

SERICULTURE TECHNOLOGY DESCRIPTOR FOR NORTH AND NORTH-WEST INDIA



CENTRAL SERICULTURAL RESEARCH
AND TRAINING INSTITUTE

CENTRAL SILK BOARD, MINISTRY OF
TEXTILES, GOVT OF INDIA, GALANDER
PAMPORE - 192121 JAMMU & KASHMIR,
INDIA



SERICULTURE TECHNOLOGY DESCRIPTOR

FOR NORTH & NORTHWEST INDIA

**Central Sericultural Research & Training Institute
Central Silk Board
Ministry of Textiles
Govt. of India
Pampore-192121, J&K, India**

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ABOUT CSB-CSR&TI, PAMPORE

The Central Silk Board (CSB), Government of India, established the **Central Silkworm Seed Station at Pampore, Kashmir (J&K)** in **1958** with the mandate of maintaining exotic and indigenous univoltine and bivoltine silkworm races. In response to the increasing demand for research and development (R&D) support in sericulture, the Seed Station was upgraded to the **Regional Sericultural Research Station (RSRS)** in **1980–81**. Subsequently, to strengthen scientific interventions and address the growing technological requirements of the sericulture sector in Jammu & Kashmir (J&K) and other North Indian states, RSRS was further elevated to the **Central Sericultural Research & Training Institute (CSR&TI)** in **March 1991**.

The Institute has been mandated to address the diverse technological requirements of sericulture in **North and Northwest India**, regions characterized by a wide spectrum of climatic conditions ranging from **subtropical and intermediate to temperate zones**. Such heterogeneity in agro-climatic conditions necessitates the development and dissemination of region-specific technologies to enhance productivity, sustainability and quality of raw silk production. Over the years, the Institute has successfully developed and commercialized a range of need-based technologies, many of which are widely adopted and transferred to the field through collaboration with the Departments of Sericulture (DoSs). The cumulative impact of these interventions has been significant, resulting in over **47% increase in raw silk production under the Silk Samagra-2 programme (2021-2025)**.

Some notable achievements of the institute are Development of package of practices for **mulberry tree cultivations** for temperate

and subtropical conditions, release of **PPR-1, a high-yielding mulberry variety** specifically bred for temperate climatic conditions, which has demonstrated remarkable adaptability and productivity. The Institute also pioneered the development of the **world's first somatic hybrids of mulberry (SH2 and SH3), representing a breakthrough in mulberry improvement through cellular hybridization**. These innovations have strengthened the genetic base of mulberry and provided new avenues for crop improvement.

In silkworm breeding, the Institute has developed regionally suitable bivoltine hybrids, with **SH6 × NB4D2 emerging as a ruling hybrid in North and Northwest India**. In addition, **eight more hybrids** are presently undergoing advanced stage evaluation, reflecting the Institute's continued emphasis on genetic enhancement and hybrid development for better silk yield and quality.

Technologies for mulberry cultivation have also been standardized, including **nursery raising methods for subtropical regions, grafting protocols for improving rooting in poor-rooting mulberry varieties under temperate conditions, and innovative cultivation models such as high-bush (tree) and medium-bush (dwarf) plantation systems**. These methods not only enhance productivity but also optimize land use under different agro-climatic conditions. The **pruning technology for multiple cropping systems** has enabled higher leaf yield per unit area, supporting intensive silkworm rearing practices.

On the silkworm rearing front, the Institute has developed **model rearing house designs for marginal and small farmers, improved rearing & mounting stand technologies** to ensure hygienic, scientific and efficient cocoon production. Furthermore, **integrated pest and disease management (IPDM) modules** have been formulated to minimize crop losses and reduce dependence on chemical interventions, thereby promoting **eco-friendly sericulture**.

A significant intervention has also been the **fortification of mulberry leaves**, which has proven effective in **stabilizing the autumn crop**.

Collectively, these technological advancements underscore the Institute's pivotal role in advancing region-specific sericulture technologies. The outcomes have substantially contributed to enhancing productivity, reducing crop vulnerability and ensuring the commercial viability of sericulture across diverse agro-climatic regions of North and Northwest India.

In recent years Institute has conceptualized and implementing innovative developmental projects like Development of **mulberry plantation on sideways of National Highways, Seri- Tourism**, and mulberry plantation on forest land for expanding sericulture base in the region. There is a pressing need to **systematically document, evaluate, and refine** the developed technologies to ensure sustained growth and competitiveness of sericulture in north and northwest India where sericulture is a subsidiary occupation with limited cropping patterns.



केन्द्रीय रेशम बोर्ड CENTRAL SILK BOARD
(वस्त्रमंत्रालय, भारत सरकार Ministry of Textiles -
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MESSAGE



It gives me immense pleasure to note that the CSB-Central Sericultural Research & Training Institute (CSB-CSR&TI), Pampore, is bringing out a comprehensive Technology Descriptor showcasing the diverse sericulture technologies developed over the years.

Sericulture in North and North-West India has witnessed remarkable transformation owing to the concerted efforts of CSB-CSR&TI, Pampore, in developing region-specific, cost-effective, and innovative technologies. These advancements have not only enhanced the productivity and quality of silk but have also significantly improved the socio-economic conditions of farming communities, especially in temperate and sub-tropical regions.

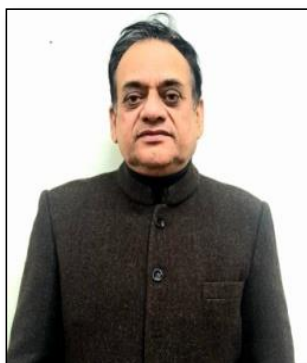
The documentation of these technologies will serve as a valuable resource for researchers, development departments, entrepreneurs and farmers. It will facilitate wider dissemination and adoption, thereby strengthening the sericulture sector in alignment with the Silk Samagra vision and the national goal of enhancing bivoltine silk production.

I congratulate the Director, scientists and staff of CSB-CSR&TI, Pampore, for their dedicated efforts in bringing out this publication and wish them continued success in their endeavours towards sustainable growth of sericulture in the country.

Warm regards,

[P.SIVAKUMAR, IFS]
Member Secretary and
CEO, Central Silk Board,
Ministry of Textiles, Government of India

FOREWORD



Sericulture, the art and science of silk production, occupies a unique place in India's agricultural and economic landscape. The North-West region, with its diverse agro-climatic conditions, presents both opportunities and challenges for this vital industry. Over the years, the region has made commendable progress through innovative technologies, refined methodologies, and the dedication of the sericulture community.

This book provides a comprehensive overview of technologies and practices tailored to the needs of North-West India. It covers mulberry cultivation, silkworm rearing, disease management, and post-harvest technologies, thereby presenting the entire spectrum of sericultural activities. I congratulate the authors and contributors for their dedication in bringing this work to fruition. I am confident that it will act as a cornerstone for future research and development while inspiring innovation and excellence in the field.

I also wish to acknowledge the contribution of all earlier scientists and Directors of the Institute, guidance of the Research Advisory Committee (RAC) and the Research Coordination Committee (RCC) of the Central Silk Board. My sincere thanks go to the Sericulture Development Departments of Northern and North-Western states for their cooperation and to Shri P. Sivakumar, IFS, Member Secretary, Central Silk Board, for his continuous support and his guidance.

It is with pride that I present this book to the sericulture community. May it guide, inform, and inspire efforts to strengthen this vibrant industry in North-West India.

A handwritten signature in black ink, appearing to be 'Sardar Singh'.

[Sardar Singh]

Director,
CSB-CSR&TI, Pampore

PREFACE

The Central Sericultural Research & Training Institute (CSB-CSR&TI), Pampore, was established in March 1991. Owing to the disturbances in the Kashmir Valley during the early years, the Institute initially functioned from Jammu as a camp office. Research activities at the main campus in Pampore were revived in 1994, marking the beginning of a new era in sericulture research and development in the region.

Over the years, CSB-CSR&TI Pampore has evolved into a premier centre of excellence and an international hub for research and training in mulberry sericulture science and technology. The Institute has been serving the technological needs of the farming community in North and Northwest India.

Through the dedicated efforts of its scientists and staff, the Institute has developed high-yielding mulberry varieties, superior silkworm breeds producing quality silk, cost-effective methods of mulberry cultivation, effective pest and disease management strategies and innovative labour-saving rearing techniques. These advancements have transformed sericulture from a marginal subsidiary occupation into a profitable farm-based enterprise, attracting many new farmers across North and Northwest India.

This descriptor presents a comprehensive account of the mulberry and silkworm rearing technologies developed by CSB-CSR&TI Pampore and highlight their adoption levels in the field. A detailed list of the technologies along with salient features and field impact has been given in this compilation.

Editors



ORGANIZATIONAL SETUP



CSB-CSR&TI, Pampore (J&K)



CSB-RSRS, Jammu (J&K)



CSB-P4,BSF, Manasbal (J&K)



CSB-RSRS, Sahaspur (UK)



CSB-REC -Ghumarwin (HP)



CSB-REC -Lamberi, Rajouri (J&K)



CSB-REC - Basti (UP)

S.NO	TECHNOLOGY	YEAR OF RECOMMENDATION	PAGE NO
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TECHNOLOGIES FOR CULTIVATION/ IMPROVEMENT OF MULBERRY

TEMPERATE MULBERRY VARIETY: PPR1

(Selection from *Goshoerami* × *Chinese whitecross*)

YEAR OF RECOMMENDATION: 2016

Scientists Associated: Shamim Baksh, Aftab Ahmad Shabnam, Anil Dhar, R.K. Fotadar, Rajeev Lochan, S.S. Chauhan and M.S. Rathore

Salient Features

Phenology:

- Exhibits *early sprouting after winter dormancy*, with 50-55% sprouting observed by the end of March, compared to only 0-1% in *Goshoerami*.

Nutritive Quality:

Possesses a *high nutritive profile* with:

- Moisture content: **75.9%**
- Moisture Retention Capacity (MRC): **89.64%**
- Total soluble protein: **57.19 mg/g dry weight**
- Total soluble carbohydrate: **397.22 mg/g dry weight**

Rooting Ability:

- Demonstrates *>90% rooting success*, in contrast to *<20% rooting* in *Goshoerami*.

Stress Tolerance:

- Shows *moderate tolerance to frost*, with only *10-15% damage* recorded compared to *35-40% damage* in *Goshoerami*.

Yield Potential:

- Dwarf plantation (6' × 3' spacing): 26-30 MT/ha/year
- Tree-type plantation (9' × 8' spacing): 15-18 MT/ha/year

Adaptation

- Recommended for *temperate climatic regions* of Jammu & Kashmir



Field Impact

- Completion of All India Coordinated Experimental Trial for Mulberry (AICEM-IV).
- Under popularization under Temperate climatic conditions of Jammu and Kashmir.

SOMATIC HYBRIDS (SH2 AND SH3) OF MULBERRY

YEAR OF RECOMMENDATION: 2019

Scientists Associated: Gulab Khan Rohela, Aftab Ahmad Shabnam, Azra Nahaid Kamili, Pawan Saini, Ashok Kumar K, S Syam and Sardar Singh

Somatic hybrids were evolved in three combinations—SH1 (PPR1 - Ichinose), SH2 (PPR1 - Chinese White), and SH3 (PPR1 - PPR1)—through *protoplast isolation*, *protoplast fusion*, and *plant regeneration* techniques.

Salient Features

- ✦ The Primary Yield Trial (PYT) conducted in 2022-2025 demonstrated encouraging results across all hybrids. SH2 and SH3 performed on par with, or better than, elite control varieties in terms of leaf yield and agronomic traits.
- ✦ SH2 exhibited higher total soluble carbohydrate and protein levels, enhancing nutritional quality for silkworm feeding.
- ✦ Bioassays with Bivoltine Double Hybrid (FC1×FC2) silkworms confirmed the hybrids' suitability for rearing.
- ✦ SH2 excelled in pupation rate and silk yield, while SH3 showed superior cocoon and reeling traits.
- ✦ Both hybrids demonstrated strong potential for commercial sericulture, combining agronomic advantages with enhanced silkworm rearing performance.



SH2
(PPR1-CHINESE WHITE)



SH3
(PPR1-PPR1)

Field Impact

The hybrids will undergo Final Yield Trials (FYT) for multi-location validation and the most promising lines will be recommended for commercial adoption and utilized as parental material in future mulberry breeding programmes.

PROMISING MULBERRY GENOTYPES (S-146 AND S-1635) FOR SERICULTURE IN HIMACHAL PRADESH

YEAR OF RECOMMENDATION: 2010

Scientists Associated: Rajat Mohan and Sardar Singh

Salient Features

- Two mulberry genotypes, **S-146** and **S-1635**, were identified as promising varieties suitable for diverse eco-zones of Himachal Pradesh.
- Both genotypes are adaptable for **tree (High bush) form** plantations at altitudes ranging from **1000 to 4000 ft** above mean sea level.
- Recorded an average **leaf yield of 9-10 t/ha/year** from five-year-old trees under rainfed conditions, with **three harvests annually**.
- Exhibited **stable performance** across varied agro-climatic conditions of the state.

Field Impact

- Enhanced **leaf availability** and contributed to **higher cocoon productivity**, leading to increased farmer income in hill regions.
- Facilitated the **expansion of sericulture** into non-traditional mulberry belts of the state.
- Currently under **widespread commercial utilization** through the Department of Sericulture, Himachal Pradesh.



MULBERRY GENOTYPES RECOMMENDED FOR DIFFERENT AGRO-CLIMATIC CONDITIONS OF UTTARAKHAND AND UTTAR PRADESH

YEAR OF RECOMMENDATION: 2009

Scientists Associated: Rajat Mohan, V. K. Awasthi, P.N. Mishra, M. M. Bhat and M. A. Khan

Salient Features

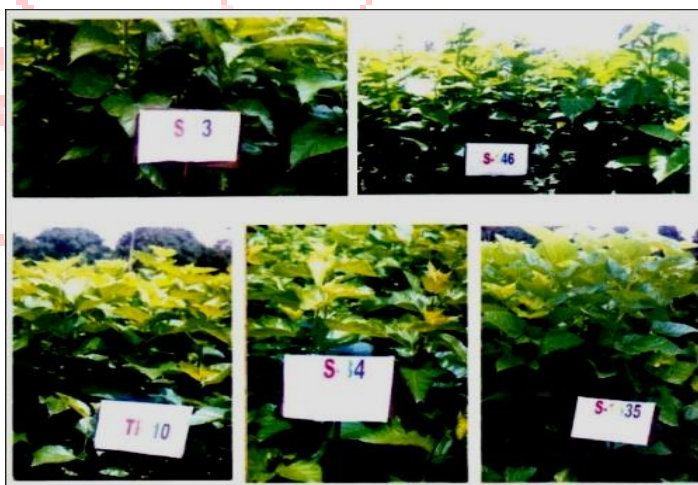
- Field evaluation of mulberry genotypes under varied soil conditions in Uttarakhand revealed significant differences in leaf yield across regions:
 - ✓ **Doon Valley/Foothills:** Genotype S-146 recorded the highest yield (15 t/ha) followed by S-13 and S-34 (14 t/ha each) in two harvests.
 - ✓ **Sodic Soils:** Genotype AR-14 performed best (6.26 t/ha) followed by S-1635 (6.20 t/ha) in two harvests.
 - ✓ **Tarai Regions:** S-146 again showed superiority (14 t/ha) followed by S-13 (13 t/ha) and S-635 (12 t/ha).

Recommended Zones:

- ✚ **S-146:** Doon Valley/Foot Hills and Tarai regions of Uttarakhand
- ✚ **AR-14:** Sodic soils
- ✚ **S-13/S-34/S-635:** Suitable alternatives for respective regions

Field Impact

- ✚ Adoption of region-specific mulberry genotypes ensures higher leaf yield compared to existing practices, contributing to enhanced cocoon productivity.
- ✚ The survival of identified varieties is 75% in the sodic soils with pH ranging from 8.7 to 9.7



GRAFTING TECHNIQUE FOR MULBERRY PROPAGATION UNDER TEMPERATE CONDITIONS

YEAR OF RECOMMENDATION: 1997

Scientists Associated: Shamim Baksh and Mushtaq Rasool Mir

Salient Features

- ✚ A novel grafting technique for the propagation of poor-rooting genotypes of mulberry (*Morus* spp.). Hardwood stem cuttings from high-rooting genotypes are used as rootstock. This reduces the time to raise planting material in the temperate conditions of the Kashmir valley from 4-5 years to 2-3 years.
- ✚ Under temperate conditions, the technique has shown a graft success rate of about 80% in Goshomerami. It also enables productive use of hardwood cuttings from good-rooting genotypes that are otherwise discarded after removing shootlets for spring silkworm rearing.
- ✚ The technology has been disseminated through field demonstrations for Department of Sericulture (Kashmir) staff, ensuring practical adoption at scale.
- ✚ Recommended for raising saplings of poor-rooting genotypes under temperate climatic conditions of Jammu & Kashmir.



Field Impact

The technology is mostly adopted by the Sericulture Development Department (J&K) for raising poor rooting mulberry varieties with more than 78% survival.

MULBERRY NURSERY TECHNOLOGY FOR SUB-TROPICAL CONDITIONS OF NORTH AND NORTHWEST INDIA.

YEAR OF RECOMMENDATION: 1997

Scientists Associated: Anil Dhar

A scientifically standardized **nursery-raising technique** for the **monsoon season** has been developed to ensure the **availability of quality mulberry saplings** during **winter**. The method effectively addresses the major constraint of **cutting decay under high-moisture conditions** prevalent during monsoon periods.

Salient Features

- ✚ **Genetic fidelity:** Ensures **perpetuation of parental characters** through vegetative propagation.
- ✚ **Efficiency:** Significantly **reduces the time requirement** for sapling production compared to conventional methods.
- ✚ **Economics:** The technique is **cost-effective**, making it suitable for large-scale adoption.

Field Impact

- ✚ Successfully adopted for the establishment of Kisan Nurseries in North and Northwest India.
- ✚ Under commercial exploitation through Departments of Sericulture across North and Northwest India for sustainable sapling production and supply.



MULBERRY TREE (HIGH BUSH) CULTIVATION TECHNOLOGY FOR NORTH INDIA

Year of Recommendation: 1995

Scientists Associated: Anil Dhar , A.C. Juyal and B.B. Bindroo

Salient Features

- ✚ **Planting Material:** Healthy, disease-free saplings with an average height of 180 cm and basal girth of 5 cm should be selected and planted during spring (March).
- ✚ **Mulberry Varieties:** Goshorami, S-146, KNG and Tr-10 are suitable genotypes for this system.
- ✚ **Spacing:** A spacing of 2.4 m × 2.7 m ensures adequate sunlight interception, aeration and canopy development.
- ✚ **Planting System:** Pit Size 1 ft × 1 ft × 1 ft dimensions recommended for proper root establishment.
- ✚ **Planting Medium:** Each pit should be filled with 2-3 kg of well-decomposed FYM or compost to improve soil fertility and moisture retention.
- ✚ **Training of Saplings:** An apical cut at a height of 150-170 cm should be made after planting to encourage lateral branching, followed by pruning after one year.
- ✚ During the first year, retain only 4-5 topmost lateral branches for canopy formation.
- ✚ In the subsequent spring, top-clip these primary branches and allow only three uppermost lateral shoots on each branch for crown development.
- ✚ **Precautions:** Careful uprooting of saplings is essential to minimize root injury.
- ✚ Adequate irrigation should be provided immediately after planting to maintain soil moisture.
- ✚ Use sharp and sterilized pruning tools (e.g., secateurs) to avoid mechanical damage and pathogen entry.



Goshorami



TR-10



S-146

Field Impact

Farmers in North & North West India with limited land holdings prefer tree mode of mulberry for plantation on agriculture land boundaries, bunds, river bunds & roadsides. Such type of plantation has shown higher survivability as compare to other mode of plantations. The survivability of mulberry tree plants in the field is reported from 75-80%.

PRUNING TECHNOLOGY FOR MULBERRY TREE (HIGH BUSH) CULTIVATION

YEAR OF RECOMMENDATION: 2009

Scientists Associated: Anil Dhar and A.C. Juyal

Salient Features

Pruning Schedule:

- + Bottom pruning in the first fortnight of June, followed by top clipping in March under temperate conditions.
- + Bottom pruning in mid July, followed by middle level pruning during second fortnight of December under subtropical conditions.
- + Repeated bottom pruning should be avoided to prevent stress on plants.

Leaf Harvesting Strategy:

- + Harvest shootlets up to the 4th instar stage and conduct shoot harvesting during the 5th instar stage of silkworm rearing in the spring season.
- + During autumn, harvest only 50% of leaves through individual leaf plucking. This ensures adequate leaf availability for the main rearing season in spring under temperate conditions.

Yield Improvement:

- + 20% gain in leaf yield during autumn and 40% gain in spring, with an overall gain of 30% compared to control practices.
- + Significant improvement in leaf quality can be achieved by adopting the recommended pruning schedule.

Advantages

- + Enhanced leaf yield and improved leaf quality.
- + Better plant shape maintenance for long-term productivity.
- + Synchronization of leaf availability with silkworm rearing requirements.



Field Impact

Adopted by farmers across North and Northwest India. Under commercial exploitation through Departments of Sericulture in North and Northwest India.

RESCHEDULED PRUNING AND BRUSHING TECHNOLOGY FOR STABILIZATION OF SECOND COMMERCIAL COCOON CROP IN KASHMIR

YEAR OF RECOMMENDATION: 2022

Scientists Associated: Gulzar Ahmad Khan, Gulab Khan R, Haroon Rashid, Kamlesh K. Rai, Babulal.

Salient Features

- Standardized pruning and brushing schedule formulated specifically for early autumn rearing under temperate climatic conditions of Kashmir.
- Brushing rescheduled 10-15 days earlier (5th-10th August) instead of the traditional date of 20th August.
- Optimized package developed for both **Chawki** and **late-age silkworm rearing**.
- Ensures better synchronization of silkworm brushing with availability of optimum quality mulberry leaf.
- Aimed at stabilizing the **second commercial cocoon crop** in the valley for sustainable bivoltine sericulture.
- Technology recommended for **on-station and on-farm testing (OST/OFT)** at larger scale before widespread field adoption.

Field Impact

- Enhances utilization of the autumn season by enabling successful rearing of a **second commercial crop**, improving annual cocoon productivity.
- Results in **better leaf-silkworm synchronization**, leading to improved larval health and uniform growth.
- Potential to increase **cocoon yield and quality**, thereby enhancing **farmers' income**.
- Offers a **climate-resilient schedule** adaptable to temperate zones, reducing the risk of crop failure in the second season.
- Provides a pathway to achieve **two stable commercial crops annually** in Kashmir, boosting regional raw silk output.



Development of Mulberry (*Morus* spp) Plantation on National Highways on the sides of carriageways in Uttarakhand

YEAR OF COMMENCEMENT: 2023

Scientists Associated: Sardar Singh, S.S. Chauhan and Chhattar Pal

Salient Features

- ✚ **Mulberry plantations on carriageways of Highways:**
 1. To develop mulberry (*Morus* spp.) Tree reserve in identified stretch on carriageways of NHAI.
 2. To explore sericulture based livelihood opportunity for the farmers residing on sides of carriageways
- ✚ **Economic Potential:** Green highway and scope of utilization of mulberry leaves from third row of plantation for silkworm rearing.
- ✚ **Silkworm Rearing Trial (Spring 2025):** The Trial crop undertaken during spring 2025 has demonstrated commercially standard cocoon quality with a 21.13% shell ratio, 82.32% reelability, 614 m filament length, and 2.79 denier, demonstrating the viability of highway-based mulberry plantations for quality silk production.

Field Impact

- ✚ Demonstrated feasibility of mulberry plantations along National highway stretches as a viable model for green highway and sericulture-based livelihood generation.
- ✚ **Established:** A replicable model is established on NH 72A-&73. NH 125 and NH 74 under RO NHAI Dehradun .
- ✚ **Green Highways :** Mulberry has a long life span and to contribute freshness and green cover to the environment for many years
- ✚ **Beautification:** Mulberry canopy gives a beautiful green look and will increase the beauty of our National Highways.
- ✚ Enabled Scope for income diversification for local farmer groups through sustainable sericulture practices.



AGRO-BASED MODEL OF MULBERRY TREE (HIGH BUSH) PLANTATION

YEAR OF RECOMMENDATION: 2017

Scientists Associated: Sardar Singh, Chhattar Pal, Sanstosh M.

Salient Features

- ✚ Agro-based model of mulberry tree cultivation *integrated with traditional cereal crops like wheat, maize* is a sustainable option for enhanced farm income through Sericulture
- ✚ The integration of mulberry tree plantation with existing crops offers a viable strategy for augmenting farmers' income without requiring additional land resources.
- ✚ Through the adoption of this agro-based model, farmers can potentially double their income within **3-4 years** of implementation. Economic projections indicate that, from the **fifth year onwards**, farmers can realize up to **45% additional income** over and above the returns from conventional crop cultivation alone.

Field Impact

This model is currently under **commercial exploitation** by Departments of Sericulture in **Northwest India**, following its successful demonstration and validation under the ToT initiatives of CSB-CSR&TI, Pampore.



INTERCROPPING MODELS WITH MULBERRY FOR ENHANCED PRODUCTIVITY, PROFITABILITY AND SUSTAINABILITY

YEARS OF RECOMMENDATION& SCIENTISTS ASSOCIATED:

- **Leguminous Crops (Tarai, Uttaranchal & UP) - 2003** (P. K. Singh, Ramakant, S. Chakrabarti)
- **Medicinal Plants with Mulberry - 2010-2012** (P. K. Srivastava, Ranjan Tewari, Pratap Narayan, M. M. Bhat, P. K. Singh, M. A. Khan)
- **Saffron Intercropping (Temperate conditions, Kashmir) - 1994-1999** (Rajinder Kour, Sadaf Nazir)

Salient Features

✚ Legume Intercropping

- ✓ Mulberry planted at 8' × (2' × 2') spacing, utilizing 8 ft inter-row gaps for legumes.
- ✓ Recommended pattern: (8'+2') × 2'.
- ✓ Cropping sequence: Lentil/Gram (Rabi) and Moong/Urad (Kharif).
- ✓ Enhanced mulberry leaf yield and improved soil fertility through biological nitrogen fixation.

✚ Medicinal Plant Intercropping

- ✓ Mulberry intercropped with high-value medicinal crops.
- ✓ Increase in leaf yield per plant recorded as:
 - ❖ *Asparagus racemosus*: +26%
 - ❖ *Plumbago zeylanica*: +10%
 - ❖ *Rauvolfia serpentina*: +4%

✚ Saffron Intercropping

- ✓ Mulberry-saffron model developed under temperate conditions (Kashmir).
- ✓ Provided dual returns from mulberry leaves (for silkworm rearing) and saffron (as a premium cash crop).



Field Impact

✚ Economic Returns:

- ✓ Legume intercrops generated ₹35,985/ha additional income besides sericulture.
- ✓ Medicinal crops and saffron provided diversified and high-value income sources.

✚ Soil Health & Sustainability:

- ✓ Legumes improved soil fertility and nitrogen status.
- ✓ Organic and sustainable practices promoted long-term mulberry productivity.

✚ Farmer Livelihood Security:

- ✓ Multiple crop choices reduced income risk.
- ✓ Created integrated farming systems blending food, medicinal and cash crops with mulberry for silk production.

VERMICOMPOSTING TECHNOLOGY FOR SERICULTURE

YEAR OF RECOMMENDATION: 2008-2009

Scientists Associated: A. C. Juyal, P. K. Singh, S. S. Tomar, M. M. Bhat, B. K. Singhal and Anil Dhar

Salient Features

✦ Suitable Species

- ✓ *Eudrilus eugeniae* identified as the most efficient earthworm species for subtropical and tropical regions.
- ✓ Other effective species: *Eisenia foetida* and *Perionyx excavatus*.



✦ Technology Standardization

- ✓ Vermicomposting protocol standardized using seri-agro organic waste, sericulture by-products, farm residues, horticulture waste, and livestock dung.
- ✓ Optimized process ensures rapid biodegradation and high-quality organic manure production.



✦ Infrastructure Requirement

- ✓ Vermi-pits of 7.5 × 2.5 × 1.5 ft recommended.
- ✓ Can be constructed with raised pucca walls or simple polythene-lined bases, depending on farmer resources.

✦ Cost Economics

- ✓ Initial investment: ₹3,000 (using family labour).
- ✓ Net income: ₹4,500 in the first year and ₹15,000 annually from the second year onwards through sale of vermicompost and earthworms.

Field Impact

- ✦ Provided a **low-cost, sustainable recycling technology** for sericulture waste.
- ✦ Reduced dependence on chemical fertilizers through production of **organic manure**.
- ✦ Generated **supplementary income** for farmers from both vermicompost and earthworm multiplication.
- ✦ Enhanced **soil fertility and crop productivity** in mulberry plantations.
- ✦ Contributed to **eco-friendly waste management** in sericulture-based farming systems.

ORGANIC FARMING OF MULBERRY IN DOON VALLEY

YEAR OF RECOMMENDATION: 2010

Scientists Associated: P.K. Singh, S. S. Tomar and M. M. Bhat.

Salient Features

- ✚ **High Leaf Yield:**
 - ✓ **Tree type:** Increased from 8.41 to 9.93 t/ha/year under organic package
 - ✓ **Bush type:** Increased from 16.41 to 18.99 t/ha/year
- ✚ **Effective Organic Package (T-2):**
 - ✓ Combination of Seri-waste, Dhaincha green manuring (*Rhizobium* inoculated), FYM, vermicompost, rock phosphate, liquid bio-boost and bio-potash.
- ✚ **Improved Cocoon Production:**
 - ✓ **Highest ERR by number:** 9,833 larvae (trees) and 8,780 larvae (bushes)
 - ✓ **Enhanced reelability:** 90.24% (trees) and 90.92% (bushes)
- ✚ **Eco-friendly & Sustainable:**
 - ✓ Organic inputs utilized with recycling of sericultural waste and biofertilizers.

Field Impact

- ✚ The package has been circulated to DoS, Uttarakhand and Uttar Pradesh and is under commercial **exploitation** through DoSs.



AZOTOBACTER-BASED BIOFERTILIZATION FOR SUSTAINABLE MULBERRY NURSERY MANAGEMENT UNDER TEMPERATE CONDITIONS

YEAR OF RECOMMENDATION: 2005

Scientists Associated: Rajinder Kour, Mushtaq Rasool Mir, Sadaf Nazir and M. A. Khan.

Salient Features

- ✚ Enhances nutrient uptake and restores soil fertility in mulberry nurseries.
- ✚ Offers a cost-effective and eco-friendly substitute for chemical fertilizers.
- ✚ Reduces nitrogen fertilizer requirement by up to **50%**.
- ✚ Improves stress tolerance (biotic and abiotic) and sapling vigor.
- ✚ Simple package of practice: basal dipping of cuttings, soil/FYM mixing for grafts, and complementary use with reduced chemical fertilizers.



Package for Biofertilizer (*Azotobacter*) Application in Mulberry Nurseries

- ✚ **Preparation of Inoculum**
 - ✓ Prepare a slurry by mixing Nitrogenous Biofertilizer (NB) with water in a **1:1 ratio** to form a thick paste.
- ✚ **Treatment of Cuttings**
 - ✓ Dip the basal ends of mulberry cuttings up to **10 cm depth** in the slurry for **30 minutes**.
 - ✓ Shade-dry the treated cuttings and then plant them in nursery beds.
- ✚ **Dosage and application for Cuttings/Grafts**
 - ✓ Apply **250 g** of NB inoculum per **1000 cuttings/grafts**.
 - ✓ Mix Nitrogenous Biofertilizer with FYM or farm soil (if FYM unavailable) in **1:3 ratio**.
 - ✓ Apply after **75-90 days** of planting @ **3 kg/acre**.
- ✚ **Irrigation**
 - ✓ Irrigate nursery beds **immediately after NB application** to provide adequate moisture for the multiplication of microorganisms.
- ✚ **Supplementary Fertilization**
 - ✓ Apply chemical fertilizer at **25:25:25 kg N:P:K/ha**, in **two equal splits**:
 - ✓ First dose: **90-105 days** after planting.
 - ✓ Second dose: **30 days** after the first application.

Field Impact

- ✚ Net economic gain of about ₹993/ha/year under irrigated conditions.
- ✚ Improves establishment, growth and health of mulberry saplings.
- ✚ Reduces dependence on chemical nitrogen fertilizers, encouraging sustainable practices.
- ✚ Promotes eco-friendly sericulture nursery management under temperate conditions.

PACLOBUTRAZOLE (PBZ) APPLICATION FOR ENHANCING WATER STRESS TOLERANCE IN MULBERRY

YEAR OF RECOMMENDATION: 2014

Scientists Associated: Rajat Mohan; Dhiraj Vyas (IIIM-Jammu); R. K. Pandey; Anil Dhar

Salient Features

- ✚ Paclobutrazole (PBZ), a triazole-based plant growth regulator, has been demonstrated to enhance drought and rainfed stress tolerance in mulberry.
- ✚ Application of PBZ significantly improves survival of cuttings and promotes higher biomass accumulation under limited water availability.
- ✚ The effective concentration range lies between **10-25 mg L⁻¹**, with optimum response observed at the higher dose.
- ✚ PBZ induces the antioxidant defense system, reduces lipid peroxidation and enhances membrane stability under stress conditions.
- ✚ Application of PBZ has no adverse effect on silkworm rearing performance or silk quality parameters.
- ✚ Sustains both qualitative and quantitative leaf yield, thereby maintaining mulberry productivity in water-stress-prone environments.

Recommendations

- ✓ **Standard Dose:** 25 mg L⁻¹ PBZ solution applied through soil drenching.
- ✓ **Tree-Level Requirement:** Approximately 3 litres of prepared solution for a 10-year-old tree.
- ✓ **Dose Adjustment:** The quantity should be calibrated based on plant age and type (nursery cuttings, saplings, or field-grown trees).
- ✓ **Nursery Application:** Immediate application of PBZ after planting of cuttings ensures better establishment and higher survival under rainfed or stress conditions.

Field Impact

- ✚ Under commercial exploitation through Departments of Sericulture in North and Northwest India.

TECHNOLOGY FOR QUALITY IMPROVEMENT OF MULBERRY LEAVES THROUGH CCC APPLICATION

YEAR OF RECOMMENDATION: 2008

Scientists Associated: Rajat Mohan, A.C. Juyal, Ramakant, P.K. Singh & B.D. Singh

Salient Features

- ✚ **Recommended Dose:** 10 ppm CCC (2-Chloroethyl trimethyl ammonium chloride) + 0.5 ml/litre agro vet as foliar spray.
- ✚ **Timing of Application:** Spray during summer on leftover leaves after spring crop.
- ✚ **Impact on Leaf Quality:** Improves leaf moisture content by 5-10%.
- ✚ **Physiological Benefits:**
 - ✓ Enhances root water status of plants.
 - ✓ Mitigates effects of salinity and soil drought.
 - ✓ Improves frost tolerance of mulberry.

Field Impact

- ✚ Enhanced leaf succulence and nutritive quality for silkworm rearing.
- ✚ Improved abiotic stress tolerance of mulberry plantations.
- ✚ Contributed to sustained leaf production under summer stress conditions.



NUTRIENT MANAGEMENT

The requirement of inputs for tree block plantation is worked out as 10 MT of FYM/ha and NPK @ 100:50:50 kg/ha/year. However, for bush plantation it is advocated to apply chemical inputs @ 150:75:75 kg/ha/year under sub-tropics and @ 250:150:150 kg/ha/year under temperate conditions. The Nitrogenous fertilizer is to be applied in two equal split doses, with first dose applied 20-30 days before first silkworm brushing and the second one about 20 days before second brushing. The exact input requirement, however, would vary from place to place depending upon the soil conditions. It is advocated, further, to apply the second dose of fertilizer only when leaf is required to be utilized for rearing.

The requirement of inputs by individual tree depends upon the quantum of leaf borne by it. Since the leaf yield ranges from less than a kg to about 50 kg/tree/year, and even more in certain cases, the input requirement, is worked out based on expected leaf yield of an individual tree. Vermicomposting could also be encouraged at both departmental as well as farmer's level.

INPUT REQUIREMENT OF MULBERRY TREES

Age group of trees	Expected leaf yield/plant (kg)	Requirement of fertilizer/plant (g)				Requirement of Farm-Compost/ FYM per plant (kg) JUL/DEC
		1 st Dose			2 nd Dose	
		Urea	DAP	MOP	Urea	
Upto 2 years	Upto 1	7	11	8	11	4-6
	1-2	13	22	17	22	4-6
	2-3	20	33	25	33	4-6
2-5 years	2-3	20	33	25	33	4-6
	3-4	26	44	33	44	5-10
	4-5	33	54	42	54	5-10
	5-10	66	109	83	109	10-20
5-10 years	4-5	33	54	42	54	5-10
	5-10	66	109	83	109	10-20
	10-15	99	163	125	163	10-20
	15-20	132	217	167	217	10-20
	20-25	165	272	208	272	10-20
Above 10 years	15-20	132	217	167	217	10-20
	20-25	165	272	208	272	10-20
	25-30	199	326	250	326	10-20
	30-35	232	380	292	380	10-20
	35-40	265	435	333	435	10-20
	>40	331	543	417	543	10-20



TECHNOLOGIES FOR REARING / IMPROVEMENT OF SILKWORM

SILKWORM HYBRID: SH6 ×NB4D2

YEAR OF RECOMMENDATION: 1986

Salient Features

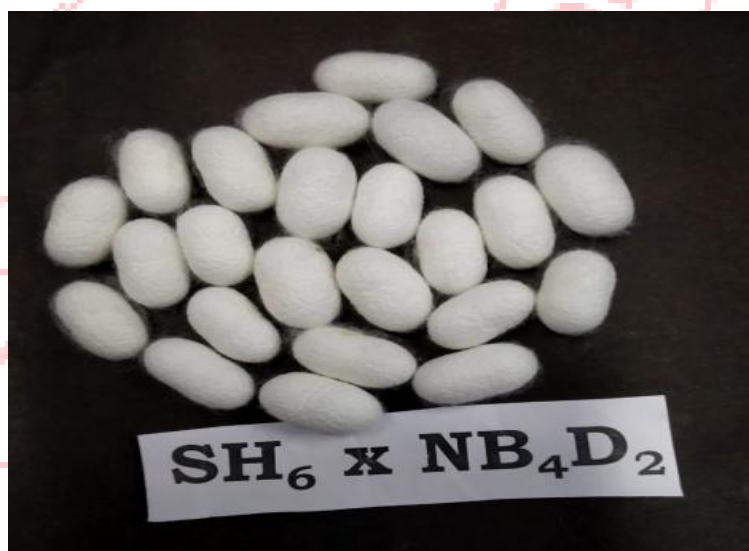
- SH6 × NB4D2 is used in Northern states as ruling hybrid for the last three decades.
- Evolved bivoltine races from Dehradun, UK namely SH6, YS3, SF19 & JD6, which led to formation of viable hybrids (SH6XNB4D2. SH6XKA & YS3XSF19) authorized by race authorization committee.
- Average cocoon yield is 68 kg/100 DFLs in laboratory conditions and 35 to 40 kg/100 DFLs in field conditions.

CHARACTERS :

- ✓ Cocoon wt. (g): 2.03
- ✓ Shell wt. (g): 0.418
- ✓ Shell ratio (%): 20.59
- ✓ Avg. Filament length (m): 832.0
- ✓ Denier: 2.87
- ✓ Reelability: 92 %.

Field Impact

- It is the ruling control hybrid in the field across the North and Northwest India and it is in seed channel right from P4-BSF to F1 Level. It's Seed is being produced from SSPC, Dehradun and SSPC, Udhampur under NSSO, Bengaluru.



SILKWORM HYBRID: Dun 6 × Dun 22

Parentage: Breed Dun 6: (CC1 × NN6D); Dun 22: [(KS × NB4D2) × (AT × NB4D2)]

YEAR OF RECOMMENDATION: 2003 (Developed), 2005 (Recommended) and 2008 (Improved)

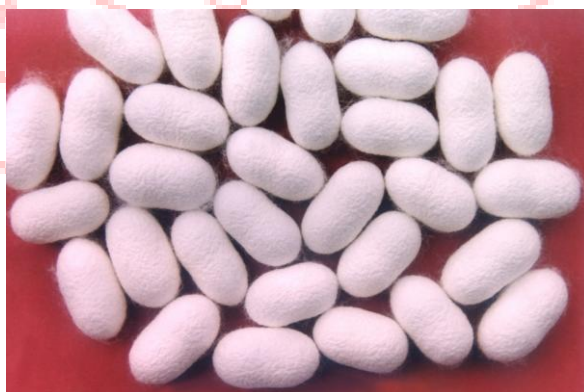
Scientists Associated: A.A. Siddiqui *et.al.*

Salient Features

- ✚ The hybrid Dun 6 × Dun 22 is a productive and farmer-friendly bivoltine cross, characterized by distinct larval and cocoon traits along with superior reeling performance.
- Larval Characteristics: Marked larvae with bluish-white body colour; larval duration of 23-24 days.
- Cocoon Traits: Bright white, dumbbell-shaped cocoons with medium-sized grains.
- Cocoon Yield: 59-60 kg/100 DFLs, significantly higher than the ruling hybrid SH6 × NB4D2 (40 kg/100 DFLs).
- Cocoon Shell Ratio: 23-24%.
- Pupation Rate: 92%.
- Reeling Performance: Raw silk recovery of 18-19%, reelability 83%, filament length 1021 m.
- Fibre Quality: 2A-3A grade, with renditta of 7.5-8.0.

Field Impact

- ✚ The hybrid is suitable for rearing in Jammu & Kashmir, Uttarakhand, Andhra Pradesh, Karnataka, and Tamil Nadu, particularly during the spring and autumn seasons, when managed under the recommended rearing package.
- ✚ The hybrid is under commercial exploitation through the **Departments of Sericulture in North India.**



SILKWORM HYBRID: Dun 17 x Dun 18

Parentage: Breed Dun 17: (JPN4 x A 22); Dun 18: (JPN 5 x NK 5)

YEAR OF RECOMMENDATION: 2003 (Developed), 2005 (Recommended) and 2008 (Improved)

Scientists Associated: A.A. Siddiqui *et.al.*

Salient Features

- Marked larvae with bluish-white body colour
- Larval duration: 23-24 days
- Bright white, dumbbell-shaped cocoons with medium grains
- Cocoon yield: **62-64 kg/100 DFLs**, significantly higher than the ruling hybrid SH6 x NB4D2 (35 kg/100 DFLs)
- Cocoon shell ratio: **23%**
- Pupation rate: **90%**
- Raw silk recovery: **19-20%**
- Reelability: **81%**
- Filament length: **1042 m**
- Fibre quality: **2A-3A grade**
- Renditta: **8.0**

Field Impact

- The hybrid is suitable for rearing in Himachal Pradesh during spring and Karnataka, West Bengal and Assam in autumn seasons.



SILKWORM DOUBLE HYBRID- (PAM114×CSR50 X PAM117×APS4)

YEAR OF RECOMMENDATION: 2023

Scientists Associated: Bharath Kumar N, Shivkumar, Kiran R, Mir Nisar Ahmad and Sardar Singh

Salient Features

- ✚ The silkworm double hybrid (PAM114×CSR50 X PAM117×APS4) reared under field conditions during spring records potential yield of 80 kg/100 DFLs in Kashmir, 60 kg/100 DFLs in Jammu and 47.2 kg/100 DFLs in Uttarakhand region.
 - Larval Marking: Plain,
 - Larval Color: Creamy White,
 - Larval Period (Days): 24-26,
 - Fecundity: 500-600,
 - Cocoon Color & Shape: Creamy White & Oval (Elongated with constriction),
 - Yield/10000 Larvae: 15.00-16.00,
 - Pupation Rate (%): 88-93,
 - Single Cocoon Weight: 1.75-1.98g,
 - Single Shell Weight: 0.36-0.41 g,
 - Shell Ratio: 20.69-21.25%,
 - FilamentLength: 816-904 m,
 - Filament Size (d): 2.61-2.75,
 - Raw Silk (%): 14.6-15.0,
 - Reelability (%): 80.00-85.00
 - ✚ The first ever silkworm double hybrid developed at CSR&TI, Pampore has the potential to thrive well in field conditions by following all the recommended silkworm rearing practices
- ### Field Impact
- ✚ The hybrid is currently under On-Farm Trial (OFT) evaluation for large-scale validation.



AUTUMN SPECIFIC SILKWORM HYBRID-ASH-14 (Line18×Line6)

YEAR OF RECOMMENDATION: 2024

Scientists Associated: Shivkumar, Bharath Kumar N, Kiran R and Sardar Singh

Salient Features

- ASH -14 Parentage : (APS 5XCSR27) X (PAM117XCSR2)
- During autumn 2023, On-Station Trials (OST) conducted at CSR&TI, Pampore, RSRS Jammu and RSRS Sahaspur recorded cocoon yields of 68, 58, and 63 kg/100 DFLs, respectively, compared to the control hybrid SH6 × NB4D2, which yielded 57, 49, and 55 kg/100 DFLs at the same locations.
 - Larval Marking: Plain,
 - Larval Color: Creamy White,
 - Larval Period (Days): 26-28
 - Fecundity:450-500,
 - Cocoon Color & Shape: Creamy White & Oval (Elongated with constriction),
 - Yield/10000 Larvae: 13.50-14.50,
 - Pupation Rate (%):85-90,
 - Single Cocoon Weight: 1.63-1.76g,
 - Single Shell Weight: 0.33-0.35 g,
 - Shell Ratio: 19.56-20.25%,
 - Filament Length: 808-851 m,
 - Raw Silk (%):13.5-14.6,
 - Reelability (%): 80.00-88.00,
 - Neatness:85 Points.
 - Renditta (kg): 7.5-7.8
 - 15 - 20% improvement in cocoon yield.

Field Impact

- The hybrid is currently under On-Farm Trial (OFT) evaluation for large-scale validation.



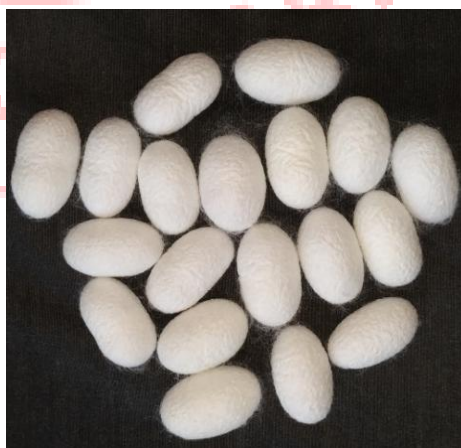
SILKWORM HYBRID-BP2XSO17

YEAR OF RECOMMENDATION: 2023

Scientists Associated: Kiran R, Bharath Kumar N, Shivkumar, Mir Nisar Ahmad, Chhattar Pal, Rita Singh and Santosh Kumar Magadam

Salient Features

- ✦ The bivoltine hybrid was shortlisted following the hybrid evaluation of sixteen hybrids conducted over six seasonal trials at CSB-CSR&TI, Pampore
 - **Larval Marking:** Plain and marked,
 - **Larval Color:** Creamy White
 - **Larval Period (Days):** 25-26
 - **Fecundity:** 450-550,
 - **Cocoon Color & Shape:** Creamy White & Oval with constriction,
 - **Yield/10000 Larvae:** 13.49-15.15,
 - **Pupation Rate (%):** 88-93,
 - **Single Cocoon Weight:** 1.64-1.85g,
 - **Single Shell Weight:** 0.32-0.37 g,
 - **Shell Ratio:** 19.51-20%,
 - **Filament Length:** 850-945 metre,
 - **Filament Size (d):** 2.5-3.18,
 - **Reelability (%):**84.60,
 - **Neatness:** 90 Points,
 - **Renditta (kg):** 7
 - ✦ The hybrid BP2 × SO17 demonstrated yield improvements of up to 11% in On-Station Trials (OST) and 16% in On-Farm Trials (OFT).
- ### Field Impact
- ✦ It is currently under multi-location OFT evaluation as an alternative for the conventional hybrid SH6 × NB4D2.



NUTRIGENETIC SILKWORM HYBRID-CSR50xBCon4

YEAR OF RECOMMENDATION: 2024

Scientists Associated: Murali, S., Kiran R, Rita Singh, Sardar Singh, Santosh Kumar Magadum and Chhattar Pal

Salient Features

- ✦ The hybrid has shown the potential to replace the conventional single hybrid SH6 × NB4D2, which has been in use for over three decades.
 - **Larval Marking:** Plain and marked,
 - **Larval Color:** Creamy White,
 - **Larval Period (Days):** 22-25,
 - **Fecundity:** 450-520,
 - **Cocoon Color & Shape:** Creamy White & Oval with constriction,
 - **Yield/10000 Larvae:** 14.87-16.50
 - **Pupation Rate (%):** 87-94,
 - **Single Cocoon Weight:** 1.68-1.90g,
 - **Single Shell Weight:** 0.32-0.38 g,
 - **Shell Ratio:** 19.05-20%,
 - **Efficiency convergence of ingesta to cocoon (ECI) (%):** 18.66,
 - **Filament Length:** 800-950metre,
 - **Filament Size (d):** 2.5-2.65,
 - **Reelability (%):** 84.60,
 - **Neatness:** 90 Points
- ✦ In On-Station Trials, CSR50 × BCon4 achieved up to a 16% yield improvement

Field Impact

- ✦ The hybrid is presently undergoing multi-location On-Farm Trials (OFTs) for large-scale validation.



NUTRIGENETIC SILKWORM HYBRID-CSR50xBCon1

YEAR OF RECOMMENDATION: 2024

Scientists Associated: Murali, S., Kiran R, Rita Singh, Sardar Singh, Santosh Kumar Magadum and Chattarpal

Salient Features

- ✦ The bivoltine hybrid CSR50 × BCon1 was shortlisted based on the outcomes of systematic hybrid evaluation involving fifteen hybrids across four seasonal trials at RSRS, Jammu, and six On-Station Trials conducted at CSB-CSR&TI, Pampore; RSRS, Jammu; and RSRS, Sahaspur under the project "Development of Nutrigenetic Hybrids of Bivoltine."
 - Larval Marking: Plain and marked,
 - Larval Color: Creamy White,
 - Larval Period (Days): 22-25,
 - Fecundity: 450-540,
 - Cocoon Color & Shape: Creamy White & Oval with constriction,
 - Yield/10000 Larvae: 14-16.10
 - Pupation Rate (%): 90-94,
 - Single Cocoon Weight: 1.70-1.85g,
 - Single Shell Weight: 0.34-0.38 g,
 - Shell Ratio: 19.80-20.5%,
 - Efficiency convergence of ingesta to cocoon (ECI) (%): 18.76,
 - Filament Length: 840-980metre,
 - Filament Size (d): 2.31-2.46,
 - Reelability (%): 85,
 - Neatness: 90 Points,
 - Renditta (kg): 6.42
- ✦ The hybrid has demonstrated its potential as a superior alternative to the conventional single hybrid SH6 × NB4D2, recording up to 12% higher cocoon yield in On-Station Trials.

Field Impact

- ✦ On-Farm Trials of CSR50 × BCon1 are currently in progress at multiple locations to validate its field-level performance and economic viability.



NUTRIGENETIC SILKWORM HYBRID-RSJ14xBCon1

YEAR OF RECOMMENDATION: 2024

Scientists Associated: Murali, S., Kiran R, Rita Singh, Sardar Singh, Santosh Kumar Magadum and Chattarpal

Salient Features

- ✚ The bivoltine hybrid RSJ14 × BCon1 was shortlisted following the evaluation of fifteen hybrids tested across four seasonal trials at RSRS, Jammu, and six On-Station Trials conducted at CSB-CSR&TI, Pampore; RSRS, Jammu; and RSRS, Sahaspur, under the project "Development of Nutrigenetic Hybrids of Bivoltine Silkworm."
 - Larval Marking: Plain and marked,
 - Larval Color: Creamy White,
 - Larval Period (Days): 22-25,
 - Fecundity: 450-530,
 - Cocoon Color & Shape: Creamy White & Oval with constriction,
 - Yield/10000 Larvae: 14.58-16.20,
 - Pupation Rate (%): 89-94,
 - Single Cocoon Weight: 1.65-1.78g,
 - Single Shell Weight: 0.31-0.37 g,
 - Shell Ratio: 18.79-20.17%,
 - Efficiency convergence of ingesta to cocoon (ECI) (%): 18.33,
 - Filament Length: 830-990metre,
 - Filament Size (d): 2.25-2.75,
 - Reelability (%):80,
 - Neatness: 90 Points,
 - Renditta (kg): 7.3.
- ✚ The hybrid has been identified as a potential replacement for the conventional single hybrid SH6 × NB4D2.
- ✚ In On-Station Trials, RSJ14 × BCon1 recorded up to 18% higher cocoon yield compared to the ruling hybrid.

Field Impact

- ✚ On-Farm Trials are underway at multiple locations to validate its performance, adaptability and economic advantage under farmers' conditions.

A MODEL REARING AND MOUNTING STAND.

YEAR OF RECOMMENDATION: 2008

Scientist Associated: Sardar Singh

Salient Features

- ✚ The rearing stand has been completely adopted in Himachal Pradesh owing to its ease of use and suitability for regional rearing practices.
- ✚ It is particularly effective for *shoot-feeding* methods and offers *multiple utilities*, as the same stand can be used for both rearing and spinning.
- ✚ Compared to plastic rearing trays, the stand is highly cost-effective, providing equal rearing space at nearly half the cost.
- ✚ It is also easy to assemble and dismantle and has been well accepted by farmers.



Field Impact

- ✚ This technology is currently under commercial exploitation in Himachal Pradesh and Jammu & Kashmir.

SAMRIDDHI: A NOVEL SYNCHRONIZING AGENT FOR UNIFORM MATURATION AND SPINNING OF SILKWORMS

YEAR OF RECOMMENDATION: 2011

Scientists Associated: Pankaj Tewary

Salient Features

Problem Addressed:

- ✚ Variation in larval maturation and spinning in silkworm crops often leads to staggered mounting, excess leaf consumption, and uneven cocoon quality.

Innovation:

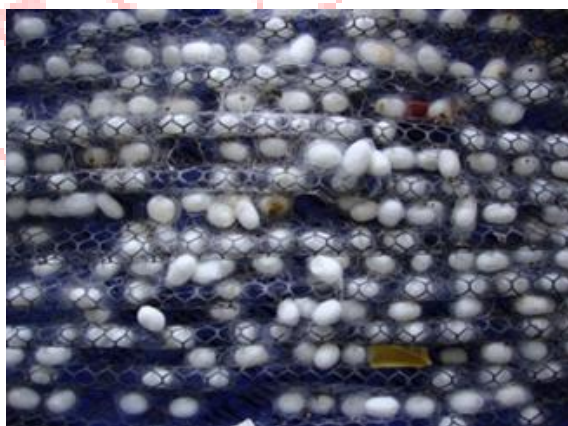
- ✚ Development of a novel product "**Samriddhi**" in collaboration with the Chemistry Division, Forest Research Institute (FRI), Dehradun, designed to ensure uniform maturation and synchronized spinning of silkworm larvae.

Benefits:

- ✚ Facilitates synchronized mounting of worms
- ✚ Saves mulberry leaf by reducing the late-age feeding duration.
- ✚ Contributes to uniform cocoon quality and improved rearing efficiency

Field Impact

- ✚ The product is patented and will be taken up for commercialization



MULTIPLE COCOON CROPS AND STABILIZATION OF AUTUMN CROP IN NORTH-WEST INDIA

YEAR OF RECOMMENDATION: 2021

Scientists Associated: Sardar Singh, Murali S., Pankaj Tewary

Salient Features

- ✚ **Hybrid Evaluation:** First-time screening of mulberry silkworm hybrids at CSB for multiple cocoon crops (spring, summer and autumn).
- ✚ **Optimized Brushing Dates:**
 - ✓ **Spring crop:** Preponed by 7-10 days.
 - ✓ **Summer crop:** Conducted during 2nd-4th week of June based on climatic conditions.
 - ✓ **Autumn crop:** Postponed to 1st-2nd week of September based on climatic conditions
- ✚ **Hybrids Recommended:**
 - ✓ **Spring:** CSR double hybrid (FC1 × FC2).
 - ✓ **Summer & Autumn:** SH6 × NB4D2.
- ✚ **Region-Specific Recommendation:** Suitable for subtropical regions of Jammu & Kashmir, Himachal Pradesh and Uttarakhand.
- ✚ **Innovative Rearing Practices:**
 - ✓ Shelf rearing for shoot feeding on shoot rearing & mounting stand.
 - ✓ Use of plastic collapsible mountages for effective cocoon harvest.

Field Impact

- ✚ Ensures **three cocoon crops per year** (spring, summer, autumn), stabilizing farmer income.
- ✚ Revised brushing dates help **synchronize silkworm rearing with climatic conditions**, minimizing crop failures.
- ✚ Improved autumn crop by introducing summer crop in between spring & autumn. In Himachal & Jammu region a gain in yield/100 dfls of 44.70 to 67.14% was demonstrated.
- ✚ Adoption of **shelf rearing, shoot feeding and plastic collapsible mountages** enhances operational efficiency and reduces labour.
- ✚ Provides a **sustainable model for cocoon production** in North-West India, particularly in stress-prone autumn seasons.

FORTIFICATION OF MULBERRY LEAF WITH 0.5% GLUTAMIC ACID FOR STABILIZATION OF AUTUMN CROP IN KASHMIR.

YEAR OF RECOMMENDATION: 2024

Scientists Associated: Ravindra MA, Shivkumar, Bharath Kumar N, Sardar Singh, Chattar Pal and Rita Singh.

Salient Features

- ✦ Fortification of mulberry leaves with amino acids significantly enhanced silkworm performance and silk yield parameters.
- ✦ Amino acid-supplemented diets resulted in a 12-13% increase in larval weight, an increase in cocoon shell weight from 0.37 g (control) to 0.39 g and an improvement in shell ratio from 19.9% to 23.8%.
- ✦ Further, silk filament length increased from 815 m (control) to 916 m in treated groups, indicating substantial gains in silk productivity and quality.



Field Impact

- ✦ Technology is at the popularization stage for stabilization of autumn crop in Kashmir Valley and summer crop in Himachal Pradesh.

LOW-COST MODEL OF SILKWORM REARING HOUSE FOR HILL, PLAIN AND TARAI REGIONS

YEAR OF RECOMMENDATION: 1994-95

Scientists Associated: S. N. Sumbli M. Aslam, Haroon Rashid and M. A. Khan.

Salient Features

- Developed a **semi-pucca rearing house** with country tiles and mud floor, designed for cost-effectiveness and functional rearing capacity of 100 Dfls.
- Inner dimensions: **15' (L) × 12' (B) × 10' (H)** with an additional verandah of **15' (L) × 5' (B)**.
- Total construction cost: **₹30,000** (as per 1994-95 rates).
- Ensures better environmental conditions for silkworm rearing compared to traditional temporary structures.
- Simple design, easily replicable for farmers with limited resources.

Recommended Zones / States / Season

- Suitable for hill, plain, and tarai regions of Uttarakhand and Uttar Pradesh.

Field Impact

- Provided an **affordable and farmer-friendly solution** to establish scientific silkworm rearing units.
- Improved rearing environment, leading to **better silkworm health and cocoon yield**.
- Helped in the **expansion of sericulture activities** among small and marginal farmers in the region.



FABRICATION OF MOUNTAGES FROM LOCALLY AVAILABLE MOUNTING MATERIAL

YEAR OF RECOMMENDATION: 1999-2000

Scientists Associated: P.M. Tripathi, Anil Dhar, B.B. Bindroo

Salient Features

- ✦ Identification of suitable locally available materials such as dried mango twigs, indigo leaf and eucalyptus leaf for use as mountages in silkworm rearing.
- ✦ Dried mango twigs with dried indigo leaf and eucalyptus leaf were found to be the best locally available mounting material in sub-tropical regions of Himachal Pradesh and Uttarakhand.
- ✦ Defective cocoon percentage in mountages prepared from these materials was reduced to **10-15%**, compared to **20-30%** in traditional mounting methods.
- ✦ Mounting frames are prepared by aligning dried mango twigs with leaf and eucalyptus leaf in a criss-cross manner on rearing trays up to 1 ft height.
- ✦ Each mounting frame can accommodate **400-450 worms**.
- ✦ Provides an alternative to plastic collapsible mountages, which though effective, are less adopted by farmers due to cost and unscientific local practices.

Field Impact

- ✦ Reduced defective cocoons enhance cocoon shape in commercial rearing, leading to improved cocoon quality.
- ✦ Locally available materials make this method cost-effective and easily adoptable by farmers under Sub-tropical regions that directly improve silk quality and increase the price realization of cocoons.



Kalpavriksha, Joshimath (Uttarakhand) — Believed to be over 2,400 years old, this sacred **mulberry tree** holds deep religious significance as the site where Adi Shankaracharya meditated in the 8th century, revered as a divine symbol of Lord Shiva.



TECHNOLOGY FOR PEST AND DISEASE MANAGEMENT

INTEGRATED PEST AND DISEASE MANAGEMENT MODULE (IPDM)

YEAR OF RECOMMENDATION: 2009 (DEVELOPED) 2015 (RECOMMENDED)

Scientists Associated: M.A. Khan, N. A. Munshi, Haroon Rashid, Irfan Illahi, Shakeel Ahmad, Vishal Mittal and Mir Nisar Ahmad

Salient Features

- ✚ An Eco-friendly technology
- ✚ Botanical Extract Formulations for Mulberry Protection:
 - ✓ **Garlic Extract (*Allium sativum*, local variety Rohan):**
Fresh bulbs are peeled, ground, and soaked in water (1:10 w/v) overnight. The extract is filtered through muslin cloth, and the mother solution is used at **6% (60 ml/L water)**. Spray @ **300 L/acre** using a high-volume nozzle.
 - ✓ **Euphorbia Extract (*Euphorbia* spp., local name Ghur-sochal):**
Shade-dried plant material is powdered and soaked in water (1:10 w/v) overnight. The filtrate is diluted to **6% (60 ml/L water)** and sprayed @ **300 L/ha** using a low-volume nozzle.
 - ✓ **Artemisia Extract (*Artemisia* spp., local name Tethuwan):**
Shade-dried leaves and stems are powdered and soaked in water (1:10 w/v) overnight. The filtrate is diluted to **6% (60 ml/L water)** and sprayed @ **250 L/acre** using a high-volume nozzle.

Field Impact

- ✚ Adoption of the recommended plant protection measures in mulberry significantly reduces the pest and disease incidence.
- ✚ Infestation of **leaf webber** and semilooper reduces by **43.66%** and **48.82%**, respectively.
- ✚ Incidence of leaf spot and powdery mildew declines by **39.56%** and **49.92%**, respectively.
- ✚ The IPDM contributes to an overall increase in cocoon productivity of **7.0 kg/100 DFLs** at the farmer's level.



BPL: A COST-EFFECTIVE BED DISINFECTANT FOR SUSTAINABLE SILKWORM REARING

Salient Features

- ✚ **Composition:** Powder mixture of
 - ✓ Benzoic Acid (1 part)
 - ✓ Para-formaldehyde (2 parts)
 - ✓ Slaked lime (9 parts)
- ✚ **Cost-effectiveness:** Preparation cost is around Rs. 20 per kg.
- ✚ **Shelf life:** Freshly prepared mixture should be consumed within 25 days.
- ✚ **Application:** To be used like any other silkworm bed disinfectant.
- ✚ **Efficacy:** Tested and found very effective in reducing crop loss due to silkworm diseases at farmer level.



Field Impact

- ✚ **Enhanced Cocoon Yield:** Trial in Badipur (Dehradun) through SSPC, CSB, Dehradun showed increase in average cocoon production **33.3%** from **28 kg/100 dfls** (previous years) to **42 kg/100 dfls** after BPL use.
- ✚ **Improved Disease Control:** Effectively controlled silkworm diseases, reducing mortality and ensuring healthier crops.
- ✚ **Low-cost & Farmer-friendly:** Affordable, easy-to-use and suitable for adoption at farmer level without sophisticated infrastructure.
- ✚ **Sustainability:** Contributes to better productivity, profitability and disease management in sericulture, promoting sustainable rural livelihoods.

STAGE OF LARVAE	QUANTITY OF BPL (gms)
Out of first moult	50
Out of second moult	100
Out of third moult	600
Out of fourth moult	1250
Fourth day of fifth stage	2000
TOTAL	4000

CALENDAR OF OPERATIONS FOR MULBERRY CULTIVATION IN NORTH AND NORTHWEST INDIA

Month	Fortnight	Activity	
		Temperate	Sub-tropic
January	1 st	-	Application of FYM
	2 nd	-	Digging/weeding
February	1 st	-	Application of inorganic fertilizer: 1 st dose of Nitrogen (1 st Split) and PK as a basal dose.
	2 nd	Digging of pits.	-
March	1 st	A. Plantation of saplings. (i) Application of FYM @1.5 to 2 Kg per pit as a basal dose, Subsequent plantation of saplings.	Leaf Harvesting (1 st crop)
	2 nd	B. Established Plantation (ii) Pruning/top clipping to remove dry/frost affected Portion (disease portion) at a height of 80 to 120 cms from crown. (iii) Digging/weeding (a) Established Plantation (b) New Plantation.	
April	1 st	Application of inorganic fertilizer: 1 st dose of Nitrogen (1 st Split) and PK as a basal dose.	Leaf Harvesting (1 st crop)
	2 nd	-	-
May	1 st	Leaf Harvesting (1 st crop)	-
	2 nd		-
June	1 st	(i) Leaf Harvesting (1 st crop) (ii) Bottom Pruning at zero crown height.	-
	2 nd	(iii) Digging/Weeding	-
July	1 st	Application of inorganic fertilizer: 2 nd dose of Nitrogen in the form of Urea.	Bottom Pruning at zero crown height for bush type of plants.
	2 nd	-	-
August	1 st	Dressing/thinning	Application of inorganic fertilizer: 2 nd dose of Nitrogen in the form of Urea.
	2 nd	Leaf harvesting for Autumn crop (2 nd Crop)	-
September	1 st	Leaf harvesting for Autumn crop (2 nd Crop)	Leaf harvesting for Autumn crop (2 nd Crop)
	2 nd	-	Crop)
October	1 st	-	Leaf harvesting for Autumn crop (2 nd Crop)
	2 nd	-	-
November	1 st	Digging/weeding	-
	2 nd	Application of FYM	-
December	1 st	Irrigation before plants enter dormancy.	-
	2 nd	-	Middle pruning for bush type of plantation.

Note: Schedule of calendar depends on the given conditions in a region and can be changed accordingly.



WINTER

CHILLAI KALAN



SPRING



AUTUMN



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