ERICULTURE AND PROSPECTS FOR EXPLOITATION

BY:
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PRODUCTION OF ERI SILK

Over the period of last ten years, eri silk production increased significantly from 735 MT in 1995-96 to 1079 MT in 2000-2001, further to 1417 MT during 2004-05.
## PRODUCTION STATISTICS OF ERI SILK DURING LAST DECADE

<table>
<thead>
<tr>
<th>Year</th>
<th>Northeastern States (MT)</th>
<th>Other parts of the country (MT)</th>
<th>Total production (MT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995-96</td>
<td>734.67</td>
<td>10.33</td>
<td>745.00</td>
</tr>
<tr>
<td>1996-97</td>
<td>734.67</td>
<td>10.33</td>
<td>745.00</td>
</tr>
<tr>
<td>1997-98</td>
<td>762.47</td>
<td>51.53</td>
<td>814.00</td>
</tr>
<tr>
<td>1998-99</td>
<td>848.09</td>
<td>121.91</td>
<td>970.00</td>
</tr>
<tr>
<td>1999-00</td>
<td>682.56</td>
<td>291.44</td>
<td>974.00</td>
</tr>
<tr>
<td>2000-01</td>
<td>1079.00</td>
<td>10.00</td>
<td>1089.00</td>
</tr>
<tr>
<td>2001-02</td>
<td>1148.00</td>
<td>12.00</td>
<td>1160.00</td>
</tr>
<tr>
<td>2002-03</td>
<td>1300.70</td>
<td>15.30</td>
<td>1316.00</td>
</tr>
<tr>
<td>2003-04</td>
<td>1333.00</td>
<td>19.00</td>
<td>1352.00</td>
</tr>
<tr>
<td>2004-05</td>
<td>1417.00</td>
<td>31.20</td>
<td>1448.20</td>
</tr>
</tbody>
</table>
USES OF ERI

- Mainly two types of eri products are made in North East, *i.e.*, 
- Eri-chaddars for gents and 
- Eri-scarves with small motifs for ladies as winter clothing. Eri silk possesses excellent thermal properties 
- The loose fibers can be used as a filling material in quilts and winter clothing due to its thermal properties.
It can be used for production of diversified and specialized items like:

- Ladies garments, Chaddars, Dokhanas, skirts, midies, maxis, etc.
- Children garments.
- Kurtas, Jackets, etc.
- Cross stitch and embroidery work.
- Fashion accessories like ties, scarves, stoles, kerchiefs, etc.
- Bags, wallets, file, folders, etc.
ADVANTAGE OF ERI SILK

- Traditionally, eri is known for simple living and used only in manufacture of gents chaddars and ladies shawls, that too in natural colour.

- Besides the traditional shawls we can see stoles, garments, scarf, furnishing materials of eri in varied colour combinations that were not available earlier.

- Eri crepes using extra twist in both warp and weft and increasing the shrinkage so that it could well be used for modern dresses like ladies skirt etc. by blending it with other silks and natural fibers like cotton, wool and pashmina.

- Because of its natural warmth it is user friendly.
BY-PRODUCTS AND ITS UTILITY

1. Food plants By-products:
   - The unused leaves and branches produced from pruning are utilized as cattle feed, fuel and manure.
   - The stem of castor can be used in paper industry.
   - The castor seeds, which contains about 45% of nitrogen in the oil cake, can be used as manure or antidote to white ants in the field.

2. Uses of Eri Silkworm Litter:
   - The litters of eri silkworms can be used as component in production of vermi-compost.
3. Uses of Pupae:

- The eri pupa contains 60% crude protein, 25% lipid and 5-8% free amino acids and it is a delicacy among many tribes of North East India.

- The pupa oil is used in preparation of emulsion solution in jute industry to make jute fibre soft for easy spinning.
ERI SILKWORM AND ITS DIVERSITY

The structure of the genitalia, wing pattern and chromosome number demonstrate that *Samia ricini* (Donovan)(2n=40) is derived from its wild form, *Samia canningi* (Hutton).

- The cultivated variety of *Samia ricini* does not occur in the wild.

- The taxonomic position of eri silkworm is as follows.
  
  A) Order : Lepidoptera
  B) Family : Saturniidae.
  C) Tribe : Attacini
  D) Genus : *Samia*
  E) Species : *ricini* (Donovan)
Six homozygous strains were isolated on the basis of larval colour and marking,

- Yellow Plain (YP),
- Yellow Spotted (YS),
- Yellow Zebra (YZ),
- Greenish Blue Plain (GBP)
- Greenish Blue Spotted (GBS)
- Greenish Blue Zebra (GBZ).
COCOON CHARACTERS:

- Cocoon colours are white, off-white and brick red.
- White colour cocoon is available in whole North East India.
- In Kokrajhar of Assam, eri silkworm is reared exclusively for brick red cocoons. Cocoons are oval in all cases.
Different types of eri cocoons
STRAINS

MOTH CHARACTERS

- Moth colour is variable, but always solidly white on the dorsal surface of the abdomen.
- Ground colour was usually light or dark grayish brown, rarely reddish, but occasionally olive gray.
- Wing pattern was heavily marked whiter in ante median and post median lines.
Different type of moth of eri silkworm moths
In eri silkworm, eight eco-races are known, 

1. Borduar, 2. Titabar, 
3. Dhanubhanga, 4. Khanapara, 
5. Sile, 6. Nongpoh, 

Among these, Borduar, Titabar and Kokrajhar eco-races are commercially exploited due to their better economic traits.

These eco-races are being reared by farmers of Meghalaya, Assam, Manipur and Nagaland.
<table>
<thead>
<tr>
<th>Eco-races</th>
<th>Locality /origin</th>
<th>Larval colour (Strains)</th>
<th>Fecundity (Nos.)</th>
<th>Cocoon colour</th>
<th>Shell wt. (g)</th>
<th>Silk Yield (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Borduar</td>
<td>Borduar, Kamrup</td>
<td>YP, YZ, GBP, GBZ</td>
<td>465</td>
<td>White</td>
<td>0.53</td>
<td>13.47</td>
</tr>
<tr>
<td>Titabar</td>
<td>Titabar, Jorhat</td>
<td>YP, YS, GBP, GBS,</td>
<td>464</td>
<td>Off White</td>
<td>0.50</td>
<td>13.01</td>
</tr>
<tr>
<td>Dhanubhanga</td>
<td>Dhanubhanga, Goalpara</td>
<td>YP, GBP, GBS,</td>
<td>443</td>
<td>White</td>
<td>0.47</td>
<td>13.24</td>
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<tr>
<td>Khanapara</td>
<td>Khanapara, Kamrup</td>
<td>YP, GBP, GBS,</td>
<td>461</td>
<td>White</td>
<td>0.50</td>
<td>12.85</td>
</tr>
<tr>
<td>Kokrajhar</td>
<td>Kokrajhar,</td>
<td>YP</td>
<td>466</td>
<td>Brick red</td>
<td>0.51</td>
<td>14.64</td>
</tr>
<tr>
<td>Sille</td>
<td>Sille, Arunachal</td>
<td>YP</td>
<td>438</td>
<td>White</td>
<td>0.46</td>
<td>12.92</td>
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<tr>
<td>Nongpoh</td>
<td>Meghalaya, Nongpoh</td>
<td>YP, GBP</td>
<td>448</td>
<td>White</td>
<td>0.47</td>
<td>12.76</td>
</tr>
<tr>
<td>Mendipathar</td>
<td>Mendipathar East Garo Hills</td>
<td>YP, YZ, GBP, GBZ</td>
<td>454</td>
<td>White</td>
<td>0.46</td>
<td>12.67</td>
</tr>
</tbody>
</table>
### Rearing performance of different eco-races of eri silkworm (Av. of 7 crops).

<table>
<thead>
<tr>
<th>Eco-races</th>
<th>Fecundity (nos.)</th>
<th>Hatchi ng (%)</th>
<th>Larv al weig ht (g)</th>
<th>ERR (%)</th>
<th>Av. coco on wt. (g)</th>
<th>Av. shell wt. (g)</th>
<th>Silk Ratio (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Borduar</td>
<td>433.71</td>
<td>91.34</td>
<td>5.82</td>
<td>88.22</td>
<td>3.54</td>
<td>0.50</td>
<td>14.22</td>
</tr>
<tr>
<td>Dhanubhanga</td>
<td>421.57</td>
<td>89.64</td>
<td>5.78</td>
<td>88.26</td>
<td>3.56</td>
<td>0.50</td>
<td>14.26</td>
</tr>
<tr>
<td>Khanapara</td>
<td>413.00</td>
<td>89.10</td>
<td>5.83</td>
<td>85.28</td>
<td>3.33</td>
<td>0.48</td>
<td>14.22</td>
</tr>
<tr>
<td>Mendi Local</td>
<td><strong>436.20</strong></td>
<td>90.33</td>
<td><strong>5.79</strong></td>
<td>87.28</td>
<td>3.37</td>
<td>0.50</td>
<td><strong>15.09</strong></td>
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<tr>
<td>Nongpoh</td>
<td>425.70</td>
<td>88.69</td>
<td><strong>5.92</strong></td>
<td>86.91</td>
<td>3.43</td>
<td>0.50</td>
<td>14.74</td>
</tr>
<tr>
<td>Titabar</td>
<td>393.14</td>
<td>89.27</td>
<td>5.61</td>
<td>87.53</td>
<td>3.32</td>
<td>0.48</td>
<td>14.41</td>
</tr>
</tbody>
</table>
## Rearing performance of different strains of eri silkworm (Av. of 5 crops).

<table>
<thead>
<tr>
<th>Strains</th>
<th>Fecundity (nos.)</th>
<th>Hatching (%)</th>
<th>Larval weight (g)</th>
<th>ERR (%)</th>
<th>Av. cocoon wt. (g)</th>
<th>Av. shell wt. (g)</th>
<th>Silk Ratio (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y. Plain</td>
<td>452.0</td>
<td>90.17</td>
<td>5.77</td>
<td>79.54</td>
<td>3.42</td>
<td>0.51</td>
<td>14.94</td>
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<tr>
<td>Y. Spotted</td>
<td>448.20</td>
<td>89.63</td>
<td>5.77</td>
<td>80.18</td>
<td>3.43</td>
<td>0.53</td>
<td>15.35</td>
</tr>
<tr>
<td>Y. Zebra</td>
<td>440.40</td>
<td>91.34</td>
<td>5.67</td>
<td>80.35</td>
<td>3.30</td>
<td>0.47</td>
<td>14.39</td>
</tr>
<tr>
<td>G. B. Plain</td>
<td>337.20</td>
<td>90.57</td>
<td>5.65</td>
<td>84.54</td>
<td>3.45</td>
<td>0.510</td>
<td>15.00</td>
</tr>
<tr>
<td>G. B. Spotted</td>
<td>452.20</td>
<td>89.21</td>
<td>5.53</td>
<td>77.57</td>
<td>3.39</td>
<td>0.54</td>
<td>15.90</td>
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<tr>
<td>G. B. Zebra</td>
<td>428.60</td>
<td>90.73</td>
<td>5.56</td>
<td>79.74</td>
<td>3.25</td>
<td>0.46</td>
<td>14.42</td>
</tr>
</tbody>
</table>
Grainage Hall:

1. Bamboo made house with thatched roof and mud plastered wall is preferable for grainage in rural areas. For concrete halls, it should be well ventilated.

2. Size of the hall will depend on the numbers of dfls to be prepared during a particular period.

3. Varanda should be provided round the hall for keeping temperature down during summer.
MATERIALS REQUIRED FOR GRAINAGE OPERATION

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# MATERIALS REQUIRED

## EQUIPMENTS

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Spray machine</td>
</tr>
<tr>
<td>2.</td>
<td>BOD incubator</td>
</tr>
<tr>
<td>3.</td>
<td>Microscope</td>
</tr>
<tr>
<td>4.</td>
<td>Micro-slides and cover slips</td>
</tr>
<tr>
<td>5.</td>
<td>Moth crushing set</td>
</tr>
<tr>
<td>6.</td>
<td>Masks and gloves</td>
</tr>
<tr>
<td>7.</td>
<td>Moth cage</td>
</tr>
<tr>
<td>8.</td>
<td>Kharika or netlon pouch</td>
</tr>
<tr>
<td>9.</td>
<td>Foam pad</td>
</tr>
<tr>
<td>10.</td>
<td>Measuring cylinder</td>
</tr>
<tr>
<td>11.</td>
<td>Balance</td>
</tr>
<tr>
<td>12.</td>
<td>Muslin cloth</td>
</tr>
<tr>
<td>13.</td>
<td>Scissor</td>
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<tr>
<td>14.</td>
<td>Bucket</td>
</tr>
<tr>
<td>15.</td>
<td>Threads</td>
</tr>
</tbody>
</table>

## CHEMICALS

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>1.</td>
<td>Formalin</td>
</tr>
<tr>
<td>2.</td>
<td>Bleaching powder</td>
</tr>
<tr>
<td>3.</td>
<td>Lime powder</td>
</tr>
<tr>
<td>3.</td>
<td>Potassium hydroxide</td>
</tr>
</tbody>
</table>
Disinfections should be done 3-4 days prior to consignment of seed cocoons and immediately after completion of grainage operations.

Drench the walls of the hall and grainage appliances with 5% Bleaching Powder solution.

Seal the grainage hall air tight and put all appliances inside it.

Prepare fresh disinfectants by mixing 5 g slaked lime/l of 2% Bleaching powder solution.

Disinfection should be done preferably during a sunny day.

Spray freshly prepared disinfectants in the grainage hall and keep the room closed for 24 hours.

Amount of disinfectants to be used is 1 litre per 2.5 sq.m floor area.

Open the hall one day prior to receipt and transfer of seed cocoons into the hall.

Use masks and hand gloves during the process.
SELECTION, COLLECTION AND TRANSPORTATION OF SEED COCOONS

- Select only compact and fully formed cocoons for seed purpose.
- Before selection, pupal gut test should be done to pebrine freeness of the lot.
- Cocoons from the date of highest worm ripening day are preferable.
- Transport seed cocoons after complete pupation avoiding direct sunlight, rain, jerk etc.
The seed cocoons should be kept in moth cages in single layer to facilitate proper aeration and at temperature between 26-28 degree Celsius with RH 80%.

Moth emergence generally takes place during morning and continues till noon.

Male and female moths should be kept in moth cages at 1.5:1 ratio for easy coupling for a period of 10 hours.

Decouple the moths next day morning and female moths may be tied in kharikas or in netlon pouch.

First three days laid eggs should be kept for rearing.

The mid gut of the mother moths should be examined to detect presence of pebrine spores and positive moths should be rejected and burnt.

The eggs selected are then should be drenched with soap solution followed by dipping in 2% formaldehyde solution for three minutes and then washing in running water till smell of formaldehyde goes off.

Sterilized eggs then should be dried in shade.

For uniform hatching of eggs, the dfIs packed in paper or bamboo boxes should be incubated at 26±1° C temperature and 85±5 % RH.
REARING HOUSE

- Rearing house should be well aerated and dry.
- For 100 dfls rearing, size of the rearing house should be 16x12x10 ft (LxBxH) with 1.5 m verandah all around is ideal.

DISINFECTION OF REARING HOUSE AND APPLIANCES

- Prior to rearing, rearing house and appliances should be sterilized thoroughly with 5% Bleaching powder solution @ 1 litre per 2.5 sq m area. One kg bleaching powder is required to disinfect the rearing house per operation.
- Disinfect the rearing house and appliances immediately after completion of rearing in similar way.

REARING APPLIANCES

- Five tier bamboo platform with carrying capacity of 25 dfls i.e. 5 dfls in each tier.
FEEDING AND BED CLEANING

- Newly hatched silkworms should be put to tender leaves with the help of a feather or soft hair brush.

- Provide tender leaves to 1\textsuperscript{st} and 2\textsuperscript{nd} instar, medium leaves to 3\textsuperscript{rd} instar and mature leaves to 4\textsuperscript{th} and 5\textsuperscript{th} instar worms.

- Daily provide feeding 2 times to 1\textsuperscript{st}, 2\textsuperscript{nd} and 3\textsuperscript{rd} and 4 times to 4\textsuperscript{th} and 5\textsuperscript{th} stage silkworms.

- For 100 dfls rearing, requirement of leaf is 120 kg for I-III stage, 120 kg for IV stage and 960 kg for V stage larvae.

- Clean rearing beds once during 1\textsuperscript{st} stage, twice during 2\textsuperscript{nd} stage, thrice during 3\textsuperscript{rd} stage and daily during 4\textsuperscript{th} and 5\textsuperscript{th} stage.

- Avoid overcrowding of worms in the rearing tray/platform.
PRECAUTIONS TO BE TAKEN DURING MOULTING PERIOD

- Eri silkworm moults four times during its larval life.
- During moulting period, larvae should not be disturbed.
- When more than 80% worms enter moulting, rearing bed should be dusted with slacked lime powder to keep the rearing tray/platform dry.
- When 90% worms complete moulting, resume feeding.
SPINNING OF WORMS AND HARVESTING OF COCOONS

- Bamboo chandraki, bamboo strip mountage and collapsible plastic mountages are found most suitable for cocooning of eri silkworm.
- Ensure well aeration in the cocooning hall.
- Harvest cocoons from the mountage after 5 days of cocooning during summer and after 8 days during winter.
ADVANTAGE OVER EXISTING PROCESSES/PRODUCTS

- NBR-1 variety of castor with recommended package of practices ensures 12 MT leaf yield per hectare as against 8 MT yield at farmers level which amounts to 33.3% gain.
- It enhances the carrying capacity per hectare from 667 dfls to 1000 dfls per year.
- Recommended Borduar and Titabor eco-races of eri silkworm have higher potential in respect of fecundity (Av. 400 nos.) and shell weight (Av. 0.38g).
HOST PLANTS OF ERI SILKWORM
1. **CASTOR** (*Ricinus communis*)

It is an evergreen, bush or small tree, shoots and panicles glaucous, leaves green, 30-45 cm diameter, membranous, lobes from oblong to linear acute, gland serrated, petiole 12-30 cm., racemes stout, erect, male flower 1.5 cm in diameter, female calyx nearly oblong, styles often highly coloured, capsules 1.5 to 3.0 cm, long globosely oblong, smooth or echinate, seeds oblong, smooth and mottled.
METHOD OF PROPAGATION

Castor is grown generally through seeds, which are sown during March-April and September-October in NE India.

Perennial varieties are recommended to be sown at a spacing of 1 X 1.5 meter spacing while annual in 1 X 1 meter spacing.

Both pit and furrow method of planting could be adopted for castor cultivation.
VARIETIES OF CASTOR

There are several varieties of castor available in India. NBR-1, local green, local pink, 48-1 Varieties of castor showed better performance in leaf yield and silkworm rearing in N.E. India.

Some other varieties grown for eri silkworm rearing are, 12B Hardasbigha, Damalgiri, T-3, Hojai, Local Red -Powdery, Dharmanagarpur, RG-885 and RG-919, etc.

The ruling castor varieties/hybrids for seed production in India are Co-1, Jyothi, Kranthi, Aruna, Bhagya, GCH-4, DCH-32, DCH-177, Gauch-1 etc.
VARIETIES OF CASTOR

Ten promising castor varieties have been identified suitable for eri silkworm rearing *viz.*,

i) Local Green,  
ii) 12B Hardasbigha,  
iii) Damalgiri,  
iv) T-3,  
v) Local Red - Non-powdery (NBR-1),  
vi) Hojai,  
vii) Local Red - Powdery,  
viii) Dharmanagarapur,  
ix) RG-885 and  
x) RG-919.

Among these, NBR-1 is proved to be the best performer.
BIOMASS YIELD PER UNIT AREA

High yielding varieties of castor have the potentiality of producing 10-12 t leaf/ha/year.

In addition, it could also produce 2-4 quintals of seeds per hectare in a year.

Under NE condition, from castor plantation, four leaf harvests can be made in a year during 1) May (3500 kg/ha), 2) July-August (3000 kg/ha), 3) October-November (3000 kg/ha) and 4) February-March (2500 kg/ha).

NBR-1 variety of castor with recommended package of practices ensures 12 MT leaf yield per hectare as against 8 MT yield at farmers level which amounts to 33.3% gain.

It enhances the carrying capacity per hectare from 667 dfls to 1000 dfls per year.
TAPIOCA OR CASSAVA: *MANIHOT ESCULENTA*

- Tapioca is a perennial shrub with variously branched stems growing to a height of 3-4 meters and produces enlarged tuberous roots.

- It grows best in warm and humid climate, soils of all types except in saline or alkaline having pH within 5.5 to 7.0, but could not withstand water logging.

- The leaves of this plant are very large with long petioles, having 5-10 lobes or sometimes more, dark green in colour but red, yellow and purple colour leaves are also found.
<table>
<thead>
<tr>
<th>State</th>
<th>Area under tapioca (,000 Ha)</th>
<th>Tuber production (,000 tonnes)</th>
<th>Productivity (t/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kerala</td>
<td>130.1</td>
<td>2578.0</td>
<td>19.82</td>
</tr>
<tr>
<td>Tamil Nadu</td>
<td>81.3</td>
<td>3066.0</td>
<td>37.71</td>
</tr>
<tr>
<td>Andhra Pradesh</td>
<td>21.7</td>
<td>220.5</td>
<td>10.17</td>
</tr>
<tr>
<td>Assam</td>
<td>2.2</td>
<td>10.0</td>
<td>4.36</td>
</tr>
<tr>
<td>Karnataka</td>
<td>1.0</td>
<td>8.0</td>
<td>8.0</td>
</tr>
<tr>
<td>Others</td>
<td>9.5</td>
<td>107.0</td>
<td>11.3</td>
</tr>
<tr>
<td>All India</td>
<td>242.8</td>
<td>5929.0</td>
<td>24.40</td>
</tr>
</tbody>
</table>
METHOD OF PROPAGATION

- Tapioca is propagated through cuttings.
- Stems of 8-10 months old with a diameter of 2-3 cm are selected for preparation of cuttings.
- Discarding the upper immature and lower mature base, the stem is cut into pieces of 20 cm which are used as planting material.

VARIETIES

- Varieties namely, Co-1, H-1423, M4 and H-2304 were found suitable for eri silkworm rearing under NE condition.
- The tapioca leaves can be utilized for eri silkworm rearing throughout the year excepting during the months of December to February (winter).
BIOMASS YIELD PER UNIT AREA

Study conducted revealed that with the increase in spacing, the plant produces more no. of branches/plant (8.17 nos. to 11.4 no.).

Maximum leaf yield recorded per acre is 10250 kg in 30 cm spacing followed by 60 cm (7846 kg).

Tuber yield is maximum in 120 cm (8057.14 kg /ha) followed by 60 cm (6498.93 kg /acre).

Four tapioca varieties namely, H-1423, H-97, H-468 and Local were screened for leaf yield, tuber yield and rearing performances.

Tapioca variety, H-468 recorded highest leaf and tuber yield (23,798.35 and 29,859.62 kg/ha/yr, respectively) which also showed better rearing performance compared to other varieties.
Kesseru, *Heteropanax fragrans*

Kesseru is a soft wooden evergreen tree, bark nearly white to dark grey, about 1.5cm thick, soft and pale to greenish with brown strands inside.

**Leaves enormous often with a pair of leaflets at the nodes.**

Flowers about 1 cm across, polygamous, yellow, fragrant, sub-sessile or shortly pedicellate in dense sub-globose umbels.

**Flowers and inflorescence covered with rusty granules**

Fruit compressed at right angle to the septum, 3-5 cm by 7.5-10 cm, endocarp crustaceous, seed-2, orbicular, compressed with ruminated albumen.
METHOD OF PROPAGATION

Kesseru is generally propagated through seeds.

Ripened Kesseru seeds are to be collected during February-March and viable seeds are selected through floating test.

Around 1000 seeds are to be sown in a seedbed of 6x2 m size at a distance of 15 x 10 cm.

The seedlings will be ready for transplantation to main field during September (6 months old seedlings), which is the convenient month for Kesseru plantation.

Kesseru can also be propagated through stem cutting.
BIOMASS YIELD PER UNIT AREA

- Recommended package of practices for Kesseru cultivation ensures production of 20 MT of effective leaf per hectare at full grown stage, which would support 1600 dfls to produce 90 kg cocoon shell.

- Kesseru being perennial in nature, productive life span is 20-25 years and thus recurring expenditure on plantation like castor cultivation will not be required.
PAYAM, EVODIA FRAXINIFOLIA:

- Payam is a lofty forest tree with lusty growth. It is a moderate size (10-15 ft tall) evergreen perennial tree, which prefers to grow on the sloppy hills. The plant has shallow root system and hence, the tree is easily swept away by the strong wind.

- Leaves are pinnately compound, imparipinnate, stipulate.

- The mature capsules are red, cocci usually 4, seeds rather compressed weighing 9-10 mg, testa dark brown to blackish in colour.

- The albumen and cotyledons are oily.
METHOD OF PROPAGATION

- The plant is commonly grown from seedling.
- Air layering is also practiced for vegetative propagation.
- The mature seeds are collected during September-October and sown immediately to get maximum germination.
- Due to absence of an ideal propagation technique, plantation of Payam could not be taken up at farmers’ level and therefore, it is found as stray plantation in some pockets of this region.
In Nagaland and Meghalaya, Payam is used as major food plant for eri silkworm rearing as it is evergreen in nature.

After two years of plantation, the plants are pruned to get a thick crown at a manageable height.

The normal gestation period is 3-4 years and leaves can be harvested 4 times in a year.

The leaf yield per acre of plantation was estimated up to the tune of 10,125kg/year.

- It is a lofty fast growing tree found extensively in Sub-Himalayan region, introduced probably from Japan.
- It is extensively cultivated as an avenue tree.
- The leaves often exceeding one foot, pubescent or sub-glabrous, the leaflets very numerous coarsely toothed at the base.
- The stamens exerted; filaments are several times than the length of the anther; samara one inch by half an inch, membranous, linear, oblong.
METHOD OF PROPAGATION

- This plant can be propagated easily from seed or from cuttings.
- The seeds should be sown in April-May in light texture soil under shade and germination takes place within 1-2 weeks.

BIOMASS YIELD PER UNIT AREA

- It has been estimated that, around 40-42-t/ha leaves biomass can be obtained from 6-11 years old plants.
AILANTHUS EXCELSA

- The leaves are 1-2 feet long, glandularly hairy, leaflets very coarsely toothed.
- The fruit of the plant is a samara, which is two inches by half inches in size, red, twisted.
- The flowers are larger than that in *Ailanthus glandulosa*, on longish pedicels in large lax; often very much branched panicles.
- In India, the bark of the *Ailanthus excelsa* Roxb. is used as a bitter tonic.
AILANTHUS ALTISSIMA

- In India, this tree is distributed in Jammu & Kashmir as a forest tree.
- It is a native tree of Northern China.
- It is almost similar to A. excelsa.
- The leaflets with a few short teeth or lobules only near the base, petioles less than 1 cm, petals wooly.
- It generates abundantly from seeds and easily from root cuttings and reproduces profusely from root suckers.
LEAF YIELD POTENTIAL AND COMPARATIVE REARING PERFORMANCE OF ERI SILKWORM ON DIFFERENT FOOD PLANTS

Seventy two castor genotypes were collected from Golaghat, Jorhat, Sivasagar, Lakhimpur, Sunitpur, Nagoan and Karbi Anglong districts of Assam during 2003-04 under germplasm collection & conservation programme of CMER&TI.

Out of these, seven genotypes have been found promising on economic traits for including them in evaluation programme and data on leaf harvests were recorded.
## Leaf yield and rearing performance of promising castor germplasm accessions

<table>
<thead>
<tr>
<th>Accession No.</th>
<th>Leaf yield (Kg/ha.)</th>
<th>Larval period (days)</th>
<th>Larval weight (g)</th>
<th>ERR (%)</th>
<th>Single cocoon weight (g)</th>
<th>Single shell weight (g)</th>
<th>SR (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>11189.48</td>
<td>18</td>
<td>7.06</td>
<td>80.0</td>
<td>2.79</td>
<td>0.34</td>
<td>12.10</td>
</tr>
<tr>
<td>2</td>
<td>11721.63</td>
<td>18</td>
<td>8.09</td>
<td>95.0</td>
<td>3.15</td>
<td>0.46</td>
<td>14.68</td>
</tr>
<tr>
<td>3</td>
<td>10833.18</td>
<td>18</td>
<td>7.92</td>
<td>91.67</td>
<td>3.33</td>
<td>0.45</td>
<td>13.70</td>
</tr>
<tr>
<td>4</td>
<td>11546.88</td>
<td>18</td>
<td>7.76</td>
<td>83.0</td>
<td>2.85</td>
<td>0.35</td>
<td>12.25</td>
</tr>
<tr>
<td>5</td>
<td>11235.63</td>
<td>19</td>
<td>7.10</td>
<td>93.33</td>
<td>2.73</td>
<td>0.39</td>
<td>13.62</td>
</tr>
<tr>
<td>6</td>
<td>10551.13</td>
<td>18</td>
<td>7.48</td>
<td>85.33</td>
<td>3.19</td>
<td>0.36</td>
<td>11.21</td>
</tr>
<tr>
<td>7</td>
<td>9877.70</td>
<td>18</td>
<td>7.64</td>
<td>78.0</td>
<td>2.87</td>
<td>0.30</td>
<td>10.90</td>
</tr>
<tr>
<td>NBR-1</td>
<td>10301.48</td>
<td>18</td>
<td>6.68</td>
<td>82.33</td>
<td>2.52</td>
<td>0.31</td>
<td>12.18</td>
</tr>
<tr>
<td>CD_{0.05}</td>
<td>176.52</td>
<td>0.69</td>
<td>0.38</td>
<td>3.76</td>
<td>0.37</td>
<td>0.06</td>
<td>2.09</td>
</tr>
</tbody>
</table>
Study on leaf yield of different eri food plants revealed maximum production in payam and kesseru (25,000 kg) followed by castor (14,000 kg) and tapioca (8,028 kg in H-648 variety) per hectare per year.

April-May and September-October are the best seasons for tapioca planting. Leaf yield/hectare of tapioca was recorded as 9271.09 kg and tuber yield/hectare as 18529.84 at a spacing of 90 x 90 cm.

Four tapioca varieties namely, H-1423, H-97, H-468 and Local were screened for leaf yield, tuber yield and rearing performances.

Tapioca variety, H-468 recorded highest leaf and tuber yield (23,798.35 and 29,859.62 kg/ha/yr, respectively) which also showed better rearing performance compared to other varieties.
### Leaf yield potential of different food plants of eri silkworm

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Vernacular Name (Botanical Name)</th>
<th>Leaf yield potential (t/ha.)</th>
<th>Rearing capacity (No. of dfls/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Castor (<em>Ricinus communis</em>)</td>
<td>12.0</td>
<td>1000-1200</td>
</tr>
<tr>
<td>2.</td>
<td>Tapioca (<em>Manihot esculenta</em>)</td>
<td>25.0</td>
<td>2000 (full utilization of leaves) 500 (25% leaf plucking)</td>
</tr>
<tr>
<td>3.</td>
<td>Kesseru (<em>Heteropanax fragrans</em>)</td>
<td>20</td>
<td>1600</td>
</tr>
<tr>
<td>5.</td>
<td>Barpat (<em>Ailanthus grandis</em>)</td>
<td>40.0-42.0</td>
<td>3200</td>
</tr>
<tr>
<td>6.</td>
<td>Barkesseru (<em>Ailanthus excelsa</em>)</td>
<td>35.0-40.0</td>
<td>3000-3200</td>
</tr>
</tbody>
</table>
One dfi of eri silkworm with fecundity of 400 nos. of eggs, with 94% hatching consumes about 11 kg castor leaves and 82% of the same is consumed in the last instar (Singh, 1994).

It has been well established that defoliation of castor leaves up to 25-30% in each plant has no deleterious affect on the quality and yield of castor seeds.

Various experiments conducted to study the comparative performance of different food plants on rearing silkworms have well established

1. the superiority of castor over all the others.
2. Kesseru occupies the first position among the perennial plants.
3. The kesseru fed eri cocoons are compact and take more time for degumming during spinning.
## Rearing performance of eri silkworms on different food plants

<table>
<thead>
<tr>
<th>Food plants</th>
<th>Larval period (days)</th>
<th>Wt. of mature larva (g)</th>
<th>ERR (%)</th>
<th>Cocoon wt. (g)</th>
<th>Shell wt. (g)</th>
<th>Shell Ratio (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Castor</td>
<td>20.00</td>
<td>5.83</td>
<td>82.41</td>
<td>3.38</td>
<td>0.49</td>
<td>14.49</td>
</tr>
<tr>
<td>Kesseru</td>
<td>25.00</td>
<td>4.46</td>
<td>59.99</td>
<td>2.64</td>
<td>0.38</td>
<td>14.39</td>
</tr>
<tr>
<td>Tapioca</td>
<td>22.75</td>
<td>4.15</td>
<td>47.99</td>
<td>2.79</td>
<td>0.40</td>
<td>14.33</td>
</tr>
<tr>
<td>Payam</td>
<td>24.50</td>
<td>4.90</td>
<td>51.83</td>
<td>2.80</td>
<td>0.35</td>
<td>12.50</td>
</tr>
</tbody>
</table>

* This study was conducted at RERS, Mendipathar.
Further study conducted at CMER&TI, Lahdoigarah

Table: Rearing performance, larval and cocoon characters of eri silkworm fed on different food plants. (pooled data of 4 seasons)

<table>
<thead>
<tr>
<th>Food plants</th>
<th>ERR</th>
<th>Cocoon Wt. (g)</th>
<th>Shell Wt. (g)</th>
<th>S. R. (%)</th>
<th>Pupal Wt. (g)</th>
<th>Larval duration (Days)</th>
<th>Wt. of larva (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Castor</td>
<td>92.00</td>
<td>3.86</td>
<td>0.49</td>
<td>12.67</td>
<td>3.39</td>
<td>19.00</td>
<td>6.91</td>
</tr>
<tr>
<td>Borpat</td>
<td>84.67</td>
<td>2.97</td>
<td>0.38</td>
<td>12.80</td>
<td>2.59</td>
<td>20.00</td>
<td>6.56</td>
</tr>
<tr>
<td>Kesseru</td>
<td>86.00</td>
<td>3.36</td>
<td>0.39</td>
<td>11.60</td>
<td>2.97</td>
<td>20.00</td>
<td>6.40</td>
</tr>
<tr>
<td>Tapioca</td>
<td>41.00</td>
<td>2.09</td>
<td>0.21</td>
<td>10.04</td>
<td>1.88</td>
<td>28.00</td>
<td>4.09</td>
</tr>
<tr>
<td>Payam</td>
<td>70.00</td>
<td>2.81</td>
<td>0.33</td>
<td>11.74</td>
<td>2.48</td>
<td>20.00</td>
<td>6.05</td>
</tr>
<tr>
<td>Korha</td>
<td>60.00</td>
<td>2.60</td>
<td>0.28</td>
<td>10.82</td>
<td>2.32</td>
<td>22.00</td>
<td>5.50</td>
</tr>
</tbody>
</table>
As mentioned earlier,

- Although castor is the best food plant for eri silkworm rearing, due requirement of its cultivation annually, its cost of cultivation as per recommended package of practices is very high.

- But, although these plants have got long gestation period to support rearing, perennial plants have got the advantages of producing leaves round the year with very low recurring expenditure once established.
R & D requirement

A. HOST PLANT IMPROVEMENT

- Development of package of practices of perennial eri host plants cultivation and management.
- Development of suitable package of practices for improvement and utilization of castor for dual purposes i.e. for castor seed production and silkworm rearing.
- Standardization of vegetative propagation for perennial eri host plants.
- Micro-propagation of eri host plants like Kesseru, Ailanthus and Payam
- Identification, characterization and evaluation of perennial eri host plant genotypes.
- Development of integrated disease and pest management strategy for eri host plants.
R & D requirement

B. Breeding and Genetics:

- Enrichment of eri host plant gene pools and establishment of GPB
- Breeding programme for improvement in foliage yield and quality.
- Evolution of high yielding perennial castor varieties, castor varieties suitable for eri rearing as well as seed production.
- Identification, characterization and evaluation of perennial eri host plant genotypes.
C. Silkworm Improvement:

- Enrichment of eri silkworm gene pools and establishment of GPB for future breeding programme.
- Evolution of superior races of eri silkworm.
- Development of cost effective and eco-friendly IPM strategy.
- Development of low cost rearing technology with maximum utilization of locally available materials.
- Evaluation of suitable techniques for exploitation of eri pupae and other by-products.
- Development of suitable method for preservation of cocoon and eggs.
- Molecular characterization of the eri silkworm races/strains through DNA fingerprinting, etc.
- Biotechnological approach to evolve high yielding disease tolerant race/strain in eri silkworm/food plant cultivars.
- Molecular characterization of the pathogens of eri silkworm diseases