BIBLIOGRAPHY


Arora, G.S. and Gupta, I.J. (1979) Taxonomic studies on some of the Indian Non-mulberry silkmoths (Lepidoptera : Saturniidae : Saturniinae), Memoires of the Zool. Surv. of Ind. 16(1), 49-54.


Arunachalam, V. and Bandyopadhyay, A. (1994) A method to make decisions jointly on a number of dependent characters, Indian J. Genet., 44(3) : 419-424.


Bharali, N. (1984) Investigation on the growth and development of muga worm (A. assama Ww.) on different morpho-physico types of 'Som' plant (M. bombycina) and chemical analysis of the leaves and hormone treatment of seeds to select the best variety of plants, Ph.D. Thesis, Dibrugarh Univ. Assam.


Bongale et al. (1997) Leaf nutritive quality associated with maturity levels in fourteen important varieties of mulberry (Morus sp.), Sericologia, 37(1), 71-81.


*Chowdhury, S.N. and Sharma, L. (1965) Studies on propagation of Som (M. bombycina K.) by stem cuttings with the aid of growth regulators, Indian Agriculturist, 19(1), 82-83.


Gupta, M.P. and Chandra, J.P. (1979) Vegetative propagation of coniferous forest tree species from branch cuttings with the help of mist chamber, Indian For., 105(6).


Nanda et al. (1968) Seasonal rooting response of stem cuttings of some forest tree species to auxins, *Indian For.*, 94(2), 154-162.


Saluja et al. (1993) Physical and chemical properties of Mulberry, Tasar and Eri silk fibres, Indian silk, 31(9), 35-38.


Sharma, T.C. and Bordoloi, D.N. (1986) Observations on propagation and
growth of poplar (*Populas deltoides* Clone G-3), *Indian For.*, 112(9), 808-813.

*Shull, C.A. (1920) Temperature and rate of moisture uptake in seeds,

Sikdar, A.K. (1993) Chemo and bioassay of high yielding triploids and

*Singh, K.N. and Jolly, M.S. (1969) Air-layering in *Terminalia arjuna*
(Roxb.) W and A., *Indian For* 94(8), 539-540.

Singh, R.S. and Singh, K.K. (1980) Propagation of *Dioscorea floribunda*
M. & G. by air/ground layering, *Indian For.*, 106(11), 805-809.


as influenced by moisture stress, *Indian For.*, 109(6), 357-358.

bottom one third part of *Populas ciliata* plants perform better, *Indian For.*, 110(4), 375-380.

seed as affected by depth of sowing, *Indian For.*, 111(5), 245-249.

Sinha, A.K. and Jolly, M.S. (1971) Foliar constituents of the food
plants of tasar silkworm *Antheraea mylitta* D., *Indian For.*, 97(5) : 261-263.


Sinha et al. (1993) Variation of chemical constituents in relation to maturity of leaves in mulberry varieties *S*₁ and *K*₂ under the agro-climatic conditions of Ranchi District, *Indian J. Seric.*, 32(2), 196-200.


Tikader, A. (1993) Improved local variety is also suitable for better cocoon production, Indian silk, 32(3), 34-36.


Venkatagiriappapa et al. (1989) Studies on green cocoon parameters of the cross breeds PM X NB, and PM X NB, Indian J. Seric., 28(1), 113-114.


Yadav, G.S. and Goswami, B.C. (1990c) Pre ringing effect on rooting behaviour in air-layering of Som (M. bombycina K.), Geobios, 16, 110-112.


Yadav, G.S. and Goswami, B.C. (1990c) Effect of thickness of the twig on rooting behaviour in air-layering of Som (M. bombycina K.), Indian Agric., 34(2), 239-243.


* Original not consulted.
Conservation of Muga silkworm food plants with special reference to Dighioti (Litsaea salicifolia Roxb.)

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ABSTRACT
Muga silk industry of rural Assam is deteriorating. There are two major food plants and a number of secondary and tertiary food plants of muga silkworm (Antheraea assama Westwood) which are not properly conserved. Dighioti (Litsaea salicifolia Roxb.) is an important secondary muga food plant requiring urgent attention. A suitable air-layering technique has been standardized which may help in improving the deteriorating muga silk industry. Two rooting hormones such as IBA and IAA were applied separately on the upper end of the girdle in 400, 600 and 800 ppm concentrations. Though all the treatments were effective, 400 ppm IBA was the best in the spring season which was followed by 600 ppm IAA. Rooting percentage of 95.5 was observed in case of 400 ppm IBA and 90.4 percent in case of 600 ppm IAA. Post transplantation survival was found to be 91.4 percent in the spring season followed by 85.5 percent in the autumn season. Thus, air-layering with 400 ppm IBA in the spring season may be a suitable method of multiplication of Dighioti.

Keywords: Silkworm, muga silk, rooting in Litsaea.

INTRODUCTION
The golden yellow muga silk, most elegant of all the natural silk fibres, is a unique natural wealth. It is produced in the Brahmaputra Valley of Assam. Muga silkworm (Antheraea assama Westwood) is a polyphagous insect which feeds on several food plants.

The muga food plants are classified into three groups namely, primary, secondary and tertiary. There has been a long experience that Muga silkworm larvae primarily feeds on two major food plants. Som (Machilus bombycina King) and Soalu (Litsaea polyantha Juss). However, there are six secondary food plants e.g. Dighioti (Litsaea salicifolia Roxb.), Mejankari (Litsaea austrata Blume), Chapa (Magnolia sphenocarpa Roxb.), Panchapa (Michelia oblangea), Tithachapa (Michelia champaka Linn) and Patichonds (Actinodaphne obovata Blume). Over and above there are seven tertiary food plants, namely, Bogori (Ziziphus jujuba Mill), Bhomloti (Celastrus monosperma Hook), Bajramoni (Xanthoxylum rhuesta DC), Gamari (Gmelina arborea Roxb.), Kotholao (Cyclcodaphne nitida Hook.f.), Gonsoroi (Cinnamomum glanduliferum Meissn) and Tejpat (Cinnamomum tamala).

Feeding (rearing) of muga silkworm larvae on som tree leaves mainly serves two purposes that is for both commercial silk and seed cocoon production in Upper Assam and Soalu for only seed cocoon production in Lower Assam. Som trees are primarily used due to its quality leaves throughout the year, long life span of the tree, resistance against stem borer and also for quality cocoon and quality silk fibres. The som plant respond well to pruning. Soalu trees are primarily used for seed cocoon production as the muga silkworms feeding on it give high fecundity (egg laying). Soalu is not used for commercial silk cocoon production because of its poor leaf quality particularly during the winter months, i.e. from November to February (Chaudhuri, 1981, Yadav and Goswami, 1987) and due to production of low quality cocoons and silk fibres. Soalu trees also do not respond well to pruning.
There are many morphotypes of the primary, secondary and tertiary muga food plants mentioned above. It has been reported that there are about 28 morphotypes of som alone in Assam. The best morphotypes for quality muga silk production are yet to be exploited. No step has been taken yet for collection, analysis and conservation of germplasm for future genetic improvement of muga food plants. Many valuable genes from the great genetic diversity of North-Eastern Region of India are under depletion or under serious threat of fast extinction. The Botanical Survey on India reported about 10,000 plant species of this region which equals to about 50 per cent of the total flora of the country. The loss of genes can be attributed to various factors such as continuous deforestations, shifting cultivation, soil erosion, flood, earthquake, industrialization, population explosion, urbanization and other developmental activities. Mejankari (Litsea citrata), an important muga food plant, which was used primarily for production of creamy-white glossy muga silk fibres during the reign of Ahom Kings is almost at the verge of extinction. The Mejankari muga silk fabric was highly valued in the ancient past and was mainly reserved for the kings and upper classes in the society. It is as white as mulberry silk but thicker, much stronger, more glossy and durable. But this age-old mejankeri culture has vanished from the Earth because of non-availability of this valuable muga food plant as this plant is nearly extinct. Champa (Magnolia sphenocarpa) another important food plant of muga silkworm producing creamy-white glossy silk like mejankari is fast depleting from their natural habitat. Other secondary and tertiary muga good plants are also fast disappearing, most likely, some of them may be considered as endangered species.

Dighloti (Litsea salicifolia) An evergreen plant is one of the most important secondary food plant of muga silkworm. The plant has some advantages for muga silkworm culture; e.g. it has bushy nature, responds well to pruning and rearing of Chawki (young stage) and weak worms. Though the plant is called secondary food plant, it is being utilized as a viable primary food plant both for commercial and seed cocoon production in some parts of upper Assam and some other parts of Jorhat district. It is an interesting and important point to record here that our personal experiences gained from exploration of the forest are as two species of wild muga (not identified) and bivoltine wild eri (Philosamia cynthia) are exclusively found on this dighloti plant. A review of past literature could not provide any information about feeding of Philosamia cynthia on the dighloti plant. A rearing effort of this wild eri (Philosamia cynthia) on the dighloti plant under domestic condition both outdoor and indoor gave encouraging performance. This may help in collection of these wild silkworm races and maintain in Dighloti farms for feeding and further genetic improvement of the muga silkworm. Due to its evergreen nature Dighloti (Litsea salicifolia) can probably replace Soalu (Litsea polyantha) for the whole rearing period, particularly during the winter months i.e. from November to February (Chaudhuri, 1981; Yadav and Goswami 1987) every year to maintain continuity of muga silkworm rearing. During the winter season muga silkworm rearing on Soalu plants becomes unsuitable due to defoliation and poor quality of leaf.

It is clear from the above facts that Dighloti (Litsea salicifolia) has tremendous potential for improvement of muga silk industry and can be recommended and raised as primary food plant. Despite tremendous potentialites offered by this plant, it has not been adopted so far either by the Government or by the private rearers as primary muga food plant, due to ignorance on the proper methods of propagation. The plant is rapidly disappearing from its natural habitats, because of the environmental stresses. Evaluation of proper methods of propagation can help to conserve this important plant.

It is generally propagated from seeds. But it usually leads to genetic segregation of characters. Plants raised from such seedlings take long time to grow and create heterogeneous plant population. Improvement of the food plant population thus demands selection of mother plants and propagate them by vegetative methods. Vegetative propagation e.g. grafting, air-layering and cuttings thus provide a strong basis
for plant improvement and conservation.

Plant propagation by air-layering is a convenient method by which root can be easily induced. It has already been reported in primary muga host plants-Som (Machilus bombycina) and Soalu (Litsaea polyantha), but it has not been tried in Dighloti. Because of its good prospects of large scale planting, it was thought important to standardise the air-layering technique in Dighloti which was not yet available for future use in vegetative propagation as well as for using of the technique in future genetic improvement programme of Dighloti.

A study was undertaken to standardise the technique of air-layering in Litsaea salictfolia, with and without the aid of plant growth hormones. The present paper gives in detail the air-layering studies in Dighloti.

MATERIALS AND METHODS

Two year old healthy plants of Litsaea salictfolia were used for air-layering studies, in a private farm at Sibsagar in 1993. Eight to ten months old branches of vigorously growing Dighloti plants were selected at different height for the purpose. The thickness of the branches were 1.8 cm to 2.5 cm in circumference and rings were prepared about 25 to 30 cm below the tips. Approximately 1.5 to 2.0 cm wide girdles were made with the help of a sharp knife by completely removing the bark (cambium and phloem) for interruption of downward translocation of carbohydrates, auxins and other growth factors.

Root inducing hormones, IAA (Indole acetic acid) and IBA (Indole butyric acid) were used separately in concentrations of 400, 600 and 800 ppm. These concentrations were selected based on previous findings. Near 500 ppm by concentration of IBA was found to be very effective in root initiation of Machilus bombycina (Yadav and Goswami, 1992). The hormones were applied with the help of cotton on the upper end of the girdle. Saw dust which was first dipped in water for 24 hours and then squeezing out the excess water was placed around the stripped girdles. The mass of saw dust was covered with polythene sheets and tied firmly at both the folded ends to retain moisture, aeration, moderate temperature and protect it from sunlight which are prerequisite conditions for root initiation.

Two most favourable growing seasons for plants were considered for the study - spring (March, April, May) and fall (August, September, October) in 1993. Seven treatments and four air-layers were prepared for each treatment. A total of 28 air-layers were prepared at a time and replicated four times in each season. In all, 224 air-layers were prepared and studied. Routine observations on the air-layers were made to record the formation of callus as well as root initiation, without disturbing the polythene covers.

RESULTS AND DISCUSSION

The data on root initiation in Litsaea salictfolia by air-layering with and without the applications of rooting hormones are presented in table-1. The environmental factors like minimum and maximum temperature, relative humidity and rainfall were recorded.

All the treatments undertaken for study were effective in inducing rooting. However, the degree of success and duration of time taken for the initiation of root varied depending upon the season and the degree of concentration of rooting hormones. The most effective treatment was 400 ppm IBA in which 95.5 per cent of treated air-layers rooted and root initiation was observed 22 days after the treatment in the spring season. Both the hormones were found effective over control. 600 ppm IAA was found to be one of the most effective which took 25 days for root initiation in the spring and the rooting percentage was 90.4 per cent. Profuse rooting was found in air-layers treated during spring season (March-May) followed by autumn (August-October). Spring season was also found to be the best in post transplantation survival with 91.4 percent success followed by autumn with 85.5 per cent. Significant difference was observed in relation taken for root initiation, percentage of rooting and post transplantation survival with different treatment combinations and seasons. Primary and secondary roots in
average were also found to be significantly higher in spring season and with 400 ppm IBA than autumn season and with other treatment combinations.

*Litsaea salicifolia* is naturally propagated by seeds. Seed propagation may be economic but similar plants with desirable morphotypes and genotypes cannot be maintained generation after generation due to genetic segregation. Moreover viability of seeds is lost after ripening. Vegetative propagation of *Litsaea salicifolia* by air-layering can help to maintain homogeneous food plant population in different seasons by using different rooting hormones. This method of propagation in Dighloti has not been reported as well. Several attempts were made in woody plants to propagate through air-layerings Arya and Haque (1982) studied air-layering on *Pinus patula* and *P. caribaea* and achieved success during the month of June to August. Yadav and Goswami (1992) in *Machilus bombycina* reported good rooting with 500 ppm IBA during April to June. Solanki et al. (1986) with 100 ppm IAA and achieved good success during July to August. Hence, it is clear that the seasons and concentrations of rooting hormones differ with the species. Nevertheless, the period of root initiation falls around the spring and autumn seasons. Thus, the method developed from the present investigations on vegetative propagation of Dighloti may be suitable one for practical utility and adoptability by the muga farmers (rearers).

It is, therefore, strongly felt that vegetative method of propagation of Dighloti can conserve different morphotypes of muga food plants including Dighloti and help maintaining a standard type with all genetic relevance of selected morphotypes. A further emphasis may be laid here for micropropagation of the selected types through tissue culture to develop planting material on a commercial scale.

It is our considered opinion that Dighloti can fill the gap in conserving the wild muga silkworms and the wild *eri* (*P. cynthia*) in domestic condition.

**REFERENCES**


Yadav, G.S. and Goswami, B C. 1987 Indian Silk, 26(2): 14-15

Yadav, G.S. and Goswami, B C 1992 *Ecology and Environment*, Kalyani, Calcutta
STUDIES ON REARING PERFORMANCE OF MUGA SILKWORM (ANTHERAEA ASSAMA WESTWOOD) ON DIGHLOTI (LITSAEA SALICIFOLIA ROXB.)

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Rearing performance of the silkworm is a measure used to evaluate the quality of the host plants. The muga silkworm (Antheraea assama Westwood) was found on the dighloti (Litsaea salicifolia Roxb.) plants in their wild habitat more than once, although in the semi-domesticated condition muga silkworms are usually reared on Som (Persea bombycina King) and Soalu (Litsaea monopetala (Roxb.) Pers.). For the obvious reason of the wild nature of the muga silkworm, a rearing program of both the semi-domesticated and wild type muga silkworm on dighloti (Litsaea salicifolia Roxb.) plant was undertaken and the feeding behaviour of the insect was studied carefully. The present study could not record any remarkable variations in the semi-domesticated muga silkworms on their fecundity, hatchability, E.R.R. and silk ratio per cent between dighloti and published data of som and soalu fed insects. Though the fecundity of the wild muga has been found to be comparatively lower, the hatchability, E.R.R. and silk ratio per cent have been significantly higher than for the cultivated type.

Keywords: Muga silkworm, rearing performance, Litsaea salicifolia Roxb.

INTRODUCTION

The lustrous golden yellow muga silk is a dominant natural product produced only in India in the North-Eastern states, particularly in the Brahmaputra valley of Assam. The muga silk is produced by the rarest muga silkworm, Antheraea assama Westwood in the Brahmaputra valley of North-East India, which is most important and precious among the non-mulberry silkworms. The North-Eastern region of India is a peculiar biosphere where muga silkworm and its various host plants abundantly grow only in this eco-climatic region of the world. Therefore, muga silkworms and their various host plants are a unique wealth of the world.

The muga silkworm is a multivoltine, polyphagous and semi-domesticated insect which thrives very well only in the open air outdoor culture. It feeds on various primary, secondary and tertiary host plants. Som (Persea bombycina King) and Soalu (Litsaea monopetala (Roxb.) Pers.) are the two primary host plants of the muga silkworm. The most important among the secondary host plants is the dighloti (Litsaea salicifolia Roxb.) which is a small evergreen bushy shrub and is found abundantly in the natural habitat in Assam. The dighloti plant has some advantages for muga silkworm rearing because it suitably supports net rearing throughout the year. This plant offers other advantages such as: supervision is convenient due to its evergreen and bushy nature, it responds well to pruning, clonal propagation is easy through cuttings and air-layerings (Gogoi and Goswami, 1996) and the advantage of rearing the early stage, late hatched and weak worms. Dighloti is also authenticated as a primary food plant of the tetravoltine wild eri silkworm, Philosamia cynthia (Gogoi and Goswami, 1994). The
wild bivolitine Kotkori muga (Attacus atlas) was also collected by us from the dighloti plant from the forest areas. The wild counterpart of Antheraea assama Westwood was found and collected from the forest exclusively from dighloti plants.

Despite tremendous potentialities offered by this plant for the development of the muga silk industry, the dighloti has been neglected so far due to lack of scientific information based on the feeding behaviour and rearing performance of the muga silkworm on it. The present investigation, therefore, was undertaken to study the feeding behaviour and rearing performance of both, the semi-domesticated Antheraea assama Westwood and its wild counterpart (found on dighloti in the wild habitat) on dighloti plants in the four different seasons of the year.

MATERIALS AND METHODS

Dighloti fed healthy cocoons of semi-domesticated muga silkworm have been collected from a private rearer from Sapekhati, Assam and from its wild counterpart from the forest. The present experimental rearing was conducted on three years old dighloti plants during 1994 at a private dighloti farm at Sonari, in the Sibsagar district of Assam. Layings of both types were prepared by ourselves in domestic conditions. The established and normal open air rearing procedure was then followed for both the semi domesticated and wild type muga silkworm. Of course, nylon nets were used over the dighloti bushes to protect the silkworms from pests and predators. Two commercial broods namely Jethua (April/May) and Kotia (Oct./Nov.) and two seed broods i.e. Aherua (June/July) and Bhodia (Aug./Sept.) were studied for the semi-domesticated type and only Jethua (April/May) was studied for its wild counterpart because the emergence of male and female moths did not synchronise which created problems for mating to continue subsequent broods. During the study careful observations were made which were recorded, evaluated and analysed.

RESULTS AND DISCUSSION

The rearing performance during different broods along with cocoon quality and meteorological data are presented in Table 1. The fecundity of dighloti fed semi-domesticated muga silkworm ranges between 150-250 eggs per laying. The fecundity of its wild counterpart was found to be 200 eggs per laying in the spring brood. The hatching percentage of the semi-domesticated type was found to be minimum in the summer brood i.e. 85.12% and maximum in the spring brood i.e. 95.30%. The hatchability was recorded 98.11% for the wild type in the spring brood. The highest E.R.R. for the semi-domesticated has been recorded as 70.51% in the autumn brood followed by 65.25% in spring, 48.62% in late summer and 45.50% in summer. The E.R.R. has been recorded to be 75.20% for the wild type in the spring brood. The larval period of the domesticated silkworm was found to have varied in different seasons ranging from a minimum of 23 days in summer and a maximum of 32 days in spring. The wild silkworms however took 5 days less than the semi-domesticated worms in the spring season. The silk ratio per cent of the semi-domesticated type has been found to be the highest (9.28%) in the autumn season followed by 8.64% in spring, 8.14% in late summer and 7.76% in summer. The silk ratio percent of the wild type in the spring season has been recorded to be 10.34% which is significantly higher than the semi-domesticated type. The silk ratio per cent of dighloti fed male cocoons has been found to be higher in all the seasons studied.

S. N. Chaudhury (1981) reported that fecundity of som fed muga silkworm ranges between 200-250, J. K. Gogoi (1984) reported fecundity to range between 150-200 and Yadav and Goswami (1987) reported fecundity of som fed muga silkworm to range between 140-245 and that of the soalu fed muga silkworm to range between 100-205. It is clear from our present investigation that the fecundity of dighloti fed muga silkworm is almost similar to that of the som and soalu fed muga silkworm. The highest hatchability i.e. 95.0% was recorded in the som fed muga silkworm in May/June by J. K. Gogoi (1984) and 80.00% in the Soalu fed muga silkworm in May/June by Yadav and Goswami (1987).
Table I. Rearing performance of semi-domesticated and wild muga silkworm (*Antheraea assampa* Westwood) in different seasons.


<table>
<thead>
<tr>
<th>Brood or season</th>
<th>Muga silkworm species</th>
<th>Fecundity (No. of eggs /laying)</th>
<th>Hatching (percent)</th>
<th>E.R.R. (percent)</th>
<th>Larval period (days)</th>
<th>Quality of cocoons / Qualité des cocons</th>
</tr>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Male / Mâle</td>
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<td></td>
<td></td>
<td></td>
<td>C.W. (g)</td>
</tr>
<tr>
<td>Jethua or spring (April/May)</td>
<td>Wild / Sauvage</td>
<td>200</td>
<td>98.11</td>
<td>75.20</td>
<td>27</td>
<td>5.80</td>
</tr>
<tr>
<td>Jethua or printemps (Avril/mai)</td>
<td>Semidomesticated</td>
<td>250</td>
<td>95.30</td>
<td>65.25</td>
<td>32</td>
<td>5.55</td>
</tr>
<tr>
<td>Aherna or summer (June / July)</td>
<td>“</td>
<td>175</td>
<td>85.12</td>
<td>45.50</td>
<td>23</td>
<td>5.15</td>
</tr>
<tr>
<td>Aherua ou été / Juin/juillet</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Bhodla or late summer (Aug /Sept.)</td>
<td>“</td>
<td>150</td>
<td>90.23</td>
<td>48.62</td>
<td>24</td>
<td>5.40</td>
</tr>
<tr>
<td>Bhodla ou fin de l’été (Août/sept.)</td>
<td></td>
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<tr>
<td>Kotia or autumn (Oct./Nov.)</td>
<td></td>
<td>205</td>
<td>94.50</td>
<td>70.51</td>
<td>25</td>
<td>5.60</td>
</tr>
<tr>
<td>Kotia ou automne (Oct/Nov.)</td>
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</tbody>
</table>

Abiotic factors / Facteurs abiotiques

<table>
<thead>
<tr>
<th>Brood / season</th>
<th>Temperature (° C)</th>
<th>Relative humidity (%)</th>
<th>Rainy days</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Max.</td>
<td>Min.</td>
<td>Max.</td>
</tr>
<tr>
<td>Spring (April/may) / Printemps (Avril / mai)</td>
<td>31.5</td>
<td>28.2</td>
<td>76.5</td>
</tr>
<tr>
<td>Summer (June/July) / Été (Juin / juillet)</td>
<td>34.4</td>
<td>29.2</td>
<td>87.5</td>
</tr>
<tr>
<td>Late summer (Aug./Sept.) / Fin de l’été (Août/sept.)</td>
<td>32.5</td>
<td>27.5</td>
<td>90.1</td>
</tr>
<tr>
<td>Autumn (Oct./Nov.) / Automne (Oct/nov.)</td>
<td>26.5</td>
<td>18.5</td>
<td>84.3</td>
</tr>
</tbody>
</table>

But in our present investigation the highest hatching percentage was found to be 95.30% in April/May in the semi-domesticated type and 98.11% in the wild type. Yadav and Goswami (1987) reported 83.25% E.R.R. in soalu fed muga silkworms in May/June but the E.R.R. of the dighloti fed semi-domesticated muga silkworm has been recorded to be 70.51% in Oct./Nov. The silk ratio per cent has been reported highest i.e. 10.23% by Yadav and Goswami (1991) in som fed male cocoons in Oct./Nov. In our present investigation the silk ratio per cent has been found to be the highest in the wild type male cocoons i.e. 10.34% followed by 9.28% in the male cocoons of the semi-domesticated type. It has to be noted that since this study is a pioneering work on comparison between the rearing of the wild and of the semi-domesticated muga-silkworm, further study is needed to authenticate the results with statistical analysis which has not been presented in this work.

In the present investigation though certain variabilities on fecundity, hatchability, E.R.R. and silk ratio per cents from published data of som and soalu fed worms were compared in different seasons with that of dighloti fed muga silkworms the differences were not significant. So, it may well augur that the dighloti can be commercially raised and recommended as an apparently viable primary food plant of the muga silkworm particularly for rearing the autumn commercial brood, of course other parameters regarding silk production and quality have to be studied on dighloti fed muga silkworms. Dighloti plants can thus equally be used for seed cocoon production also. Moreover, the wild counterpart of *Antheraea assama* Westwood can be maintained on the dighloti plant in the germplasm bank for future breeding programs. The present study provides the basis for further investigation on the wild counterpart of the muga silkworm. It may facilitate the planning of muga silkworm breeding for further development of improved muga silkworm breeds.

REFERENCES


STUDIES ON CERTAIN ASPECTS OF WILD ERI SILKWORM (PHILOSAMIA CYNTHIA DRURY) WITH SPECIAL REFERENCE TO ITS REARING PERFORMANCE

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Philosamia cynthia Drury is a wild counterpart of the domesticated eri silkworm (Philosamia ricini Boisduval). Some caterpillars were observed in the forest areas under in situ condition at the 5th instar stage, especially on the dighloti (Litsaea salicifolia Roxb.) plant of which it is also the first report. Those caterpillars were not removed from their natural habitat but allowed to grow for subsequent observations. On maturity the worms started spinning and formed cocoons on the green leaves of dighloti which is also a muga silkworm food plant. Then these were removed and kept hinging indoor. Subsequently it was found that pupae inside the cocoons practically hibernated from November for five long months. After moth emergence a clear picture emerged and the insect was identified as Philosamia cynthia Drury. Since these worms were collected from in situ conditions i.e. wild outdoor state, a standard procedure of outdoor rearing like for the muga silkworm was followed on dighloti plants under domestic conditions for four generations. Then they underwent hibernation again. Philosamia cynthia Drury was observed to be resistant to the diseases like pebrine, grasserie and fiacherie, and to be also less susceptible to the uzi infection. E.R.R. was more than 80 per cent in average, silk filament was continuous and cocoons were reelable unlike Philosamia ricini Boisduval which is spun. Interestingly, Philosamia cynthia Drury performed excellently with indoor rearing as well.

Keywords: Wild eri silkworm, rearing performance, Dighloti.

INTRODUCTION

Eri silkworm culture is a traditional vocation of the Assamese people in general and Indo-mongoloid and aboriginal tribes of Assam in particular, since immemorial times. Eri culture is still in the form of a cottage industry and forms an integral part of the socio-economic and cultural life of the rural Assamese people. Hand-spun eri yarn is only valued for man’s wraps and women’s scarves. But there is further scope for blending eri silk with other natural silk, polyester and ramie fibres for ultimate production of new kinds of textile products. Despite tremendous potentialities for development, the age-old ericulture remained in a state of under exploitation, due to many reasons. One of the reasons is that the genetic vigour of the eri silkworm (Philosamia ricini Boisduval) declined over the centuries probably due to the multivoltine nature of the insect and inbreeding depression. A genetically stable, improved hybrid eri silkworm breed with higher effective rate of rearing, disease resistance and reelability needs to be developed. A sound strategy involving investigation, analysis, evaluation and detailed understanding of qualitative and quantitative traits of various available eco-races, strains and wild counterparts of the eri silkworm is to be worked out for evolving a new...
improved race. Although 6 eco-races of the eri silkworm have been collected and 6 strains have been isolated from a mixed lot by the Central Eri Research and Training Institute, Mendipathar, East Garo Hills, Meghalaya (CER & TI Report 1987) for an evaluation and further breeding program, the ever important bi, tri and tetravoltine wild eri silkworm (Philosamia cynthia Drury) has yet to be collected, investigated and evaluated to utilise in eri-breeding programs.

In our present investigation, attempts have been made to study the various aspects of the wild eri silkworm (Philosamia cynthia Drury), collected by us, with special emphasis on its rearing performance on dighloti (Litsaea salicifolia Roxb.). Observations and findings presented in this paper would not only help the rearers but also the silkworm breeders in evolving improved silkworm races for future breeding programs.

MATERIALS AND METHODS

Some wild caterpillars looking like eri silkworms feeding on dighloti (Litsaea salicifolia Roxb.), leaves were observed in the forest areas at the 5th instar stage on 13th November 1992. Incidentally, dighloti is also an important secondary food plant of the muga silkworm (Antheraea assama Westwood). However, the silkworms were not removed from their natural habitat till they matured, ripened and spun cocoons under in situ conditions. After five days of strict observations, i.e. until 18th November 1992, they were found to spin and form dark brown, muga like cocoons on the green leaves of dighloti which were then collected on 25th November 1992. A few cocoons were utilised to study various characteristics such as shape, size, cocoon weight and shell weight and reeling ability of the silk fibre and others were kept hanging inside the house with proper care and protection for using them as green seed cocoons and frequently observed. It was found that the pupae inside the cocoons practically hibernated from November 1992 to April 1993 for five months. After moth emergence a clear picture emerged and the insect was identified as Philosamia cynthia Drury.

Immediately after, the rearing of Philosamia cynthia Drury was carried out on three years old dighloti (Litsaea salicifolia Roxb.) which was its natural host plant. The rearing was conducted for four consecutive generations to study the various aspects of the wild eri silkworm (Philosamia cynthia Drury). The standard rearing procedure as followed in the case of outdoor rearing of the muga silkworm was followed under domestic conditions. Of course, the dighloti bushes used for rearing were covered with nylon fishing nets to protect the Philosamia cynthia Drury silkworms from predators and other enemies. The different broods studied were Jethua (April/May), Aherua (June/July), Bhodia (August/September) and Kotia (October/November).

Philosamia cynthia Drury was reared indoor for one generation, in April/May (Jethua brood) to study its performance using dighloti leaves, and the normal procedure of rearing was followed as for the eri silkworm (Philosamia ricani Boisduval).

For reeling and spinning the Philosamia cynthia Drury cocoons were boiled in water supplemented with alkalis to remove the sericin. Reeling was done by country made 'Bhowri' like muga cocoons and spinning was done by hand as in the case of eri cocoons. During the study careful observations were made at every step, which were recorded, evaluated and analysed.

RESULTS AND DISCUSSION

The data on continuous rearing of Philosamia cynthia Drury for four generations are presented in Table I. The environmental factors like minimum and maximum temperature and relative humidity recorded at the time of study are also shown in the same table.
Table 1. Rearing performance of Philosamia cynthia Drury reared continuously from 7th May to 7th November, 1993.

<table>
<thead>
<tr>
<th>Generation or brood</th>
<th>Date of egg laying</th>
<th>Date of hatching</th>
<th>Date of maturing</th>
<th>Total days</th>
<th>Weight of 10 full grown worms (grams)</th>
<th>Weight of 10 ripen worms (grams)</th>
<th>Weight of 10 cocoons with pupa (grams)</th>
<th>Weight of 10 cocoons without pupa (grams)</th>
<th>Silk content (Per cent)</th>
<th>ERR</th>
<th>(Per cent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jethua April/May</td>
<td>28 April</td>
<td>7 May</td>
<td>29 May</td>
<td>23</td>
<td>88</td>
<td>45</td>
<td>24.50</td>
<td>3.50</td>
<td>14.28</td>
<td>8.0</td>
<td></td>
</tr>
<tr>
<td>Aherua June/July</td>
<td>26th June</td>
<td>14 July</td>
<td>23rd July</td>
<td>20</td>
<td>80</td>
<td>40</td>
<td>20.50</td>
<td>2.60</td>
<td>12.68</td>
<td>62.5</td>
<td></td>
</tr>
<tr>
<td>Bhodia Aug./Sept.</td>
<td>16th Aug.</td>
<td>24th August</td>
<td>13th Sept.</td>
<td>21</td>
<td>83</td>
<td>41</td>
<td>22.50</td>
<td>2.8</td>
<td>12.44</td>
<td>65.5</td>
<td></td>
</tr>
<tr>
<td>Kota Oct./Nov.</td>
<td>8th Oct.</td>
<td>17th Oct.</td>
<td>7th Nov.</td>
<td>22</td>
<td>85</td>
<td>42</td>
<td>23.00</td>
<td>3.00</td>
<td>13.04</td>
<td>76.4</td>
<td></td>
</tr>
</tbody>
</table>

Abiotic factors / Facteurs abiotiques

<table>
<thead>
<tr>
<th>Brood/season / Couvée/saison</th>
<th>Temperature (°C)</th>
<th>Relative humidity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Max.</td>
<td>Min.</td>
</tr>
<tr>
<td>1. Spring (April/May) / 1. Printemps (avril/mai)</td>
<td>30.2</td>
<td>27.3</td>
</tr>
<tr>
<td>2. Summer (June/July) / 2. Été (juin/juillet)</td>
<td>33.3</td>
<td>28.2</td>
</tr>
<tr>
<td>3. Late summer (Aug./Sept.) / 3. Fin de l'été (août/sept.)</td>
<td>31.4</td>
<td>23.2</td>
</tr>
<tr>
<td>4. Autumn (Oct./Nov.) / 4. Automne (oct./nov.)</td>
<td>26.5</td>
<td>17.5</td>
</tr>
</tbody>
</table>
The female moth of the wild eri (Philosamia cynthia Drury) is comparatively larger than the male so far as the wing expanse and the size of the body are concerned. The wing expanse of the male and the female is of 10.5 cm and 12.6 cm respectively. This indicates that the female moth has broad wings while the male moth has pointed wings. In Philosamia cynthia Drury the ground colour of the wings varies from dark brown to pinkish white while in Philosamia ricini it is olive green to orange brown. The tips of the outer margins of the wings are light brown with dark linings. There are two black semicircular spots with sickle like white markings on the tips of the wings in both the male and the female moths. Like Philosamia ricini Boisduval there is a pinkish white cross band present across the middle of the wings. A sickle like transparent marking with yellowish lining is present in each wing. The abdominal segments of Philosamia cynthia Drury were covered with small white tufts. This is an identifying character of P. cynthia from P. ricini. Two pointed antennae are on the heads of both the male and the female moths. The male moth has a larger and a longer antenna than the female moth. Male and female moths with vestigial wings were also found to have emerged. Unlike the Philosamia ricini Boisduval moth which is diurnal, the Philosamia cynthia Drury moths are nocturnal in habit, i.e. moth emergence, pairing and laying of eggs are done at night. Nocturnal habits are also a characteristic of the muga silkworm (Antheraea assama Westwood). The size and shape of the eggs are almost similar to Philosamia ricini Boisduval but the colour of the eggs of Philosamia cynthia Drury is brownish white whereas the eggs of P. ricini Boisduval is greenish white.

The colour of the first stage larvae of Philosamia cynthia Drury is yellow with black lining and with black hairs. In the second stage the colour is yellow without black lining and with short black hairs. In the first and second stages they preferred to have a colonial habit during feeding. After the second moult of the worms the hairs disappear, tubercles develop on the back and they become white in colour. At this stage a lime like white powdery substance completely covers up the body and appears profusely on the tubercles. The colour of the worms in the 4th stage is greenish white with less lime like powder. At the 5th stage they become light green in colour without the white powder. The tubercles at this stage become much prominent and fleshy. The worms have a habit of eating their skin after moulting. The ripen Philosamia cynthia Drury silkworms are light in weight, soft and are yellow in colour. The colour of the cocoons is dark brown, the inner side is smooth and contains a long peduncle of 10.5 cm long with which they hang on the host leaves. The cocoons are also covered with a thin film of floss. The cocoons are hard, filaments are continuous and reedlike like in muga and mulberry cocoons but unlike eri (Philosamia ricini Boisduval) which are spun.

The present study indicated that April/May (Jethua brood) was found to be the best time for rearing Philosamia cynthia Drury so far as the effective rate of rearing, cocoon quality and silk percentage are concerned followed by Oct./Nov. (Kotia brood), Aug./Sept. (Bhodia brood) and June/July (Ahura brood). E.R.R. of Jethua brood was found to be 80% followed by 76.4% in Kotia, 65.5% in Bhodia and 62.5% in Ahura broods. The percentage of silk in Jethua brood was found to be 14.28 followed by 13.04 in Kotia, 12.44 in Bhodia and 12.68 in Ahura broods.

S. N. Chowdhuri (1981) reported that Philosamia cynthia Drury feeds on Ailanthus leaves. J. K. Gogoi (1984) reported that Philosamia cynthia Drury feeds on Kesseru (Heteropanax fragrans Seem), Barkesseru (Ailanthus gmelinis) and Gomari (Gnetum arbores Roxb.). Arora & Gupta reported about 28 species of the host plant of the philosamia genus but they did not include dighloti in the list. Gogoi and Goswami (1994) reported that the wild eri (Philosamia cynthia Drury) is exclusively found on the dighloti plant (Litsaea salicifolia Roxb.), which is a new report. Under domestic conditions the present rearing experiment suggested that Philosamia cynthia Drury performs well on the dighloti plant. Dighloti is also a secondary food plant of the semi domesticated muga silkworm (Antheraea assama Westwood) and its wild counterpart is also exclusively found on it (Gogoi and Goswami, 1996). Another bivoltine wild silkworm, Kotkori muga (Attacus atlas L.) was also found recently on the dighloti plant, which is also the biggest silkmoth (Gogoi and Goswami, 1996). The plant has some advantages for silkworm rearing, like net rearing which is easy, good response to pruning, easy clonal propagation through cuttings and air layerings, (Gogoi and Goswami, 1995) easy rearing of early stage, late hatching and weak worms.
J. K. Gogoi (1984) reported that *Philosamia cynthia* Drury may be univoltine and bivoltine and undergoes hibernation at the pupal stage. But in our present study the *Philosamia cynthia* Drury in domestic conditions was found to be tetravoltine and underwent 5 months of hibernation from November 1992 to April 1993 and again from November 1993 to April 1994 for two consecutive years. According to J. K. Gogoi (1984), *Philosamia cynthia* Drury silkworms were susceptible to grasserie. But in our present investigation *Philosamia cynthia* Drury was found to be completely free from grasserie and to be free from various other silkworm diseases like pebrine, flacherie and muscardine, probably due to the presence of a lime like dry powdery substance on its body, which keeps them dry. This observation may be confirmed through further study. Infestation by the uzi fly was found to be nil. Other predators and enemies like marauder insects, preying birds however, damaged the early stage worms to a certain extent.

The result of indoor rearing of *Philosamia cynthia* Drury was also found to be quite satisfactory with 70% E.R.R in April/May (Jethua brood).

**CONCLUSION**

Dighloti (*Litsaea salicifolia* Roxb.) is now established as a new host plant of the wild eri silkworm (*Philosamia cynthia* Drury). Dighloti can be raised in the same farm both for muga and ericulture for commercial and seed cocoon production as well as for maintaining various domesticated and wild silkworm races for breeding programs. *Philosamia cynthia* Drury can serve well as a resourceful material for breeding muga and eri to evolve ever important disease resistant, genetically stable, improved bivoltine silkworm races.

If the reelability of the eri cocoon (*Philosamia ricini* Boisduval) could be achieved through cross breeding with *Philosamia cynthia* Drury, it could be a breakthrough in the field of ericulture. Moreover, taking cue from the experience of outdoor rearing of *Philosamia cynthia* Drury on evergreen dighloti plants, large scale production of eri cocoons (*Philosamia ricini* Boisduval) was hitherto a challenge in the field of ericulture as outdoor rearing of eri silkworm was tried on *Ailanthus* sp. by noted sericulture scientist Dr S. N. Chowdhury in Assam Agricultural University, Jorhat, but failed. Therefore, greater attention is required for further investigations on these lines. Over and above there is a probability of blending the reeled yarn of *Philosamia cynthia* Drury with other natural silk and ramie textile fibres. Thus, the present study has established on a sound basis the genetically useful and important traits of *Philosamia cynthia* Drury, such as hibernation, reelability, disease resistance etc. for all future breeding programs of both *Philosamia ricini* Boisduval and *Antheraea assama* Westwood in evolving commercially and economically desirable improved strains of insects.

**REFERENCES**

ARORA G. S., GUPTA I. J. (1979) Taxonomic studies on some of the Indian non-mulberry silkworms (Lepidoptera: Saturniidae : Saturniinae), Memoires of the Zoological Survey of India, 16(1), 49-54.


REARING PERFORMANCE OF THE WILD ENI SILKWORM P. CYNTHIA DRURY