(1): 5-13.

**PART VII: BIODATA OF PROJECT COORDINATOR /  
PRINCIPAL INVESTIGATOR**

1.	Full Name (in Block letters)	DR. ANIL KUMAR VERMA
2.	Designation	Scientist-C.
3.	Department/Institute/University	SW Pathology Section, Central Sericultural Research & Training Institute, Berhampore(WB)-742101
4.	Date of birth	28.12.1960.
5.	Sex	Male.

6. Education (Post Graduation onwards & Professional careers)

Name of the University	Degree passed	Year of passing	Subjects taken with specialization	Class / Division
1. University of Kalyani, Nadia, West Bengal.	M.Sc.	1983	Zoology, Spl.: Entomology.	I
2. Bidhan Chandra Krishi Viswavidyalaya, WB	Ph. D	1990	<u>Title of the Thesis</u> - Studies on <b>whitefly</b> as vector of plant viruses in WB.	-

7. Awards: [Not required for in-house personnel] Not applicable

Year	Award	Agency	Purpose	Nature

8. Position held/research experience in various Institutions: [Not required for in-house personnel]

Employer	Designation of the post held	Date of joining	Date of leaving

9.	Memberships/Fellowships: [Not required for in-house personnel]	
10.	Patents: [Not required for in-house personnel]	
11.	Publications (numbers only)	19 Papers, 35 Popular articles and 06 Abstracts – Total: 60
	List of important publications whose contents can be used in the proposed area of work	

**LIST OF IMPORTANT PUBLICATIONS RELATED TO SERICULTURE:**

- Chattopadhyay, G. K., Sengupta, A. K., Verma, A. K., Sen, S. K. and Saratchandra, B. (2001a) Utilization of congenic line in silkworm breeding. In: *Perspectives in Cytology & Genetics*. G.K. Manna and Roy, S.C (edt). **10: 717-724.**

- **Verma, A. K.**, Chattopadhyay, G. K.; Sengupta. M, Sengupta, A. K. Das, S. K. and RajeUrs, S. (2003) Expression of heterotic genetic interaction among multivoltine backcross / congenic line for higher shell weight of silkworm *Bombyx mori* L. *Inter. J. of Indust. Ent. (IJIE), Korea. 7(1): 21-27.*
- Chattopadhyay, G. K., Sengupta, A. K., **Verma, A. K.**, Sen, S .K. and Saratchandra, B. (2001b) Transgression of shell weight - A multigenic trait, through development of congenic breed in tropical silkworm *Bombyx mori* L. *Sericologia. 41(1): 33-42.*
- Chattopadhyay, G. K., Sengupta, A. K., **Verma, A. K.**, Sen, S. K. and Saratchandra, B. (2001 c) Esterase isozyme polymorphism, Specific and nonspecific esterase, syngenic line development and natural occurrence of a thermo-stable esterase in tropical silkworm *Bombyx mori* L., *Insect Biochem. Mol. Biol. 31: 1191-1199.*
- Chattopadhyay, G. K., **Verma, A. K.**, Sengupta, M., Sengupta, A. K., Das, S. K and Raje Urs, S. (2004)  $\alpha$ -and  $\beta$ -amylase isozyme possessor native proteins in tropical silkworm *Bombyx mori* L. *Int. J. Indust. Entomol. 8(2): 21-27.*
- Chattopadhyay, G. K.; **Verma, A. K.**; Das, S. K. and Sarkar, A.(2005a) Acid phosphatase isozyme possessor native proteins pattern in Congenic breeds of silkworm, *Bombyx mori* L. In: 12<sup>th</sup> All India Congress of Cytology and genetics. *Institute of Science, Mumbai. C-38.*
- **Verma, A. K.**, Chattopadhyay, G. K.; Sengupta, M.; Sengupta, A. K.; Das, S.K. and Raje Urs, S. (2005) Heterobeltiotic genetic interaction between congenic and syngenic breeds of silkworm *Bombyx mori* L. *Inter. J. of Indust. Ent. (IJIE), Korea. 11(2): 119-124*
- Chattopadhyay, G. K; **Verma, A.K.**, Das, S. K. and Sarkar. A. (2005b) Esterase-a Biochemical marker for quantitative traits of silkworm, *Bombyx mori* L. In: *National Symposium on Development Dynamics. Indian Society of Developmental Biologists(Nov.23<sup>rd</sup>-25<sup>th</sup>).*Department of Zoology.University of Kalyani, Kalyani-741235. West Bengal.

12. Project(s) submitted / being pursued / carried out by Investigator:

Sl. No.	Title of the project	Funding agency	Duration From To	No. of Scientists / Associates working under the project	Total approved cost of the project
1	Utilization of Syngenic lines	CSB	Dec., 1998	3	19.30

	for improvement of shell weight and survival in silkworm, <i>B. mori</i> . L		to Dec.,2004		
2	Introgression of higher shell weight, higher survival character/gene through the development of multivoltine and bivoltine congenic breeds and identification of biochemical marker in silkworm, <i>B. mori</i> . L.	CSIR, Delhi	April, 2002 to March,2005	2	6.00
3	On farm trial of congenic silkworm hybrids for commercial exploitation	CSB	Sept., 2004 to Dec	4	1.00
4	Institute Village Linkage Programme (IVLP)	CSB	Ph.I: 07-10 Ph.I: 10-13	1	
5	Validation trial of the Ready Reckoner of sulphur fertilizer application for obtaining targeted yields of mulberry		2010-12	1	

13. Highlights of outcome / progress of the project(s) handled during the past 10 years, their outcome and utilisation (in 200 words):

Project	Outcome	Utilisation
1. Utilization of Syngenic lines for improvement of shell weight and survival in silkworm, <i>B. mori</i> . L	Isozyme based seven multivoltine and one sex linked bivoltine syngenic lines, four high cocoon shell weight multivoltine congenic breeds & four high survival bivoltine congenic breeds developed. Biochemical marker for high shell weight and high survival identified	The hybrids of the developed congenic breeds are under Post Authorization Trial.
2. Introgression of higher shell weight, higher survival character/gene through the development of multivoltine and bivoltine congenic breeds and identification of biochemical marker in silkworm, <i>B. mori</i> . L.	Isozyme based three syngenic lines of Nistari and one high survival bivoltine congenic breeds developed. Two biochemical marker identified similar to above project.	The hybrids of the developed breeds are under Post Authorization Trial.
3. Institute Village Linkage Programme (IVLP)	Mulberry leaf yield (MT/ha/year) increases from initial 8 to 10.47(30.86%). Average Mulberry holding (in acre) increases from initial 0.5 to 0.66(32.00 %). Average rearing capacity (DFLs/farmer/crop) increases from initial 75 to 125 (66.66 %). Cocoon yield/ 100 DFLs (kg.) increases from initial 28.99 to 36.62(26.31 %).	Plantation of High Yielding Variety like S1635. Plant to plant & row to row spacing- 2 ft.X 2 ft. Use of Plant Growth Hormone like Morizyme-B. Use of Vermicompost. Use of Biofertilizers like Nitrofert and Phosphofert to reduce the application of chemical nitrogen and phosphorus. Use of promising hybrids in place of existing one. Use of Bleaching Powder for general disinfection and Labex as bed

		disinfection. Use of dichlorovos for control of Whitefly infestation.
4. Validation trial of the Ready Reckoner of sulphur fertilizer application for obtaining targeted yields of mulberry	Soil from individual farmers analyzed to determine the extent of sulphur, based on this recommendation for sulphur application has been worked out.	Farmers are utilising this recommendation for use of sulphur in their field

### **Findings from First Two Projects**

Introduced a **method for introgression of a trait controlled by multiple genes**

for developing Congenic Breed (Chattopadhyay et al., 2001a, b, 2005).

Developed **four promising silkworm breeds** viz., M Con.1, M Con.4

(Multivoltine), B Con.1, B. Con.4 (Bivoltine)

Identified **five promising hybrid** combinations.

M Con.1 x M Con.4, N x M Con.4 (Multivoltine x Multivoltine)

M Con.1 x B Con.4, M Con.4 x B Con.4 (Multivoltine x Bivoltine)

B Con. 1 x B Con.4 (Bivoltine x Bivoltine)

Registration of breeds: Six (6) congenic breeds viz., V<sup>3</sup> CB5-Con.Ow, V<sup>3</sup> M6DPC-Con.C, V<sup>2</sup> D6p-Con.Ow, V<sup>2</sup> D6p- Conc., V<sup>2</sup> D6p-Con.F and one sex limited breed (JPN <sup>+HS</sup>) was send for registration at CSGRC, Hosur.

**Biochemical study / Markers:** Established that **amylase** is one of the most important enzymes in tropical silkworm having **positive correlation with high survival**.

It has been identified **224kDa Protein as a biochemical marker at pH-8.5 for high survival**. The apparent native protein in haemolymph is the possessor of  $\alpha$ -Est s are exclusively present in multivoltine.

It has been Identified that **180 kDa protein as a biochemical marker for high cocoon shell weight (at pH-8.5)**. The apparent native protein in haemolymph is the possessor of  $\alpha$ -Est s and exclusively present in bivoltine.

**$\beta$  -amylase presence** in haemolymph and digestive of Silkworm, *Bombyx mori* L. and **Identified specific and non-specific esterases** using  $\alpha$ - and  $\beta$ -naphthyl-acetate separately as non-specific substrates. The non-specific  $\beta$ -esterase-Est-3 in haemolymph is a **thermo-stable enzyme ( $80 \pm 1^\circ\text{C}$ ), which has been considered as one of the molecular factor for thermo-tolerance**.

Specific **Isozyme possessor native proteins** are associated with **non-hibernation and hibernation character** of silkworm has been identified some (CSIR Final report)

**PART VII: BIODATA OF CO-INVESTIGATOR(S)**

1. Full Name (in Block letters): DR.N.SURESH KUMAR
2. Designation: Scientist-C
3. Department/ Institute/ University: Silkworm Breeding and Genetics,  
CSRTI, Berhampore
4. Address for Communication: Silkworm Breeding and Genetics,  
CSRTI, Berhampore-742101
  
5. Date of birth: 01-06-1956
6. Sex: Male

7. Education (Post Graduation onwards & Professional Career):

Name of the University	Degree Passed	Year of Passing	Subjects taken with Specialization	Class/ Dvn.
University of Kerala, Trivandrum	BSc.	1978	Zoology (Main) Botany, Chemistry ( Subsidiaries)	I Class
University of Kerala, Trivandrum	MSc.	1980	Zoology	II Class
University of Madras, Chennai	Ph.D	1986	Zoology ( Entomology)  Title: “ Bio-ecological studies on some insects predatory on thrips ( Thysanoptera : Insecta)”  Guide : Prof. T.N.Ananthakrishnan, Formerly Director, Zoological Survey of India	

7. Awards:

[Not required for in-house personnel]

Year	Award	Agency	Purpose	Nature

8. Positions Held / Research Experience in various institutions:

[Not required for in-house personnel]

Employer	Designation of the post held	Date of Joining	Date of leaving

9. Memberships/Fellowships: [Not required for in-house personnel]

10. Patents: [Not required for in-house personnel]

11. Publications (Numbers only):

Books:	03
Research Papers, Reports:	80
General articles:	20

List of important publications whose contents can be used in the proposed area of work:

**10 important publications**

- Suresh Kumar, N**, Kishor Kumar, C.M, Basavaraja,H.K, Mal Reddy, N, Ramesh Babu,M and Datta, R.K (1999) Comparative performance of robust and productive bivoltine hybrids of *Bombyx mori* L under high temperature conditions. *Sericologia*. **39**(4) : 567-571
- Suresh Kumar, N**; Yamamoto, T; Basavaraja, H.K and Datta, R.K. (2001)Studies on the effect of high temperature on F1 hybrids between polyvoltine and bivoltine silkworm races of *Bombyx mori* L. *Int. J. Indust.Entomol.* **2** (2) : 123-127

3. **Suresh Kumar, N**, Basavaraja, H.K, Kalpana, G.V., Mal Reddy, N, Jayaswal, K.P., Thippeswamy, T., and Datta, R.K. (2002) Cocoon filament size deviation in bivoltine silkworm, *Bombyx mori* L. *Indian J.Seric.*, **41(1)** : 42-48.
4. **Suresh Kumar, N** , Basavaraja, H.K, Kishor Kumar, C.M., Mal Reddy, N., and Datta, R.K. (2002) On the breeding of “ CSR18 x CSR19”- A robust bivoltine hybrid of silkworm, *Bombyx mori* L. for the tropics . *Int.J.Indust.Entomol.* **5(2)** : 155-162.
5. **Suresh Kumar, N.**; Basavaraja, H.K.; Mal Reddy, N. and Dandin, S.B. (2003) Effect of high temperature and high humidity on the quantitative traits of parents, foundation crosses, single and double hybrids of bivoltine silkworm, *Bombyx mori* L. *Int. J.Indust. Entomol.*, **6(2)** : 197-202.
6. **Suresh Kumar, N.**, Basavaraja, H.K., Kalpana, G.V. Mal Reddy, N., and Dandin, S.B. (2003) Effect of high temperature and high humidity on the cocoon shape and size of parents, foundation crosses, single and double hybrids of bivoltine silkworm, *Bombyx mori* L. *Indian J. Seric.***42** (1) : 35-40.
7. **Suresh Kumar, N.**, Basavaraja, H.K., Kalpana, G.V. Mal Reddy, N., Kariappa, B.K and Dandin, S.B. (2003). Evaluation of bivoltine breeds and hybrids as male component with Pure Mysore under different temperature and humidity conditions. *Indian J. Seric.***42** (1) : 41-45.
8. **Suresh Kumar, N.**, Basavaraja, H.K., Kalpana, G.V. Mal Reddy, N., Kariappa, B.K and Dandin, S.B. (2003). Evaluation of bivoltine breeds and hybrids as male component with Pure Mysore under different temperature and humidity conditions. *Indian J. Seric.***42** (1) : 41-45.
9. **Suresh Kumar, N.**, Basavaraja, H.K. and S.B. Dandin (2004). Breeding of robust silkworm, *Bombyx mori* L. for temperature tolerance – A review. *Indian J. Seric.*, **43(2)** : 111-124.
10. **Suresh Kumar, N.**; Basavaraja,H.K.; Joge, P.G.; Mal Reddy, N.; Kalpana, G.V. and Dandin, S.B.(2006) Development of a new robust bivoltine hybrid ( CSR46 x CSR47) of *Bombyx mori* L. for the tropics . *Indian J.Seric.*,**45(1)** : 21-29.

**12. Project(s) submitted/ being pursued/ carried out by Investigator:**

Sl. No	Title of the project	Funding agency	Duration From To	No. of Scientists/ Associates working under the project	Total approved cost of the project
1	Development of bivoltine silkworm breeds/hybrids suitable to adverse climatic conditions of Eastern India	Central Silk Board	2010 to 2015	Nine	



## PART VII: BIODATA OF CO-INVESTIGATOR(S)

1. Full Name (in Block letters) : MR. N. B.KAR
2. Designation : Scientist-C
3. Department/ Institute/ University: CSR&TI, Berhampore
3. Address for Communication : Reeling Section, CSR&TI, Berhampore,  
Murshidabad, West Bengal-742101
4. Date of birth : 04.01.1959
5. Sex : Male
6. Education (Post Graduation onwards & Professional Career):

Name of the Univ taken	Class/ Dvn.	Degree	Year of passing	Subjects
Calcutta Universityt Weaving,	First	B. Sc. (Tech)	1980	Spinning, Dyeing & Printing.
Calcutta University	First	M. Sc. Tech	1999	Spinning, Weaving, Fibre Science

### 7. Awards:

[Not required for in-house personnel]

Year	Award	Agency	Purpose	Nature
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8. Positions Held/ Research Experience in various institutions: Not required for in-house personnel

9. Memberships/Fellowships: [Not required for in-house personnel]

10. Patents: [Not required for in-house personnel]

### 11. Publications (Numbers only):

Books:

Research Papers, Reports: 15

General articles:

List of important publications whose contents can be used in the proposed area of work:

1. A.K.Saha, T.Datta (Biswas),S.K.Das & N.B.Kar (2007) Antijuvenoid Action of Terpenoid midazole Compound on Larval-Pupal-Adult Development of Silkworm, *Bombyx mori* L. *Int. J. Indust. Entomol.* **14(2)** : 127 – 135.
2. T.Datta (Biswas), A.K.Saha, S.K.Das, N.B.Kar & A.Sarkar (2006). Appropriate Rearing technology for assuring better cocoon crop in Eastern India, *In the proceeding of the Workshop on Appropriate technologies for Mulberry sericulture in Eastern and North Eastern India,* **1** : 101 –105.

3. T.Datta (Biswas),A. K. Saha, S.K.Das & A.Sarkar (2007) A Comparative Study of Spinning of Silkworm in two types of Mountages. *Bull. Ind. Acad. Seri.*11(2) :39 – 42
4. T.Datta (Biswas) ,A. K. Saha, S.K.Das and N.B. Kar (2008) Plastic ollapsible Mountage, an alternate to Bamboo Spirral mountage in Eastern India. *Uttar Pradesh J. Zool.* 28 (3) : 319 - 328.
5. A.K.Saha, T.Datta (Biswas), S.K.Das, N.B.Kar and A. Sarkar (2005) Induction of trimoulting in bivoltine breeds of silkworm *Bombyx mori* L. and its contribution for producing multi x bi hybrid dfls during unfavourable climatic condition of Eastern India. *In the proceeding of the 20<sup>th</sup> Congress of International Seri. Com.* 1 : 219 – 223.

**PART VII: BIODATA OF PROJECT COORDINATOR /PRINCIPAL INVESTIGATOR/CO-INVESTIGATOR(S)**

**Name** : **DR. GAUTAM KUMAR CHATTOPADHYAY,**  
**Designation** : **Scientist-C**  
**Present Address** : Silkworm Breeding, Genetics & Molecular Biology Lab.,  
Central Sericultural Research & Training Institute,  
Central Silk Board, Govt. of India,  
Berhampore - 742 101, Murshidabad, West Bengal.  
  
FAX: +91 3482 251046  
E-mail: [gkc54@rediffmail.com](mailto:gkc54@rediffmail.com)  
**Date of Birth** : 27th October 1954.

**Educational Qualifications:**

Name of the University/ College / School	Exam(s) passed& year of passing	Subjects taken with specialization
Bankura Hindu High School, West Bengal.	H.S. Exam 1971	Bengali, English, Physics, Chemistry, Mathematics, Biology
Bankura Christian College, Under Burdwan university, Burdwan, West Bengal	B.Sc. 1974	Zoology (Hons), Botany, Chemistry
Kalyani University,	M. Sc.1976	Zoology ( <b>Cytogenetics specialization</b> )

Nadia, West Bengal		
Kalyani University, Nadia, West Bengal	Ph.D.1987	Title of the Thesis: <b>Assay of Some Mutagenic and Teratogenic effects of the bacterium, <i>Pseudomonas aeruginosa</i> in treated mouse system.</b>

### Projects carried out

Title of the project	Sponsored agency	Investigator status
Restriction filament length polymorphism studies in Silkworm, <i>Bombyx mori</i> L (1990 - 1993) – <b>Concluded</b>	<b>DBT, Delhi</b> (Concluded)	Co- Investigator
Utilization of syngenic lines for improvement of shell weight and survival in silkworm, <i>Bombyx mori</i> L (Dec-1998 to Mar, 2004) – <b>Concluded</b> <i>(Final report submitted)</i>	<b>Central Silk Board, Bangalore</b> (Concluded)	<b>Principal Investigator</b>
Introgression of high shell weight, high survival character(s) / gene(s) through the development of multivoltine and bivoltine Congenic breeds and identification of biochemical markers in silkworm, <i>Bombyx mori</i> L. (April, 2002 to March, 2005) – <b>Concluded</b> <i>(Final report submitted)</i>	<b>CSIR, Delhi</b> (Concluded)	<b>Principal Investigator</b>
On farm trial of Congenic silkworm hybrids for commercial exploitation (Sept. 2004 to Dec. 2005) – <b>Concluded</b> <i>(Final report submitted)</i>	<b>Central Silk Board, Bangalore</b>	<b>Principal Investigator</b>
On Farm trials of Evolved Bivoltine and Multivoltine Congenic Breeds and their hybrid performance at Farmers Level. <b>(Collaborative Project with DOS and CSR&amp;TI, Berhampore) – Concluded</b> <i>(Final report submitted)</i>	<b>Central Silk Board Bangalore</b>	<b>Principal Investigator</b>
Development of silkworm ( <i>Bombyx mori</i> L) breeds from a gene pool with higher genetics plasticity ( <b>Approved by RC.</b>	<b>Central Silk Board(Going to start)</b>	<b>Principal Investigator</b>
Development of High Temperature and Humidity Tolerant Bivoltine Breed. <b>Submitted to Financial Assistance</b>	<b>DST, Delhi</b>	<b>Co- Investigator</b>
	<b>Central Silk Board, Bangalore</b>	<b>Co- Investigator</b>

### Sericulture related Important scientific papers

1.Chatterjee, S.N.; Rao, C. G. P.; **Chattopadhyay, G. K.**; Ashwath, S. K.; Patnaik, A.K. (1992) Genetic variability of amylase activity in the mulberry silkworm *Bombyx mori* L. and its significance. *Sericologia*, **32(4)**: 671-683. .

2. Chatterjee, S. N.; Rao, C. G. P.; **Chattopadhyay, G.K.**; Ashwath, S. K.; Patnaik, A. K. (1993) Correlation between yield and biochemical parameters in the mulberry silkworm, *Bombyx mori* L. *Theor. Appl. Genet*, **87**: 385-391.

3. **Chattopadhyay, G.K.**; Sengupta, A. K.; Verma, A. K.; Sen, S. K. and Saratchandra, B. (2000a) Utilization of congenic line in silkworm breeding. In: *Perspectives in Cytology & Genetics*. Ed by G. K. Manna and S. Roy. **10**: 717-724.

4. **Chattopadhyay, G.K.**; Sengupta, A. K.; Verma, A. K.; Sen, S. K. and Saratchandra, B. (2001b) transgression of Shell weight – A multigenic trait, through development of Congenic breed in tropical silkworm *Bombyx mori*. L. *Sericologia*, **41(1)** : 33 – 44 .

5. **Chattopadhyay, G.K.**; Sengupta, A. K.; Verma, A. K.; Sen, S. K. and Saratchandra, B. (2001c) Esterase isozyme polymorphism, Specific and nonspecific esterase, syngenic line development and natural occurrence of a thermostable esterase in tropical silkworm *Bombyx mori* L., *Insect Biochem. Mol. Biol. (USA)*, **31**: 1191-1199.

6. Manna, G.K.; **Chattopadhyay, G. K.** and Dey, Mira. (2001) Genotoxic, mutagenic and teratogenic potentials of the bacterium, *Pseudimonas aeruginosa* tested in experimentally treated albino mice and its follow up in F1 and F2 generations. In: *Perspectives in Cytology & Genetics*. Ed by G. K. Manna and S. Roy. **10**: 865-890.

7. Verma, A. K.; **Chattopadhyay, G. K.**; Sengupta, M.; Sengupta, A. K. Das, S. K. and Raje Urs, S. (2003) Expression of heterotic genetic interaction among multivoltine backcross / congenic line for higher shell weight of silkworm *Bombyx mori* L. *International Journal of Industrial Entomology (IJIE), Korea*. **7(1)**: 69-73.

8. **Chattopadhyay, G. K.**; Verma, A. K.; Sengupta, A. K.; Das, S. K. and Raje Urs, S. (2004)  $\alpha$  and  $\beta$ -Amylase isozyme expresser native proteins in tropical silkworm *Bombyx mori* L. *International Journal of Industrial Entomology (IJIE), Korea*. **8(2)**: 189-194

9. Verma, A. K.; **Chattopadhyay, G. K.**; Sengupta, M.; Sengupta, A. K.; Das, S.K. and Raje Urs, S. (2005) Heterobeltiotic genetic interaction between congenic and syngenic breeds of silkworm *Bombyx mori* L. *International Journal of Industrial Entomology (IJIE), Korea*. **11(2)**: 119-124

10. Das, S. K.; Moorthy, S. M.; **Chattopadhyay, G. K.**; Verma, A. K.; Ghosh, B.; Rao, P. R. T.; Mukherjee, S.; Sengupta, A. K. and Sarkar, A. (2006) Breeding strategies for high humidity and high temperature conditions of Eastern region. In: Mulberry silkworm Breeders Meet. Central Sericultural Research & Training Institute. Berhampore-742101, West Bengal: 42-48.

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**PART VII: BIODATA OF PROJECT CO-INVESTIGATOR(S)**

- 1. NAME : Dr. A. K. Saha
- 2. EMPLOYEE NO : CSB/GPR/00574
- 3. OFFICIAL DESIGNATION : Scientist -D
- 4. PROJECT DESIGNATION : Co-Project Leader
- 5. EXPERTISE AREA : Silkworm Physiology and Rearing Technology
- 6. INSTITUTE NAME : C.S.R. & T.I., Berhampore
- 7. INSTITUTE ADDRESS : Berhampore, West Bengal, Pin – 742 101
- 8. TELEPHONE : 03482 – 253962/63/64, Extn. – 253 (Off); 9734494570
- 9. E-MAIL : [sahaatul@rediffmail.com](mailto:sahaatul@rediffmail.com)
- 10. FAX : 03482 – 251046
- 11. BIRTH YEAR : 1957 (27.08.1957)
- 12. SEX : Male
- 13. EDUCATIONAL : M.Sc., Ph.D

HIGHEST DEGREE ( DEGREE ONWARDS)	YEAR	UNIVERSITY	COUNTRY	SUBJECT
Ph.D.	2003	Burdwan University	India	Reproductive physiology of <i>B. mori</i> .
M.Sc.	1980	Burdwan University	India	Zoology (Entomology)
B. Sc (Zoo) Hons.	1978	Burdwan University	India	Zoology (H), Botany, Physiology

**14. PROJECT PURSUED :**

**A CURRENT PROJECTS/PROJECT UNDER PROGRESS**

SL.	PROJECT	PROJECT TITLE	RESEARCH	COST [RS]
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No.	CODE		TIME SPENT %	
1	DST Project	Maximization of cocoon production and quality through demonstration of cost efficient and improved technologies suitable for West Bengal	30%	
	DBT supported collaborative project with CCMB	Development, validation and utilization of SCAR markers for powdery mildew ( <i>Phyllactinia corylea</i> ) resistance in mulberry	10%	
	PPA 3366	Development of integrated package for raising chawki leaves and young age silkworm rearing for successful cocoon production	40%	8.09
2	Field trial of APR 3250	Field trial of the rearing package developed through the project APR 3250	20%	0.13875

### **Published Research Paper/Article**

Research paper: 29	Popular Article: 10	Abstract: 05	Total: 44
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### **PART-VI: DECLARATION / CERTIFICATION**

It is certified that

- a. The research work proposed in the project does not in any way duplicate the work already done or being carried out elsewhere on the subject.
- b. The same project has not been submitted to any other agencies for financial support.
- c. The emoluments for the manpower proposed are those admissible to persons of corresponding status employed in the institute/ university or as per the Ministry of Science & technology guidelines (Annexure-III).
- d. Necessary provision for the project will be made in the Institute in anticipation of the sanction of the scheme.
- e. If the project involves the utilization of genetically engineered organism, it is agreed that we will ensure that an application will be submitted through our institutional bio-safety committee and we will declare that while conducting experiments, the bio-safety guidelines of the Department of Biotechnology would be followed in toto.
- f. If the project involves field trials / experiments / exchange of specimens etc we will ensure that ethical clearances would be taken from the concerned ethical committees of Biotechnology before implementing the project.
- g. It is agreed by us that any research outcome or intellectual property right(s) on the interven (s) arising out of the project shall be taken in accordance with the instructions issued with the approval of the Ministry of Finance . Department of Expenditure as contained in annexure-V
- h.. We agree to accept the terms and conditions as enclosed in Annexure-IV .The

same is signed and enclosed.

- i. The institute agrees that the equipment , the basic facilities and such other administrative facilities as per terms and conditions of the grant will be extended investigators through out the duration of the project .
- j. The institute assumes to undertake the financial and other management responsibilities of the project.

- |  |  |
|--|--|
| 1. Signature of Project Co-ordinator<br>[Applicable for inter-institutional<br>Projects only]<br>Date: | 2. Signature of Executive Authority of<br>Institute with Seal<br>Date: |
| 3. Signature of Principal Investigator   | 4. Signature of Co-Investigator-1                                      |
| 5. Signature of Co-Investigator-2  | 6. Signature of Co-Investigator-3                                      |
| 7. Signature of Co-Investigator-4  |  |

To,  
The Director  
CSR&TI  
Berhampore  
Sir,

(Through Proper Channel)

Sub: Submission of New Proposed Project- Reg.

Ref: Approved by Research Advisory Committee Meeting held on 10.12.2012

\* \* \* \* \*

With reference to the above I am hereby submitting Proposed Research Project entitled "Development of multivoltine silkworm (*Bombyx mori L.*) breeds with high Shell percentage and high neatness of silk filament" after the approval from RAC for necessary action.

Place : CSR&TI., Berhampore,  
24.01.2013.

Yours faithfully,

(SUNITA MUKHERJEE)  
SCIENTIST-'C'

Silkworm Breeding and Genetics Section

