EVALUATION OF FIELD LEVEL PERFORMANCE OF VISHALA MULBERRY VARIETY IN DIFFERENT LOCATIONS UNDER IRRIGATED CONDITIONS IN WEST BENGAL

New Research Project
submitted to

Central Silk Board
Ministry of Textiles - Government of India
BTM Layout, Madivala
Bangalore - 560 068

By

Dr.S.K.Mandal
Scientist -'C'
Principal Investigator
Agronomy Section

Central Sericultural Research &Training Institute
Central Silk Board, Ministry of Textiles - Govt. of India
Berhampore - 742 101, Murshidabad District
West Bengal.

PROFORMA - I
(To be filled by applicant)
PART - I : GENERAL INFORMATION

Sl. No.	Items	Particulars
1.	Name of the Institute / University / Organization submitting the Programme Proposal	Central Sericultural Research & Training Institute, Central Silk Board, Ministry of Textiles, Govt. of India, Berhampore - 742 101, Murshidad - District, 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, CSR&TI., Central Silk Board, Berhampore - 742 101 (WB).
4.	Programme Title	**"Evaluation of field level performance of Vishala mulberry variety in different locations under irrigated conditions in West Bengal"**
5.	Category of the Programme	Mulberry Crop Production
6.	Specific Area	"Crop productivity Improvement"
7.	Duration	5 (Five) years [from the date of implementation] (Apri 2013-March2018)
8.	Total cost:	**Rs. 12.217 lakes** [Detailed budget enclosed in **Annexure-1 &1(a)**]
9.	Is the Programme single Institutional or multi-institutional	Single institutional
10.	If the Programme is multi-institutional please furnish the following	NA.,
11.	**Project Summary :** **M**ulberry, the sole food plant for *Bombyx mori* L. silkworm has significant contribution in cocoon production hence consistent efforts to improve the quality linked productivity in traditional areas and non traditional mulberry sericulture areas of the country	

are being continually made by Main Research Institutes of Central Silk Board located in Berhampore (West Bengal), Mysore (Karnataka), Pampore (J&K) and State Governments. To meet the breeding research purpose in mulberry the Central Sericultural Germplasm Resources Centre, Hosur is maintaining a rich collection of mulberry germplasm of 1023 accessions [Indigenous 761 and exotic 262] (Tikader and Thangavelu, 2003).

Apart from the above CSR&TI., Berhampore (West Bengal) is also maintaining a mulberry germplasm of 82 accessions [Indigenous 53 and exotic 29] and CSR&TI., Pampore (J&K) also maintaining about 75 accessions in its mulberry germplasm to meet the region specific studies etc.,.

In India, only five important species of mulberry namely *Morus indica, M. alba, M. bambycis, M. sinensis* and *M. multicaulis* are cultivated. During 1950s and upto early 1960s low yielding mulberry varieties like Bombai, Kajli in West Bengal, local land varieties like Boodi-ranginakaddi, Bilidevalaya and Mysore Local etc., in Karnataka. These varieties with a leaf yield ranged between 5-7 and 10-12 tons / ha / year under non-irrigated and irrigated conditions respectively with low leaf moisture content of < 65% with higher adaptability in traditional areas under harsh / stress conditions.

R& D has brought improvements over the years and make available many high yielding region specific mulberry varieties like **S1, S1635, BC259, Tr-**4, **Tr-10, S-146, C1730, C-776** etc., for Eastern and North Eastern region, **K2, S-36, RF5135, RF5175**, **V1, S-13, S-34, AR-11, AR-12, Sahana, RC-1, RC-2, G-2 and G-4** etc., for Southern region of the country with leaf yield ranged between 12-15 and 35-70 tons / ha / year under non-irrigated and irrigated conditions respectively with leaf moisture content of < 75 % with higher quality.

In the above context a high yielding mulberry variety namely **'Vishala'** a clonal selection made at the KSSRDI, out of the saplings raised from the cuttings obtained from mulberry gardens of Shidlaghatta Taluk, Kolar district of Karnataka State excelled well in all regions of the country under III Phase AICEM conducted by CSB., attracted for evaluation of its performance in larger locations in farmers' field under irrigated conditions of West Bengal with check of **S1635** the ruling high yielding variety of the state and also the National Check variety under AICEM Programme of CSB., for its suitability for large scale popularization of the same under this studies.

Further the recommended package of practices for **S1635** mulberry variety and FYM 20 tons (in two equal split dose) NPK 350 : 210 : 112 (N in five equal split doses; P & K (in two equal split doses) recommended dose emanated out of the concluded research project **PPA-3248** with added green manure will be followed for this study.

PART II : PARTICULARS OF INVESTIGATORS

12. i)	Name Year of birth Sex Executive Authority Designation & Department Institute / University : Address	**Dr.B.B.Bindroo,** 1954 Male **Executive Authority,** Director, CSR&TI., CSB., Berhampore - 742 101, (WB)
ii)	Name Year of birth Sex Project Coordinator Designation & Department Institute / University : Address	**Dr.M.K.Gosh,** 1958 Male **Project Co-ordinator,** Scientist-'D', Moriculture Division Head, CSR&TI., CSB., Berhampore - 742 101, (WB)
iii)	Name Year of birth Sex Principal Investigator Designation & Department Institute / University : Address	**Dr. S.K.Mandal,** 1955 Male **Principal Investigator,** Scientist-'C', Agronomy Section, CSR&TI., CSB., Berhampore - 742 101, Murshidabad (WB)
iv)	Name Year of birth Sex Co-Investigator (1) Designation & Department Institute / University : Address	**Dr. S.Rajaram,** 1961 Male **Co-Investigator,** Scientist-'C', Agronomy Section, CSR&TI., CSB., Berhampore - 742 101, Murshidabad (WB)
v)	Name Year of birth Sex Co-Investigator (2) Designation & Department Institute / University : Address	**Dr.M.S.Rahman,** 1954 Male **Co-Investigator,** Scientist-'C', Agronomy Section, CSR&TI., CSB., Berhampore - 742 101, Murshidabad (WB)
vi)	Name Year of birth Sex Co-Investigator (3) Designation & Department Institute / University : Address	**Dr.Mili Banerjee,** 1961 Female **Co-Investigator,** Deputy Director, DoT(S)., Berhampore - 742 101, Murshidabad (WB)
vii)	Name Year of birth Sex Co-Investigator (4) Designation & Department Institute / University : Address	**Shri.Sadananda Koley,** 1954 Male **Co-Investigator,** Deputy Director, DoT(S)., Suri, Birbhum (WB)
viii)	Name Year of birth Sex Co-Investigator (5) Designation & Department Institute / University : Address	**Dr.Sudip Kumar Sen,** 1956 Male **Co-Investigator,** Scientist-'C', SSPC., NSSO., CSB., Raiganj Uttar Dinajpur (WB)

ix)	Name Year of birth Sex Co-Investigator (6) Designation & Department Institute / University : Address	**Dr.Pradip Kumar Biswas,** 1955 Male **Co-Investigator,** Scientist-'C', P1 BSF., Banguria, NSSO., CSB., Nadia, (WB)
x)	Name Year of birth Sex Co-Investigator (7) Designation & Department Institute / University : Address	**Dr.Maloy Kumar Ghosh,** 1960 Male **Co-Investigator,** Scientist-'C', SSPC., NSSO., CSB., Dhaksin Bhavanipur, Uttar Dinajpur (WB)
xi)	Name Year of birth Sex Co-Investigator (8) Designation & Department Institute / University : Address	**Dr. Shyama Prasad Chakroborthy,** 1954 Male **Co-Investigator,** Scientist-'C', REC., CSR&TI., CSB., Kamnagar, Murshidabad (WB)
xii)	Name Year of birth Sex Co-Investigator (9) Designation & Department Institute / University : Address	**Dr. Alok Kumar Dutta,** 1955 Male **Co-Investigator,** Scientist-'C', REC., CSR&TI., CSB., Mothabari, Malda (WB)
xiii)	Name Year of birth Sex Co-Investigator (10) Designation & Department Institute / University : Address	**Dr. Lal Mohan Saha** Male 1955 **Co-Investigator,** Scientist-'C', SSPC, NSSO CSB., Berhampore, Murshidabad ,W.B.

13.	Expertise available with proposed investigation group / institution on the subject of the project	Investigators are expert in mulberry cultivation and mulberry / silkworm crop productivity assessment for evaluation of performance mulberry variety.

PART III : TECHNICAL DETAILS OF PROGRAMME

14.

Programme Background :

Mulberry cultivation and silkworm rearing at farmers level is an age old practice in Eastern state and spread to North Eastern states in the 21st century. Mulberry leaf quality; as individual factor contributes about 38.2% for the success of silkworm cocoon crop (**Miyashita, 1986**); emphasis was given under R&D to evolve high yielding mulberry varieties with improved leaf qualities. Large amount of works have been done to improve the quality linked leaf productivity in mulberry through evolving high yielding varieties

time to time to meet the specific requirements for different regions at this Institute and other institutes in our country in the past five decades.

Mulberry leaf productivity of about 9-10 t / ha / year from local cultivars like Kajali & Bambay etc., in the field were replaced by high yielding varieties like S1 with 25 t and now S1635 with 45 t. Further, researches for evolving region specific and problem specific high yielding mulberry varieties are being carried out in research institutes of Central Silk Board and state governments in our country.

Mulberry being perennial plant maintained for several years (>10Years) after plantation; for sustainable leaf productivity over the years depends on better soil fertility maintenance and follow-up of packages of practices for mulberry garden. FYM and sulfur increased the moisture content of mulberry shoots and the importance of assured irrigation, well drained, clay loam to loamy, deep fertile and light textured soil with pH 6.2 to 6.8 for mulberry cultivation under sub tropical conditions were emphasized by **Bindroo *et al*., (1996)**.

Existence of positive correlation between the leaf yield and quantum of irrigation water applied and frequency of irrigation in Kanva $_2$ mulberry variety. Above all, mulberry crop response to water and **fertilizer** in terms of productivity increase by >400% compared to rainfed condition and amazing adaptability to different levels of soil moisture stress & fertilizer levels reported by **Benchamin *et al*., (1997)**. Application of appropriate quantum of fertilizer mulberry garden commensurate with the productivity potential of the variety is inevitable for sustainable productivity maintenance & to avoid depletion of soil fertility over the years.

High yielding mulberry variety namely **'Vishala'** a clonal selection made at the KSSRDI, out of the saplings raised from the cuttings obtained from mulberry gardens of Shidlaghatta Taluk, Kolar district of Karnataka State excelled well in all regions of the country under III Phase AICEM conducted by CSB., attracted for evaluation of its performance in larger locations in farmers' field under irrigated conditions of West Bengal with check of **S1635** the ruling high yielding variety of the state and also the National Check variety under AICEM Programme of CSB., for its suitability for large scale popularization of the same under this studies

15. **Work Done :**

Mulberry cultivation and silkworm rearing at farmers level is an age old practice in Eastern state and spread to North Eastern states in the 21st century. Mulberry leaf quality; as individual factor contributes about 38.2% for the success of silkworm cocoon crop (**Miyashita, 1986**); emphasis was given under R&D to evolve high yielding mulberry

varieties with improved leaf qualities. Large amount of works have been done to improve the quality linked leaf productivity in mulberry through evolving high yielding varieties time to time to meet the specific requirements for different regions at this Institute and other institutes in our country in the past five decades. Mulberry leaf productivity of about 9-10 t / ha / year from local cultivars like Kajali & Bambay etc., in the field were replaced by high yielding varieties like S1 with 25 t and now S1635 with 45 t. Further, research for evolving region specific and problem specific high yielding mulberry varieties are in progress under different levels.

Existence of positive correlation between the leaf yield and quantum of irrigation water applied and frequency of irrigation in Kanva $_2$ mulberry variety. Above all, mulberry crop response to water and **fertilizer** in terms of productivity increase by >400% compared to rainfed condition and amazing adaptability to different levels of soil moisture stress & fertilizer levels reported by **Benchamin *et al*., (1997)**. Application of appropriate quantum of fertilizer mulberry garden commensurate with the productivity potential of the variety is inevitable for sustainable productivity maintenance & to avoid depletion of soil fertility over the years.

In India :

At this Institute:

Increase in number of branches, average leaf area (ALA) and total photosynthetic rate area (TPA) in C776 mulberry variety when increase in NPK level were reported by Sinha *et al., (*2001).

Das *et al.,* (1993) observed a direct and positive correlation between fertilizer application and leaf production in mulberry.

Nitrogen application at 200, 250 and 300 kg/ha increased the leaf yield of mulberry 23.83, 9.97 and 6.82 per cent, respectively, over the corresponding next lowest application rate. Uptake of nitrogen, phosphorus and potassium increased as nitrogen application increased (Kar *et al.* 1997).

Ray (1978) applied N fertilizer @ 150, 300, 600, and 900 kg / ha / yr and observed that leaf yield increased by 88% in the highest dose. Compared to the control (T_0), leaf yield/plant of T_1, T_2, and T_3 was increased by 25.96, 41.60 and 49.29%, respectively.

Further the recommended package of practices for **S1635** mulberry variety and FYM 20 tons (in two equal split dose) NPK 350 : 210 : 112 (N in five equal split doses; P & K (in two equal split doses) recommended dose emanated out of the concluded research project **PPA-3248** with added green manure will be followed for this study

Other Institutes :

NPK dose for improved mulberry variety V1 compared to other lower yielding

varieties like K2, DWR-39 and S36 etc., are more by 16.69; 16.62 and 16.62% respectively. However the requirement of manure and fertilizer for other agriculture crops like cotton, sugarcane, paddy, sorghum, maize, millet and wheat etc., are far higher than that of mulberry. Further the quantum jump in yield in paddy and wheat which brought about the green revolution in the world in 1970s was mainly dependent on high yielding varieties and high fertilizer dose to support the additional yield obtained in the high yielding varieties and thus more fertilizer and water requirement for V1 mulberry variety than K2 was justified (Sarkar and Mallikarjuna, 2002).

Silkworm growth and development were highly dependent on NPK fertilization and foliar nutrition thus in turn protein emphasizing the dire need to apply NPK and micronutrient to mulberry. Soil application of NPK and foliar nutrients can be preferably used with advantage. Leaf / stem ratio increased with increasing rate of nitrogen and application of nitrogenous fertilizers has been shown to produce significantly higher leaf/stem ratio in geranium (Bhaskar *et al.,* 2001; Mohan and Sampath, 1983).

The response of rose-scented geranium crop to applied N fertilizer and planting time was greater in high fertilizer N dose and optimum crop length was **135 days** when crop was planted in February and higher yields were obtained with **150 kg N ha^{-1}**.

The importance of fertilizers on leaf yield of mulberry has also been reported by Ahmad (1986), Islam *et al.* (1982 and 1985), Kasiviswanathan and lyengar (1965, 1966, 1969 and 1970), Subbarayappa *et al.* (1994), Mukherjee and Sengupta (1978) & Kasiviswanathan *et al.* (1977).

The importance of NPK fertilizers for both increased productivity and improved quality of mulberry leaves has been well recognized. The yield of mulberry is influenced more by the amount of nitrogenous fertilizer than phosphorus and potassim (Pain, 1965; Kasiviswanathan *et al.,* 1979; Islam *et al.,* 1982 and 1985).

Outside India :

Application of NPK fertilizers significantly increased all the characters over the control (no NPK). Among the fertilizer treatments, T_3 (400 kg N, 200 kg P and 125 kg K/ha/yr) showed significantly the highest values for all these characters. On the other hand, T_0 had the lowest values. Similar result was reported by Miah (1989) that by the application of N, P, and K fertilizers at the rate of 400 kg N, 200 kg P, and 150 kg K/ha/yr, leaf yield was increased by 77.92% over the control.

Jiang (1993) has established relationship between leaf yield of mulberry and amount & ratio of NPK applied.

Studies on nutrient management can increase mulberry leaf yields by 35% and can also improve leaf qualities (Tan *et al.,* 1997; Wang *et al.,* 2001). High-yielding mulberry

varieties have extended throughout Hubei [NPK range 171-936 0-300 0-576, with average 453 114 176] and soil nutrient removal has increased accordingly along with the frequency of soil nutrient deficiencies. Research shows that balanced fertilization is a key for advancing sustainable development of mulberry production within the province (Lu *et al.,* 2004). According to Ushioda (1954), among the nutrients supplied through fertilizers, nitrogen has the greatest influence upon the quality of mulberry leaves. Higher nitrogen increased the protein and moisture content of leaves and decreased the phosphorus, potassium and calcium content.

Yokoyama (1962) reported that higher dose of nitrogen in combination with phosphorus and potassium was effective in increasing the foliage yield with higher dose of nitrogen fertilizer was effective in increasing the foliage yield. The increase in grain yield at higher N than lower N rate might be due to the increase in leaf area and plant heights at higher than at lower N rate in maize was reported (Greef *et al.,* (1999); Mariga *et al.,* (2000) Hamid and Nasab (2001).

Increase in N rate increased plant and ear heights with the highest rate of 180 kg N ha^{-1} produced the taller plants and higher ears heights; while the shorter plants and ears heights were recorded in the plots which received the lowest rate of 60 kg N ha^{-1}. Tallest plant and ears heights were observed in the plots to which N was applied in unequal splits at five stages (S6) by applying 33% of N at 45 days after emergence. Increase in N rates and number of splits extended vegetative growth period of maize (Amanullah *et al.,* 2009).

Grain yield and Photosynthesis Active Radiation (PAR) absorption increase with increasing nitrogen fertilizer tried upto 350 kg ha^{-1} in maize was reported by Mehdi Dahmardeh (2011).

17. **WORK PLAN**

Miyashitha (1986) categorized the various factors contributing for the successful silkworm cocoon crop as **mulberry leaves 38.2%**, rearing climate 37.8%, rearing technology 9.3%, silkworm race 4.2%, silkworm eggs 3.1% and other factors 8.2%. As the mulberry leaves' share for the success of the silkworm cocoon crop is at the maximum, production of quality linked increased productivity of the same per unit area at less cost and less water is important for sustainable sericulture in the field.

Experiment title : Evaluation of field performance of Vishala mulberry variety under irrigated conditions in West Bengal.

Objectives :

- To find out the potentiality of Vishala mulberry variety under irrigated conditions in West Bengal.
- Evaluation of field performance of Vishala mulberry variety in different locations under irrigated conditions in West Bengal.

Experimental details : Existing sericulture farmers with adequate irrigation and silkworm rearing facility will be identified as beneficiaries in all 11 regions covering 23 locations.

No. of Regions	11 [to cover entire sericulture region under irrigated condition in West Bengal] **Annexure-2, 2(a) to 2(f).**
No. of locations	23 [Under irrigated conditions]
Spacing (2)	2'x2' [60 x 60 cms]
Mulberry variety (2)	Vishala and S-1635 (Check)
Area to be planted in each location	4000 sq.ft. [5.56 Katha] [1 Katha=720 sq.ft.]
No. of plants to be established for both varieties [Vishala and S-1635]	500 plants for each variety.
Manure and fertilizer recommendations / ha / year	FYM 20 tons (in two equal split dose) NPK 350 : 210 : 112 (N in five equal split doses; P & K (in two equal split doses) recommended dose emanated out of the concluded research project **PPA-3248** with added green manure [@ 25 kg / ha seed of Sunnhemp (black & alluvial soil) or Dhaincha (red soil) will be sown during summer in between mulberry plants and incorporate bio-mass after 45 days during rainy season].
No. of crops per year	Five (2nd year onwards)
No. of years	5 (Five years) (April,2013-March,2018)

17.1. **Methodology :**

The experiment will be carried out in 23 locations from 11 different regions [**Annexure-2,2(a) to 2(f).**] as per the design and treatments of the experiment in farmers' field with assured irrigation facility.

i) Identification of farmers field and preparation of land for raising of plants will be completed by April. Seed cuttings required will be arranged from KSSRDI., Bangalore and CSR&TI., Berhampore and saplings will be raised during March-April at research farm under Agronomy Section of CSR&TI., Berhampore, West Bengal. The plantation will be raised in the farmers' field during July-August.

ii) Soil testing of the farmers' field before establishment of mulberry for necessary

Corrections if any required and after completion of 5 years study will be done to ascertain the fertility utilization status in the garden.

iii) The observations in the prevailing climatic factors at the sites of experimentation will be recorded for each location.

iv) Mulberry variety establishment behaviour like adaptability, survival, susceptibility to major pests and diseases if any will be closely monitored and recorded.

v) As per the guidelines of C.O. vide letter No. CSB-31/2 (BER-NP)/ 08-09-RCS dated 24.12.2012, for data collection on leaf yield, a square covering around 10% of the plants (49 plants) in each plot will marked and the data will be collected by harvesting entire leaf within the square when the silkworms are in 3rd,4th or 5th day of instars during rearing. Further the area of collection will be shifted form one area to other within the plot at random from crop to crop to nullify the effect of soil fertility variations within the plot. The leaf yield data, cocoon yield / 100 dfls, cocoon price, amount realized on sale of cocoons will be recorded to ascertain the productivity of leaf yield per unit area (one hectare), cocoon harvest per unit area, average leaf consumption to produce one kg of cocoon and economics besides noting of difficulties / advantages might be expressed by the farmers if any.

vi) Incidence of pest and disease attack will be studied in different seasons throughout the experimental period.

vii)Rearing will be conducted in all five crops in four years[2nd to 5th experimental year] with ruling silkworm breed [M x M (N x M12 W / N x M Con 4/ MCon 1 x MCon 4) during unfavourable season[May to September] and M x B(N x NB4D2/ N x (SK4 x SK7) and rearing data covering from fecundity and hatching 5 , larval duration, cocoon production, cocoon character like single cocoon weight, shell weight and shell ratio will be recorded.

viii)All data of the experiments will be subjected to statistical analysis using AGRES Software and the results will be tabulated and discussed separately.

ix)Detailed expenditure and income per hectare will be accounted in every year including manpower utilization (both family labour and hired labour) as per minimum wages prevailing in the state.

17.2. **Organisation of work elements**

Principal Investigator Dr.S.K.Mandal, Sc-'C'	Co-Investigator (1) Dr.Rajaram, Scientist-'C'	Co-Investigator (2) Dr.M.S.Rahman Sc-'C'	Co-Investigator (3) Dr. Mili Banerjee, DD.,	Co-Investigator (4) Shri.Sadananda Koley, DD.,	Co-Investigator (5) Dr.Sudip Kumar Sen, Sc.-'C'
➢ Preparation of checklist for conduct of experiment and arrange-ments for the same.	➢ Preparation of checklist for conduct of experiment and arrange-ments for the same.	➢ Preparation of checklist for conduct of experiment and arrangements for the same.	➢ Preparation of checklist for conduct of experiment and arrangements for the same.	➢ Preparation of checklist for conduct of experiment and arrangements for the same.	➢ Preparation of checklist for conduct of experiment and arrangements for the same.
➢ Arrangements for all inputs required for conduct of the study in all three locations.	➢ Arrangements of mul-berry seed cuttings for raising of saplings.	➢ Arrangements for pre-paration of nursery bed and raising of saplings.	➢ Soil Testing of the field before raising of plantation & necessary corrections if any.	➢ Soil Testing of the field before raising of plantation & necessary corrections if any.	➢ Soil Testing of the field before raising of plantation & necessary corrections if any.
➢ Soil Testing of the field before raising of plantation & necessary corrections if any.	➢ Soil Testing of the field before raising of plantation & necessary corrections if any.	➢ Soil Testing of the field before raising of plantation & necessary corrections if any.	➢ Layout plan and design of experiment plot in the field.	➢ Layout plan and design of experiment plot in the field.	➢ Layout plan and design of experiment plot in the field.
➢ Layout plan and design of experiment plot in the field.	➢ Layout plan and design of experiment plot in the field.	➢ Layout plan and design of experiment plot in the field.	➢ Transplantation of saplings and establishment and maintenance of mulberry garden.	➢ Transplantation of saplings and establishment and maintenance of mulberry garden.	➢ Transplantation of saplings and establishment and maintenance of mulberry garden.
➢ Transplantation of sap-lings and establishment and maintenance of mulberry garden.	➢ Transplantation of sap-lings and establishment and maintenance of mulberry garden.	➢ Transplantation of sap-lings and establishment and maintenance of mulberry garden.	➢ Close monitoring and observation of crop and record of data in all 5 crops for four years for evaluation of the mulberry variety as per work plan.	➢ Close monitoring and observation of crop and record of data in all 5 crops for four years for evaluation of the mulberry variety as per work plan.	➢ Close monitoring and observation of crop and record of data in all 5 crops for four years for evaluation of the mulberry variety as per work plan.
➢ Close monitoring and observation of crop and record of data in all 5 crops for four years for evaluation of the mulberry variety.	➢ Close monitoring and observation of crop and record of data in all 5 crops for four years for evaluation of the mulberry variety.	➢ Close monitoring and observation of crop and record of data in all 5 crops for four years for evaluation of the mulberry variety.	➢ Arrangements for soil testing on completion of the experiments to ascertain the fertility status of the field.	➢ Arrangements for soil testing on completion of the experiments to ascertain the fertility status of the field.	➢ Arrangements for soil testing on completion of the experiments to ascertain the fertility status of the field.
➢ Arrangements for soil testing on completion of the experiments to ascertain the fertility status of the field.	➢ Arrangements for soil testing on completion of the experiments to ascertain the fertility status of the field.	➢ Arrangements for soil testing on completion of the experiments to ascertain the fertility status of the field.			
➢ Analysis of raw data collected for its scientific reliability and record of the same.	➢ Analysis of raw data collected for its scientific reliability and record of the same.	➢ Analysis of raw data collected for its scientific reliability and record of the same.			
➢ Maintenance of Project Implementation Ledger, preparation of reports and compilation of the same for submission to the Competent Authority.	➢ Maintenance of Project Implementation Ledger, preparation of reports and compilation of the same for submission to the Competent Authority.	➢ Maintenance of Project Implementation Ledger, preparation of reports and compilation of the same for submission to the Competent Authority.			

17.2. **Organisation of work elements**

Co-Investigator (6) Dr.P. K. Biswas, Sc-'C'	Co-Investigator (7) Dr.Maloy Kumar Ghosh, Sc.-'C'	Co-Investigator (8) Dr. S. P. Chakroborthy, Sc.-'C'	Co-Investigator (9) Dr. Alok Kumar Dutta, Sc.-'C'	Co-Investigator (10) Dr. Lal Mohan Saha Sci-"C"
➢ Preparation of checklist for conduct of experiment and arrangements for the same.	➢ Preparation of checklist for conduct of experiment and arrangements for the same.	➢ Preparation of checklist for conduct of experiment and arrangements for the same.	➢ Preparation of checklist for conduct of experiment and arrangements for the same.	➢ Preparation of checklist for conduct of experiment and arrangements for the same.
➢ Soil Testing of the field before raising of plantation & necessary corrections if any.	➢ Soil Testing of the field before raising of plantation & necessary corrections if any.	➢ Soil Testing of the field before raising of plantation & necessary corrections if any.	➢ Soil Testing of the field before raising of plantation & necessary corrections if any.	➢ Soil Testing of the field before raising of plantation & necessary corrections if any.
➢ Layout plan and design of experiment plot in the field.	➢ Layout plan and design of experiment plot in the field.	➢ Layout plan and design of experiment plot in the field.	➢ Layout plan and design of experiment plot in the field.	➢ Layout plan and design of experiment plot in the field.
➢ Transplantation of sap-lings and establishment and maintenance of mulberry garden.	➢ Transplantation of sap-lings and establishment and maintenance of mulberry garden.	➢ Transplantation of saplings and establishment and maintenance of mulberry garden.	➢ Transplantation of saplings and establishment and maintenance of mulberry garden.	➢ Transplantation of saplings and establishment and maintenance of mulberry garden.
➢ Close monitoring and observation of crop and record of data in all 5 crops for four years for evaluation of the mulberry variety as per work plan.	➢ Close monitoring and observation of crop and record of data in all 5 crops for four years for evaluation of the mulberry variety as per work plan.	➢ Close monitoring and observation of crop and record of data in all 5 crops for four years for evaluation of the mulberry variety as per work plan.	➢ Close monitoring and observation of crop and record of data in all 5 crops for four years for evaluation of the mulberry variety as per work plan.	➢ Close monitoring and observation of crop and record of data in all 5 crops for four years for evaluation of the mulberry variety as per work plan.
➢ Arrangements for soil testing on completion of the experiments to ascertain the fertility status of the field.	➢ Arrangements for soil testing on completion of the experiments to ascertain the fertility status of the field.	➢ Arrangements for soil testing on completion of the experiments to ascertain the fertility status of the field.	➢ Arrangements for soil testing on completion of the experiments to ascertain the fertility status of the field.	➢ Arrangements for soil testing on completion of the experiments to ascertain the fertility status of the field.

17.3.	Proprietary / patented items, if any, expected to be used for this research project / programme.	Field evaluation of performance of Vishala mulberry variety under irrigated conditions of West Bengal will be utilized for further course of action accordingly.
17.4.	Suggested plan of action for utilization of the expected outcome from the research project / programme.	Field evaluation of performance of Vishala mulberry variety under irrigated conditions of West Bengal will be utilized for further course of action accordingly.

17.5. Time schedule of activities giving milestones :

Sl. No.	Milestone / Activity	Expected Date of		Expected Outcome / visible/ measurable indicator
		Starting	Completion	
i.	Arrangement of seed cuttings for raising of saplings	From the date of approval of the project / programme.	One month	Seed cuttings arrangements completion
ii.	Nursery bed preparation and seed cuttings plantation.		Within 45 days	Nursery bed preparation and seed cuttings planting completion
iii.	Nursery maintenance upto 3 months from the date planting for sufficient growth of saplings	46th day	135 days	Nursery maintenance and saplings ready for uprooting
iv.	Preparation of land at beneficiary farmers identified in all 23 locations for plantation.	136th day	150th days	Main plantation field preparation completion in all 23 locations.
v.	Uprooting of saplings and transplantation at beneficiary farmers identified in all 23 locations for plantation.	151st day	180th day	Completion of transplantation of saplings in all 23 locations.
vi.	Maintenance of plantation and observation of establishment characters.	181st day	365th day [1st year]	Establishment of plantation in all 23 locations
vii.	Commencement of 1st Crop of second experimental year and collection of growth/quality& productivity data.	From the date of approval of the project / programme.	73 days	Completion of 1st crop of 2nd experimental year and availability of 1 crop data.
viii.	Conduct of 2nd Crop of second experimental year and collection of growth/quality& productivity data.	74th day of commencement of the programme.	146th day	Completion of 2nd crop of 2nd experimental year and availability of 2 crops data.
ix.	Conduct of 3rd Crop of second experimental year and collection of growth/quality& productivity data.	147th day of commencement of the programme.	219th day	Completion of 3rd crop of 2nd experimental year and availability of 3 crops data.
x.	Conduct of 4th Crop of second experimental year and collection of growth/quality& productivity data.	210th day of commencement of the programme.	292nd day	Completion of 4th crop of 2nd experimental year and availability of 4 crops data.
xi.	Conduct of 5th Crop of second experimental year and collection of growth/quality& productivity data.	293rd day of commencement of the programme.	365th day [3rd year]	Completion of 5th crop of 2nd experimental year and availability of 5 crops data covering all seasons.
xii.	Commencement of 1st Crop of third experimental year and collection of growth/quality& productivity data.	From the date of approval of the project / programme.	73 days	Completion of 1st crop of 3rd experimental year and availability of 1 crop data.

xiii.	Conduct of 2nd Crop of third experimental year and collection of growth/quality& productivity data.	74th day of commencement of the programme.	146th day	Completion of 2nd crop of 3rd experimental year and availability of 2 crops data.
xiv.	Conduct of 3rd Crop of third experimental year and collection of growth/quality& productivity data.	147th day of commencement of the programme.	219th day	Completion of 3rd crop of 3rd experimental year and availability of 3 crops data.
xv.	Conduct of 4th Crop of third experimental year and collection of growth/quality& productivity data.	210th day of commencement of the programme.	292nd day	Completion of 4th crop of 3rd experimental year and availability of 4 crops data.
xvi.	Conduct of 5th Crop of third experimental year and collection of growth/quality& productivity data.	293rd day of commencement of the programme.	365th day [4th year]	Completion of 5th crop of 3rd experimental year and availability of 5 crops data covering all seasons.
xvii.	Commencement of 1st Crop of fourth experimental year and collection of growth/quality& productivity data.	From the date of approval of the project / programme.	73 days	Completion of 1st crop of 4th experimental year and availability of 1 crop data.
xviii.	Conduct of 2nd Crop of fourth experimental year and collection of growth/quality& productivity data.	74th day of commencement of the programme.	146th day	Completion of 2nd crop of 4th experimental year and availability of 2 crops data.
xix.	Conduct of 3rd Crop of fourth experimental year and collection of growth/quality& productivity data.	147th day of commencement of the programme.	219th day	Completion of 3rd crop of 4th experimental year and availability of 3 crops data.
xx.	Conduct of 4th Crop of fourth experimental year and collection of growth/quality& productivity data.	210th day of commencement of the programme.	292nd day	Completion of 4th crop of 4th experimental year and availability of 4 crops data.
xxi.	Conduct of 5th Crop of fourth experimental year and collection of growth/quality& productivity data.	293rd day of commencement of the programme.	365th day [5th year]	Completion of 5th crop of 4th experimental year and availability of 5 crops data covering all seasons.
xxii.	Commencement of 1st Crop of fifth experimental year and collection of growth/quality& productivity data.	From the date of approval of the project / programme.	73 days	Completion of 1st crop of 5th experimental year and availability of 1 crop data.
xxiii.	Conduct of 2nd Crop of fifth experimental year and collection of growth/quality& productivity data.	74th day of commencement of the programme.	146th day	Completion of 2nd crop of 5th experimental year and availability of 2 crops data.
xxiv.	Conduct of 3rd Crop of fifth experimental year and collection of growth/quality& productivity data.	147th day of commencement of the programme.	219th day	Completion of 3rd crop of 5th experimental year and availability of 3 crops data.
xxv.	Conduct of 4th Crop of fifth experimental year and collection of growth/quality& productivity data.	210th day of commencement of the programme.	292nd day	Completion of 4th crop of 5th experimental year and availability of 4 crops data.
xxvi.	Conduct of 5th Crop of fifth experimental year and collection of growth/quality& productivity data.	293rd day of commencement of the programme.	365th day [5th year]	Completion of 5th crop of 5th experimental year and availability of 5 crops data covering all seasons.
xxvii	Preparation of final report for submission / presentation to the Central Silk Board, Bangalore.	From the day of completion of 5th crop of 5th experi-mental year	30 Days	Season wise evaluation of performance of Vishala mulberry variety under irrigated conditions of West Bengal will be made available.

17.6. Project Implementing Agency / Agencies

Name of the Agency	Address of the Agency	Proposed Research Aspects	Proposed Amount [lakhs]	Cost Sharing %	
				Beneficiary	CSB
Central Silk Board.,	CSB Complex, BTM Layout, Madivala, Banagalore - 560 068.	Mulberry Crop Productivity	12.217	52.63	47.37

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 committee 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 / competent authorities and the same would be conveyed to the Department of Biotechnology before implementing the project.

g. It is agreed by us that any research outcome or intellectual property right(s) on the invention (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 to 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 the Principal Investigator

Date :

2. Signature of Co-Investigator (1)

Date :

3. Signature of Co-Investigator (2)

Date :

4. Signature of the Project Coordinator

Date :

5. Signature of the Executive Authority

Date :

PART IV : REFERENCES

Ahmed, M. 1. 1986. Effect of nitrogen fertilizer (urea) on *Morus alba* leaf yield. *Pak. J. For.***36:** 19-22.

Amanullah, Khan Bahadar Marwat, Paigham Shah, Noor Maula and Shahnaz Arifullah (2009) Nitrogen levels and its time of application Influence leaf area, height and biomass of maize planted at low and high density. *Pak. J. Bot*., 41(2) : 761-768.

Amanullah, R., A.; Khattak and Khalil, S.K. (2009) Effects of plant density and N on phenology and yield of maize. *Journal of Plant Nutrition*, 32: 246-260.

Benchamin, K.V.; Syed Nizamuddin; Sabitha, M.G. and Asis Ghosh.(1997) Mulberry cultivation techniques under water stress condition. *Indian Silk.*36(3):12-18.

Bhaskar ST, Vasantha K, Arun Shivananda MN, Janardhnan G, Ramchandra C (2001). Effect of FYM, nitrogen levels and its method of application on scented geranium (*Pelargonium graveolens*). J. Med. Arom. Plant Sci., 23: 388-391.

Bindroo, B.B.; Fotedar, R.K. and Anil Dhar (1996) Propagation of mulberry under sub tropical conditions. *Indian Silk*. 34 (9) : 11 - 13

Bose, P.C., Kar, R., Majumder, S.K., Dutta, R.N. and Bajpai, A.K. (2009). Fertilizer recommendations for targeted yields of mulberry under rainfed condition of West Bengal. *Abs*.17. p.174.

Chaturvedi, H.K. and Sarkar, A. (2000) Optimum size and shape of the plot for mulberry experiment. *Indian J. Seric.* 39 (1) : 66 - 69.

Das, P. K., Choudhary, P. C., Gupta, Y. K., Ghosh, A. and Datta, R. K., 1993, Effect of different levels of nitrogen, phosphorus and spacings on the growth, yield and nutritional quality of mulberry under rainfed conditions. *Indian Journal of Sericulture*, 32(2) : 201-207.

Dayakar Yadav, B.R. 2011. Mulberry varieties for diversified climate. Indian Silk 01 (9) :12- 17.

Dubois, M.K.; Giller,K.A.; Hamilton,K; Relers,P.A. and Smith,F. (1956) Calorimetric methods for determination of sugars and related substances. *Ann. Chem.* 28 : 350 - 356.

Fang Chen and Jianwei Lu (2006) Identifying Gaps in Mulberry Fertilization in Hubei Province Better Crops (4) : 29-31

Greef,J.M.; Ott,H; Wulfes, R. and Taube, F. (1999) Growth analysis of dry matter accumulation and N uptake of forage maize cultivars affected by N supply. *J.Agric. Sci.,* 132 : 31-43.

Hamid,A. and Nasab,A.D.M. (2001) The effect of various plant densities and N levels on phenology of two medium maturity corn hybrids. *Iranian J. Agric. Sci.,3*2 : 857-874.

Islam, R., M. A. Bari and R. Ali. 1985. Effect of nitrogen, phosphorus and potassium and their combination on the leaf yield of mulberry. J. *Asiatic Soc. Bangladesh (Sc.).* **11:** 1-5.

Islam, R., M. A. Bari and Z. Ahsan. 1982. Effect of different levels of fertilizers on leaf yield of mulberry under the irrigated condition. *Bangladesh J. Agric.* **6-7:** 25- 30.

Jiang, S. (1993). *Bull. Seric. 24 (1); 10-13 (Chinese).*

Kar, R. Dutta, R.N. and Majumdar, S.K. (1997) Effect of different levels of N, P and K on leaf yield and nutrient uptake pattern of mulberry (*Morus alba* L.) , *Indian Agriculturist*, 41(1) : 9.

Kar, R. Majumdar, S.K. Dutta, R.N. Bose P.C. and Ghosh J.K. (2000), Nitrogen fertilizer recommendation for mulberry (*Morus alba* L) for two soil types based on Mitscherlich-Bray concept". *Indian Journal of Sericulture*, 39(1): 33.

Kasiviswanathan, K. and M. N. Sitarama Iyengar. 1970. Effect of plant densities, methods of leaf harvest and nitrogen fertilization on the leaf yield of irrigated mulberry in Mysore State. *Indian J. Seric.* **9:** 43-48.

Kasiviswanathan, K. and M. N. Sitarama lyengar. 1966. Effect of NPK manuring on seasonal and total yield of mulberry. *Indian J. Seric*. **5:** 46-51.

Kasiviswanathan, K. and M. N. Sitararna lyengar. 1969. Varietal-cum irrigational response to different N levels on the seasonal and total yield of mulberry. *SIB,* **1:** 1-12.

Kasiviswanathan, K., S. Krishnaswami and C. V. Venkataraman. 1977. Studies on varietal-cum spacing and nitrogen fertilization on the leaf yield of mulberry under irrigated conditions in Karnataka. India. *Indian* J. *Seric.* **16:** 10-18.

Kasiviswanathan, K., S. Krishnaswami and P. C. Chowdhury. 1979. Long-term studies on the variety, spacing and nitrogen fertilization for the improvement of yield potential of mulberry. *Indian J Seric.* **18:** 23-29.

Kasiviswanathan. K. and M. N. Sitarama Iyengar. 1965. Preiliminary observation on varietal cum irrigational response to different levels of N on the seasonal and total yield of mulberry *leaf. Indians J. Seric.***4:** 4-10.

Lowry, O.H.; Rosebrough, N.J.; Farr,A.L. and Rankled, R.J. (1951) Protein measurement with folin phenol reagent. *J. Biochem*., 193 : 265 - 275.

Lu Jian-wei, Xiong Jian-ping, and Chen Fang. 2004. Hubei Agricultural Sciences, (1): 59-62.

Mahadevan, A and Sridhar, R. (1986) Methods in physiological and plant pathology. 3rd Edition. Sivakami publication, Madras, India - 600 020.

Mariga,I.K.; Jonga,M and Chivinge, O.A. (2000) The effect of timing of application of basal and top dressing fertilizers on maize (*Zea mays* L.) yield at two rates of basal fertilizer. *Crop Res.* 20 : 372-380.

Mehdi Dahmardeh (2011) Effect of plant density and nitrogen rate on PAR and maize yield. *American J. of Plant Physiol.* 6 (1) : 44-49.

Miah, M. A. B. 1989. Studies on the growth and yield of mulberry *(Morus alba* L.). Ph.D. Thesis. University of Rajshahi, Bangladesh.

Miyashita, V. (1986) A report on mulberry cultivation and training methods suitable to bivoltine rearing in Karnataka, Central Silk Board, Bangalore, India.

Mohan Doss S, Sampath V (1983). Efficacy of foliar feeding of nitrogen on foliage and oil yield in geranium. Indian Perfumer. 27: 9-11.

Mukherjee, S. K. and D. Sengupta. 1978. Studies on fertilizer, varieties, spacing, pruning and irrigation on mulberry leaf yield. *Annual Report. Central Sericulture Research and Training Institute, Berhampur, India,* 61-69.

Pain, A. K. 1965. Effect of NPK fertilizers and their combinations on the yield and nutritive value of mulberry. *Indian J. Seric.* **4:** 1-8.

Ray, D.; Mandal,L.N.; Pain,A.K. and Mondal,S.K. 1973. Effect of NPK and Farm Yard Mannure on the yield and nutritive value of mulberry leaf. *Indian J. of Seric.* 12 (1)7 - *12.*

Ray, D. 1978. Effect of different doses of ammonium sulphate and lime on soil composition, leaf yield and nutritive value of mulberry leaf. Annual Report. Central Striclure Research and Training Institute, Berhamapur, India. 51 -*55.*

Sarkar, A and Mallikarjuna, B (2002) Mulberry - a heavy feeder? Indian Silk 40 (10) : 12-14.

Sinha, P.S.; Gangwarz, S.K.; Singh, B.D.; Jaiswal, J. and Griyaghey, U.P. (2001) Evaluation of some elite mulberry *(Morus alba* l.) Varieties and NPK levels under partially irrigated conditions from sericulture view point. *Indian J Agric. Res.,* 35 (2) : 71 – 78.

Subbarayappa, C. T., A. K. Sinha, P. Sandareswaran, N. R. Singhvi and R. K. Datta. 1994. Effect of split doses of fertilizers on yield of mulberry leaves. *Indian J. Seric.* **33:** 72-73.

Sukhatme, P.V. and Amble, V.N. (1985) Statistical methods for agriculture workers. Published by Publications and Information Division, Indian Council of Agricultural Research, New Delhi.

Tan Shun-you, Li Zhang-bao, and Lin Gao-tang. 1997. Sericulture of Hunan, (1): 7-9.

Tikader, A. and Thangavelu, K. 2003. Maintenance of mulberry germplasm and utilization, Recent trends in Tropical Sericulture Technologies. UGC Sponsored Seminar Organized by the Department of Zoology, Sri Sarada College for Women (Autonomous) Accredited with Four Stars by NAAC., Salem - 636 016 Tamil Nadu. 131 – 141.

Ushioda, T., 1954, Soil and fertilizer for mulberry plantation. *Synthesized Science of Sericulture*, Chousansi Kvokai Tyohobn, Tokyo, pp. 12-38.

Vijaya, D.; Yeledhalli, N.; Aravl, . M. V.; Nagangoud, A. and Nagalikar, V. P. (2009) Effect of fertilizer levels and foliar nutrition on M-5 mulberry leaf nutrient content, quality and cocoon production. *Karnataka J. Agric. Sci., 22 (5) : 1006-1012.*

Vijayan, K.; Reghunath, M.K.; Das, K.K.; Tikader, A.; Chakraborthy, S.P.; Roy, B.N. and Quadri, S.M.H. (1997) Studies on leaf moisture of mulberry germplasm varieties. *Indian J. Seric.* 36 (2):155 - 157.

Wang Bo, Dai Xuan-yin, and Ding Rue. 2001. Sericulture of Jiangsu, 3 (1): 13-15.

Wang Ze-lin1, Chen Ji-jiu2 (2009) *Bulletin of Sericulture* : 04

Yokoyama, T., 1962, Sericulture, *Annual Review of Entomology*, 18 : 287-288.

Zhiyi Ye *Factors influencing mulberry leaf yield* Bulletin of Sericulture : 2000-01 www.fao.org/ag/aga/agap/frg/Mulberry/Posters/Pdf/Zhiyi.pdf.