

### IMPORTANT TECHNOLOGIES/CONTRIBUTIONS MADE BY CSR&TI, PAMPORE

#### 1) Research outcome and Technologies developed

S.No	Technology	Particulars	Status
<b>MULBERRY PRODUCTION AND IMPROVEMENT:</b>			
I	<b>MULBERRY VARIETIES RECOMMENDED</b>	<p>For Subtropical region varieties Tr-10, S146, S1635 and Vishala with Leaf yield ranging from 14 to 19 MT/ ha/yr (Under rainfed conditions).</p> <p>For temperate region varieties Goshorami, Ichinose, KNG and Tr-10 with Leaf yield ranging from 22 to 26 MT/ ha/yr (Under rainfed conditions).</p> <p>Varieties under pipeline are : PPR-1, S-106 &amp; S-145</p>	<p>Adopted by farmers/ DOS &amp; Established at field level</p> <p>Spread of superior varieties in the field has increased the availability of quality leaf to an extent of 40-50% as against wild and local genotypes.</p>
II	<b>PRUNING AND LEAF HARVESTING</b>	<p>Under sub-tropical sericulture zone the following pruning/harvesting schedule after two years of plantation is recommended for production of two to three healthy crops.</p> <p>❖ Bottom pruning at crown level during middle of July (45 days before onset of autumn rearing) and middle pruning at 120 cm above crown level during third to fourth week of December.</p>	<p>Adopted by DOS /farmers.</p> <p>There is gain in leaf production 20% in Autumn and 40% in</p>

		<ul style="list-style-type: none"> <li>❖ During Spring Rearing (March-April), shoot-let harvesting until IV age and thereafter-complete shoot harvesting is advocated.</li> <li>❖ During monsoon (July-Aug.)/autumn Rearing (September-October), only about 0.75- 1.0m of the apical portion of the branches is recommended to be harvested and utilized for rearing as such or after chopping, depending upon the stage of the feeding worms.</li> </ul> <p>Under Temperate Sericultural zone the following pruning/harvesting schedule is recommended.</p> <ul style="list-style-type: none"> <li>❖ Top clipping in the month of March and bottom pruning in last week of May to first week of June is recommended.</li> <li>❖ The leaf harvesting by resorting to shoot/branch pruning is suggested during spring rearing. Individual leaf plucking and partial thinning of shoots is recommended for second crop.</li> </ul>	Spring and overall gain is 30% against control.
III	<b>IDEAL SPACING OPTIMIZED</b>	<ul style="list-style-type: none"> <li>● 3' x 3' recommended for low cut (bush) type of plantation with crown height 20-25 cm (Up to 35 MT leaf yield/ha realised by adopting to bush type plantation under sub-tropical conditions)</li> <li>● 3' x 6' recommended for medium cut (dwarf) type plantation with crown height 60-70 cm (Up to 22-26 MT leaf yield/ha realised by adopting to Dwarf type plantation under temperate conditions)</li> <li>● 8' x 9' recommended for high cut (tree) type plantation with crown height 150-175 cm. {Up to 12-15 MT leaf yield/ha realised by adopting to high cut (Tree) type plantation under temperate conditions in the field}</li> </ul>	Adopted by DOS / farmers.

IV	<b>INTEGRATED NUTRIENT MANAGEMENT</b>	<p>Integrated nutrient management by using biofertilizers, FYM, Vermicompost, green manuring along with chemical NPK has been demonstrated with approximately 50% reduction in use of organic fertilizer (Nitrogen and Phosphorus).</p> <p>Dosage and application time of NPK has been recommended under irrigated &amp; rainfed conditions of sub-tropical and temperate zone.</p> <p><b>Dosage:</b> 300:100:100 (NPK), FYM: 20 MT/ha for irrigated conditions.</p> <p>100:50:50 (NPK), FYM: 10 MT/ha for rainfed conditions.</p> <p><b>Application time:</b> The nitrogenous fertilizer is to be applied in two equal split doses, with first dose 20-30 days before silkworm brushing and the second dose about 20-30 days before second brushing. FYM to be applied in one split during the month of November/December. The exact input requirement may vary from place to place depending upon the edaphic conditions. It is advocated, further, to apply second dose of fertilizer only when leaf is required to be utilized for rearing.</p>	Adopted by DOS / farmers.
V	<b>TECHNOLOGY FOR MULBERRY TREE CULTIVATION FOR TEMPERATE REGION</b>	<p>Mulberry in North India is grown as scattered tree. Block plantation with low cut (bush) and medium cut (dwarf) type plants are mostly grown in government farms only.</p> <p>The following varieties are recommended for cultivation as high cut (tree) type plantation due to their erect branching nature and higher leaf yield:</p> <p>Goshoerami, KNG and Tr-10</p> <p><b>PLANTING SEASON:</b> Spring ( March-April)</p> <p><b>PLANTING MATERIAL:</b> Healthy saplings, 180 cm in height with 5 cm girth at base</p> <p><b>SPACING:</b> 240 x 270 cm (8'x9')</p>	Adopted by DOS / farmers.

		<p><b>PLANTING SYSTEM:</b></p> <p>I) Pit Size: 40-60 cm<sup>3</sup></p> <p>II) Planting medium per pit:</p> <p>a) 2-3 kg well decomposed FYM/ Farm compost</p> <p>b) soil</p>	
<b>VI</b>	<b>MULBERRY NURSERY RAISING TECHNOLOGY</b>	<p>Mulberry nursery raising technology has been developed for temperate and sub-tropical conditions of North India.</p> <p>For Tree type of mulberry farming, use of healthy saplings with well developed root system should be ensured. The saplings should be more than 180cm in height with a girth of more than 5cm at the base and 2 years old. The saplings for sub-tropical conditions can be raised by planting of stem cutting in winter and monsoon and for temperate conditions by planting of grafts and stem cuttings in the month of March/April.</p> <p><b>The following important steps should be followed for nursery preparation:</b></p> <ul style="list-style-type: none"> <li>➤ Land should be deep dug</li> <li>➤ Clear it from all the debris, root stocks, weeds etc.</li> <li>➤ Level it Properly</li> <li>➤ Prepare the land into nursery beds preferably of 120 x 480 cm dimensions</li> <li>➤ Separate each bed from one another by 15-20 cm width bunds</li> <li>➤ Link the beds with irrigation channel of about 40 cm width and 20 cm depth.</li> <li>➤ When the beds are ready add 100 kgs of sand and 24 kg of well decomposed FYM in each nursery bed.</li> <li>➤ Mix it thoroughly with soil</li> </ul>	Adopted by DOS and under Kissan Nurseries.

		<ul style="list-style-type: none"> <li>➤ Plant the cuttings in 6" x 8" spacing and grafts in 8"x 10" spacing. 99000 cuttings and 59400 grafts can be planted in 1 acre nursery.</li> </ul> <p><b>Following steps are to taken for better maintenance of nursery:</b></p> <ul style="list-style-type: none"> <li>➤ Irrigate the nursery beds immediately after planting the cuttings, grafts or sowing the seeds and subsequently as and when required.</li> <li>➤ Nursery beds must be kept free from weeds. At least three rounds of manual weeding is required, first after 30-35 days of planting and second and third at an interval of 40-45 days.</li> <li>➤ Chemical fertilizers must be applied in the nursery when saplings attain a height of 20-25 cm.</li> <li>➤ The chemical fertilizer should be applied @ 50kg 'N': 25kg 'P': 25 kg 'K' per hectare in four split doses, each at an interval of 15 days.</li> <li>➤ Ensure irrigation prior to application of fertilizer as it will have better effect on the growth of saplings.</li> <li>➤ Biofertilizers can also be applied in the nursery for maintenance of soil fertility. In that case nitrogenous and phosphatic chemical fertilizer application may be reduced to 50%.</li> <li>➤ Spray of 0.1% Bavistin solution is recommended for controlling fungal diseases in nursery.</li> <li>➤ Maintain the saplings by removing the week shoots using a secateur and keep only one shoot.</li> <li>➤ The saplings will be ready after one/two year for dwarf/tree type plantation respectively.</li> <li>➤ Uproot the saplings without damaging the saplings. Irrigate the nursery before uprooting the saplings.</li> <li>➤ Plant the saplings immediately in field after uprooting. <ul style="list-style-type: none"> <li>➤ If not planted immediately, keep uprooted saplings under shade and cover them with gunny cloth.</li> </ul> </li> </ul>	
--	--	--	--

<b>VII</b>	<b>NEW GRAFTING TECHNIQUE FOR MULBERRY PROPAGATION</b>	For raising of saplings of poor rooting genotypes of mulberry new grafting technique has been developed. Hard wood stem cuttings of good rooting genotypes serve as stock. The above technique helped in reducing the overall time period for raising of plants in temperate climatic conditions of Kashmir valley from 4-5 years to now 2-3 years. The technology of quick raising of poor rooting mulberry genotypes was demonstrated to DOS officials, farmers and other agencies. The success rate has been found 80% in Goshorami, under temperate condition.	Adopted by DOS and under Kissan Nurseries.
<b>VIII</b>	<b>APPLICATION OF BIOFERTILIZER AT NURSERY LEVEL</b>	Nitrofert inoculum is made by adding water (1:1 ratio) so as to make a thick paste.  Basal ends of mulberry cuttings are dipped in the slurry up to a depth of 10 cm for 30 minutes.  250 grams of Nitrofert biofertilizer is required for 1000 cuttings.  Inoculated saplings are uprooted with intact root system from nursery and transplanted in the field.	Adopted by DOS
<b>IX</b>	<b>IDEAL INTERCROPS IDENTIFIED</b>	Aromatic plants <i>Lavendula officinalis</i> and <i>Cymbopogon nardus</i> , Var CN5 have been identified as ideal intercrops with tree type mulberry plantation under temperate and sub-tropical conditions, respectively. Farmers can get additional income from these inter crops.	At farm level
<b>X</b>	<b>INTEGRATED MANAGEMENT OF MULBERRY PEST AND DISEASES</b>	<i>Glyphodes pyloalis</i> has been identified as a severe pest of mulberry in temperate region and <i>Mimastra cyanura</i> in sub-tropics of the state. The management practices of both these pests has been worked out by the Institute and recommendations made accordingly.  A complete IPDM module has been developed by the institute for control of mulberry pests and diseases.	At farm level
<b>SILKWORM IMPROVEMENT</b>			

I	<b>SILKWORM HYBRIDS RECOMMENDED:</b>	<p>i) <b>Hybrids evolved recently and authorized by National Race Authorisation Committee:</b></p> <ul style="list-style-type: none"> <li>☞ Dun 6 X Dun22</li> <li>☞ Dun 16 X Dun17</li> </ul> <p>☞ <b>Hybrids Recommended for Authorization by Provincial Race Authorisation Committee Phase I:</b></p> <ul style="list-style-type: none"> <li>☞ CS6 X PAM 101</li> <li>☞ Dun 6 X Dun21</li> <li>☞ RSJ3 X RSJ1</li> </ul> <p>☞ <b>Hybrids in pipeline (Recommended for authorization by Provincial race authorization Committee Phase II)</b></p> <ul style="list-style-type: none"> <li>☞ PAM 117 X PAM 114 (For Spring)</li> <li>☞ CSR2 X PAM 117 (For Spring)</li> <li>☞ RSJ 15 X NB4D2 (For Autumn)</li> </ul>	Most of the hybrids are under large scale trials.
II	<b>SILKWORM REARING TECHNOLOGY</b>	<b>Low Cost Rearing Houses Suitable for the Northern Region:</b> Institute has designed low cost model rearing houses for various states/regions of North India on the basis of their agro-climate and availability of local building material. The rearing houses constructed at Pampore (Kashmir); Kathua, (Jammu); Sujampur, (Punjab); Pinjore, (Haryana); H. P, Uttarakhand and U. P are serving as the models of rearing houses on large scale which are fruitful for increasing the rearing space and substantial impact on quality cocoon production.	Adopted by farmers.
III	<b>SILKWORM DISEASE MANAGEMENT</b>	Under North Indian conditions, Grasserie has been found most prevalent and its prevalence is about 25 to 32 % at farmer's level. The crop loss estimation is in the range of 11 - 14 Kg per 100 DFLs. The institute has developed an integrated disease management package to minimize the crop loss caused due to this disease and other diseases.	Adopted by farmers.

**2) Technologies submitted for patenting during the year 2013-14:**

- i. Technology developed under the project **“A process for obtaining phytoecdysteroids from...Mulberry silkworm, *Bombyx mori L.*”** has been filed with National Research Development Corporation, New Delhi for patenting. Application No: 1401/DEL/2013 of 10.05.2013 (RSRS, Sahaspur)
- ii. The innovation entitled **“An improvised young age silkworm rearing technique to improve tolerance against diseases / adversities in silkworm *Bombyx mori. L* through supplementation of inorganic tissue salts combination YUKTI”** developed by Dr. M. K. Tayal, Scientist-C, RSRS, Jammu has been submitted to National Research Development Corporation, New Delhi for award of patenting. (RSRS, Jammu)

### **3) Innovations on by-product utilisation and their applicability:**

Preparation of various innovative products using the cut/pierced cocoon has been introduced across North West India. Unemployed youth and CSB staff of North West India has been trained under ISDS on utilization of seri-waste and seri by-products such as preparation of cocoon handicrafts and preparation of mulberry fruit jam.

### **4) Impact of the R&D on production, productivity, quality and cost reduction besides their user friendliness:**

Introduction of improved mulberry varieties recommended by CSR&TI, Pampore has increased the quality leaf production to an extent of 50% as against local genotypes. Likewise, introduction of improved silkworm breeds and rearing technology has enhanced the cocoon yield and quality of cocoons. The average cocoon yield of farmers covered under CDC's has increased from 35 kg to 48 kg/100 DFL (2014). The production of quality cocoon due to intervention of various rearing packages and silkworm hybrids has led to the enhancement in the average cocoon rates from Rs. 100 to 300 per kg, which in turn has improved the socio economic status of the beneficiaries.

### **5) Outcome of the collaborative research projects within and outside CSB institutions and their outcome with impact:**



Various collaborative projects within and outside CSB institutions have been concluded. The outcome of these programmes had its impact on the overall development of Sericulture in North West India. Collaborative programmes with other CSB units such as Race Authorisation Programme, AICEM, MPRAP & AIMS GEP etc were recently concluded and next phases of some of these programmes are presently under progress. Silkworm hybrids tested and authorized in these programmes are presently reared in the field conditions. Likewise, mulberry varieties authorized under 1<sup>st</sup> and 2<sup>nd</sup> phase of AICEM such as Tr-10, S-1635 and Vishala are presently recommended for plantation in North Indian states.

## **6) Challenges foreseen/issues identified affecting the productivity, production and quality.**

Contrary to South Indian states where mulberry exists on “Intensive farming basis” the sericulture in Northern states as an entity survives on scattered/disorganized mulberry plantation which exists in tree mode with no input regime followed. Under the prevailing condition the silk sector could not develop in the Northern states and the avocation remained as a subsidiary occupation with poor economic returns. Unlike multivoltines the bivoltine rearing is capital and technological intensive and even though some opportunities to build up the requisite base, came by way of various schemes of CSB, through catalytic Development Programmes, but these states could not capitalize fully with the result the targets were never achieved. Some of the problems identified are as under:

- Spring is the only main commercial rearing in whole of the North India. Mulberry foliage remains unutilized due to less quantum of rearing in autumn season.
- Most of the egg production centres of state sericulture departments cannot maintain quality standards due to lack of proper infrastructure, equipments and expertise. Even chawki rearing of parent silkworm races are conducted on mulberry leaf, which does not match with the standard quality required for young age silkworms.
- Inadequate technological support for diverse agro zones of the region.
- Lack of proper silkworm disease management at farmers’ level results in high mortality especially in autumn crop.
- Defective cocoon percentage is on a higher side in North India. This varies between 10-15% during spring season and 20-25% in autumn rearing. Reasons for higher defective cocoon percentage are use of unsuitable mountages and mounting materials for spinning silkworms, especially during autumn rearing.
- Poor extension set up of the DOS’s and lack of adequate knowledge of the field staff with the new innovative technologies.

The key issues and concerns faced by the stake holders in the sector can be summarized as:

**Farmer/rearer:**

- Shortage of space and start up tools.
- Poor quality leaf due to unorganized plantations.
- Fluctuating market prices with non-existing quality pricing system.
- Poor returns due to low productivity and mono-cropping.
- Poor quality of F1 seed from DOS's.
- Lack of facilities with P1 farmers with no proper price support from the DOS's.
- Most cocoon producers are small and cannot afford to imbibe technologies for increasing productivity quantitatively and qualitatively.

#### **Reelers:**

- Lack of cocoon at regular intervals to meet the requirements.
- Fluctuation in raw silk prices with poor linkage with the weaving sector.
- Quality based pricing and marketing of silk yarn is yet to take a shape.
- The prolonged storage of the cocoons due to poor marketing as well to meet the demand at regular intervals affects the quality parameters of the reeled silk.
- Need of modernization, besides creation of clusters for post cocoon to facilitate better utilization of facilities.
- Lack of green cocoon marketing particularly in the states of J&K and H.P.

#### **Weavers:**

- Poor facilities, modernization of the sector a dire need.
- Introduction of improved handloom/power looms.
- Local availability of the quality yarn to particularly meet the requirement of the power looms sector.
- Good quality bivoltine silk in bulk quantity at competitive price.
- Fabric finishing segment continues to be weakest link in the silk sector.

To bring about economic viability in the silk sector, the present situation of small producers and small converters to medium producers and medium converters is the requirement of the times ahead.

### **7) Preparedness for climate resilient sericulture with cost reduction, labour saving and women friendly technology development.**

The Institute is emphasizing on soil moisture conservation in the drought hit areas of North India and organic farming as a measure of preparedness for climate resilient sericulture with cost reduction and labour saving. All precautionary measures/steps are taken to combat the challenges of the nature through wide network of the extension units across North West India from time to time through fore casting and fore warning system.