Plant Archives Vol. 22, Special Issue (VSOG), 2022 pp.22-25 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org

DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2022.v22.splecialissue.005

UTILIZATION OF BORPAT (*AILANTHUS GRANDIS*) FOR UP-SCALING OF ERICULTURE: SCOPE, LIMITATIONS, AND STRATEGIES

Om Prakash Patidar[1]*, Dharmendra Kumar Jigyasu[1], Aftab A. Shabnam[1] and Amit Kumar[2]

[1]Central Muga Eri Research & Training Institute, CSB, Lahdoigarh, Jorhat-785700, Assam, India

[2]Central Sericultural Research & Training Institute, CSB, Mysuru- 570 008, Karnataka, India

*Corresponding author: oppatidar28@gmail.com

ABSTRACT

Eri silkworm (*Samia ricini*) is a polyphagous, multivoltine silkworm and around 5-6 crops can be raised per year depending on the availability of the host plants. Poor availability of host plants is a limiting factor in enhancing eri silk production and its spread in non-traditional areas. Castor is the most preferred food plant of the eri silkworm. However, the annual nature of the crop, its availability on a large scale, and leaf availability throughout the year are a big challenge. Therefore, the alternate perennial nature host plants were analyzed for their potential under various research programmes at CMER&TI. Kesseru (*Heteropanax fragrans*) and borpat (*Ailanthus grandis*) plants have been identified as potential substitutes for major host plant (castor) based on their nutritional quality and bioassay performance. Germplasm of these identified perennial host plants was collected from North-East region and is conserved in the Germplasm Conservation Centre (GCC) of CMERTI. Subsequently, a cultivation package of practice has been developed for Kesseru. However, borpat despite being the most preferred food plant after castor has been ignored due to its complex nature of propagation. The present manuscript gives an insight on the propagation of borpat through seed, scope for clonal propagation, limitations, and future strategies for its improvement.

Keywords **:** Ericulture, Borpat, Castor, Propagation, Perennial

Introduction

Sericulture belongs to the conscious large-scale rearing of sericigenous insects to obtain silk from cocoons produced by them. It plays an important role in the rural economy of India. India has the distinction of being the only country in the world, to produce all the five commercially exploited silk varieties *viz.*, Mulberry, Tropical Tasar, Temperate Tasar, Eri and Muga silk. The non-mulberry silks which include Muga Eri and Tasar, are also called as *Vanya* silk (Ahmed and Rajan, 2011).

Eri silkworm, (family-Saturniidae) is a domesticated, polyphagous, multivoltine in nature that can produce 5–6 crops a year. It is commonly reared in the Northeast Indian states of Assam, Meghalaya, Nagaland, Manipur, and Arunachal Pradesh. Most of the production of eri silk comes from the state of Assam. About 2,94,419 families in Assam are engaged in ericulture, and there are 33,433 hectares of land covered by eri food plants in Govt. and private farms, with a production of 6573 tons of eri cocoons and 5275 tons of eri raw silk in the years 2020-21. (Anon., 2021).In recent years, the farmers of several other states viz., Madhya Pradesh, Andhra Pradesh, Tamil Nadu, Maharashtra, Karnataka, Uttar Pradesh, Bihar, Jharkhand, Gujarat, West Bengal, Orissa and Sikkim, have taken up eri culture.

Host plants of Eri silkworm

Major host plants of eri silkworm are castor (*Ricinus communis*) and kesseru (*Heteropanax fragrans*). Other alternative food plants are borpat (*Ailanthus grandis),* borkesseru *(Ailanthus excelsa),* tapioca *(Manihot utilissima),* payam *(Evodia flaxinifolia) etc.* (Chutia *et al.,* 2014). Castor is an annual plant and has to be grown again every six months for continuous leaf availability which increases the cost of cultivation and difficult for small and marginal farmers. Also, its leaves become scanty during winter. Due to ecological adaptation and short seed viability, Kesseru is only found in a few pockets of the Northeastern Indian region. In such a case of leaf scarcity, the use of alternate or secondary host plants is required. *Ailanthus*, a perennial host plant found throughout India, is one of the alternatives to the eri host plant. *Ailanthus excelsa, Ailanthus grandis, Ailanthus altissima* and *Ailanthus malabarica* are the four species found in India and are distributed throughout the country. Although castor leaf is the best option, *Ailanthus* can also be used to produce sustainable eri crops (Chowdhury, 2006). *Ailanthus* is a perennial tree species. *Ailanthus* (derived from *Ailanto*, an Ambonese word probably meaning "tree of gods" or "tree of heaven") is a genus of trees belonging to the family Simaroubaceae, in the order Sapindales. The genus is native from East Asia south to northern Australasia. They are fast-growing deciduous trees growing up to 25-45 m tall, with spreading branches and large (40-100 cm) pinnate leaves with 15-41 long leaflets, the terminal leaflet normally present, and the basal pairs of leaflets often lobed at their bases.

Borpat (*A. grandis* Prain) is widely distributed in the foothills of the Himalayan range of the Northeastern Region more specifically in Arunachal Pradesh, and Nagaland states. It is a lofty tree (30-40 m in height), growing in India, Vietnam, Thailand, and China. Borkesseru (*A. excelsa*) is found in almost all the states of the country namely, NE states, Odisha, West Bengal, Tamil Nadu Andhra Pradesh, Gujarat, Rajasthan Uttar Pradesh, Delhi, Bihar Maharashtra, *etc*. Borkesseru is a lofty deciduous, tree, indigenous to the Indian peninsula, and grows almost throughout the tropical and subtropical parts of the country, especially in the dry tracts. It grows well in arid, semi-arid, and semi-moist regions.

Effects of perennial host plants on eri silkworm

Borpat and borkesseru plants of *Ailanthus* species are perennial, and leaves are accessible consistently throughout the year. These are secondary host plants and before utilizing them for feeding to eri silkworms, it is necessary to understand their effect on eri silkworms as the health and vigorousness of larvae help in deciding the cocoon and yarn quantity and quality. A significant difference in larval growth and development of eri silkworms was observed when they feed on different host plants (Borah *et al*., 2020 and Naik *et al*., 2010).

Borah *et al*. (2021) evaluated the effect of different seasons in larval growth of eri silkworm upon feeding of borpat and borkesseru. Borah *et al*. (2021) found that larval growth parameters of eri silkworm were better in terms of larval duration (25.11 days, 26.41 days), full-grown larval weight (8.91 g, 8.39 g) and matured larval weight (7.29 g, 6.71 g) on the borpat leaves as compared to the borkesseru leaves, respectively. The matured larval weight was observed significantly higher in the autumn season (8.1 g) but the shortest larval duration was observed during the early summer season (5.9 g). In another study conducted by Shaw (1998) shortest larval duration was found on the feeding of castor (17 days), compared to borpat (20 days), borkesseru (21.9 days), and *Ailanthus altissima* (26 days) in the summer season.

Ahmed *et al*. (2015) reported that the experiments on the rearing performance of eri silkworms feeding on different perennial food plants revealed the superiority of the combination of castor (*Ricinus communis*) with borpat (*Ailanthus grandis*) leaves feeding in the early and late stages of the silkworm, respectively. The treatment of castor combined with borpat was found to be at par with the treatment of borpat alone (*i.e.,* from brushing until spinning) and resulted in the lowest larval duration (~23 days), higher mature larval weight (~7.2 g), single cocoon weight (~3.3 g), single shell weight (0.42 g), and cocoon yield per disease-free laying (DFL) in numbers (~278). The treatment of eri silkworm feeding from the first instar until spinning on the Kesseru plant produced the lowest performances in all economic characteristics, including higher larval duration (29 days) and the lowest mature larval weight (5.7 g), single cocoon weight (~2.4 g), single shell weight (~0.31 g), cocoon yield per dfl in number, and cocoon yield per 100 DFLs (Ahmed *et al*., 2015). In addition to assisting in the commercialization of ericulture and resolving the issue of insufficient leaves being available year-round, the use of the borpat tree for eri silkworm rearing will also help to reduce deforestation and the consequences of climate change (Ahmed *et al*., 2015).

Sarmah *et al*. (2015) studied the effect of different host plants on C-2 breed of eri silkworm in the spring season (February-March) and observed that the best performance was found in castor followed by kesseru. *Ailanthus* species (borpat and borkesseru) showed impressive performance in eri silkworm rearing except for longer larval duration, and little lower economic characters. Hence, both the *Ailanthus* species may play a pivotal role as alternative perennial host plants of eri silkworm in addition to Kesseru.

To assess the cocoon characteristics in various seasons, Eri silkworms were raised on two *Ailanthus* species: borpat and borkesseru. Results showed that host plants and the seasons had a big impact on cocoon characteristics (Borah *and* Saikia, 2021). Autumn (84.22%) had the greatest cocoon yield percentage, followed by spring (79.00%), early summer (71.67%), and late summer (64.56%). In terms of the host plants, borpat leaves (77.33%) had the highest cocoon output percentage. In terms of cocoon weight (3.72 and 3.66 g), shell weight (0.43 and 0.43 g), pupal weight (3.28 and 3.22 g), and shell ratio percentage (11.64 and 11.67%) respectively. The Autumn season and borpat leaves performed better than the early summer season and borkesseru leaves, except for the shell ratio percentage, which was lowest in the spring season (10.65%) (Borah *and* Saikia, 2021).

Saikia and Yadav (2015) studied the effect of five different hosts, including castor, kesseru, borkesseru, tapioca (*Manihot esculenta*) and gulanch (*Plumeria rubra*), on larval and cocoon characteristics an experiment was done. Castor was the most suitable host plant, followed by borkesseru, tapioca, kesseru, and gulanch, which were ranked according to larval weight and cocoon weight. In terms of shell weight, castor was more suitable than tapioca and, kesseru was superior to borkesseru and gulanch. Larval duration ranged significantly from 21 to 26 days, with castor having the shortest and gulanch having the longest. Castor showed higher amounts of crude protein, crude fat, total soluble sugar, and reducing sugar than other chemical components of the chosen hosts. This, followed by tapioca, had improved the cocoon and pupal weight of the eri silkworm when compared to other host plants. Therefore, tapioca leaves might be used as an alternative source of nutrition to get through the castor off-season, but in dire situations, kesseru and borkesseru can also step in.

Borpat propagation through seeds

(i) Preparation of beds

Borpat prefers a deep, moist well drained loam soil. Land should be ploughed thoroughly and levelled. Prepare 10×1 m^2 size beds and raise the same up to 15 cm height. One meter width of the bed is good for weeding purposes and keep the space of 30 cm in between beds on all sides for cultural operation and proper drainage. Mix soil, FYM, and sand in a 2:1:1 ratio. Beds should be covered with an agro shade net (50% shade) or a thatched shed to prevent the seedlings from high rainfall and direct sunshine.

(ii) Seed collection

Borpat is commonly propagated through seeds collected from forests or cultivated plantations. Flowering occurs in

September and fruits are ripe from February to March. Fruits are winged samara, seeds are light brown in colour with a very thin membranous testa and oily cotyledons. Although, It is erratic in flowering and fruiting habit and; fruiting output. No two consecutive seed years are good and there is different fruiting from tree to tree even within the same plantation.

Fig. 1 : Borpatseed sowing in raised beds and raised seedlings from seeds.

(iii) Seed Treatment and Sowing

Seeds require treatment with fungicides such as Mancozeb @ 3.0 g/kg of seed to protect plants from seed-borne root rot disease. Borpat seeds are also treated with a common insecticide such as Malathion, Diafenthiuron or Thiodicarb @ 2% for 10-15 minutes to control the seed/fruit borer infestation. Seeds are sown by hands with a spacing of 10-15 cm between row to row and 2-3 cm seed to seed or broadcast evenly for good germination. One kg seeds (around 2000 nos) of borpat require around 15 m^2 of space in the nursery. Cover the seed beds with a thin layer of straw/banana leaves to retain moisture. The daily sprinkling of water is necessary during the dry season. Remove the straw after the germination of the seeds. Normally germination starts within 15-20 days.

(iv) Inter-cultural operation

Weeds restrict the growth of borpat seedlings. Attend regular weeding at an interval of 20 -30 days till the seedlings attain a height of 20-25 cm.

(v) Transportation of seedlings

3- 4 months old seedlings are ready for transfer into poly tubes filled with soil, sand & FYM in the ratio of 1:1:1. Maintain the seedlings for 3-4 months in polybags to get a good growth which ensures better survival in the field.

Vegetative propagation in borpat

Although no such earlier studies have been reported in borpat for vegetative propagation yet recently some initial trials have been made at CMERTI for vegetative propagation of borpat. In a pollarded stem of the borpat tree, generally, 2-3 new shoots are produced. In such semi-hardwood shoots of 45-60 cm in length and 1-1.5 cm in width, air layering can be done using FYM and wet sawdust in a 1:1 ratio. Roots initiation started in 25-30 days. These shoots are then cut from the mother plant and transplanted to poly bags after 50-60 days of air layering when a well-developed root system is observed. Don't damage the root system during separation. Plant in a polybag and irrigate immediately. After one or two months in the nursery shed, these saplings can be transplanted planted in the field.

Fig. 2: Root initiation from the air-layered borpat branch.

Limitations and Future strategies

Perennial borpat is a good alternative to annual castor but there are some limitations in its mass multiplication for distribution among farmers. Although, its propagation through seeds is a robust way but it is erratic in flowering and fruiting habits. No two consecutive seed years are good and there is different fruiting from tree to tree even within the same plantation. The non-synchronous erratic seed behavior of the borpat is a biggest issue to propagate it through seed. The additional problem is the cross-pollination nature which is limiting the scope to provide the true-to-type seedling/sapling material as seed material from the wildly collected seeds are having a high chance of mixing the eri cultural important trait of Borpat. Apart from this, the feasibility of collecting seeds from isolated trees is also cumbersome as an intensive survey for locating old plantations in the forest is required for the collection of seeds. Therefore, it can be summarized that presently no methodology is available for propagating true-to-type seedling/sapling material on a commercial scale. However, air layering has recently been investigated at CMERTI, Lahdoigarh, Assam but since it produces a few shoots from axillary buds, so mass multiplication is not possible. In this case, hormonal treatment to initiate multiple shoots from axillary buds from the main shoot, which can be used for stem cutting or air layering, needs to be attempted. Besides this, the micro-propagation through tissue culture may also serve the purpose to produce the borpat seedling/sapling on a commercial scale. Thus, it can be concluded that for horizontal expansion of the ericulture the diverse perennial host plants are needed at the highest priority and borpat can contribute to it significantly if the propagation of the true-to-type seedling/sapling can be achieved at a commercial scale. Tissue culture can be the best option in this direction and protocol optimization needs to be focused at utmost priority.

References

Ahmed, S.A.; Sarkar, C.R.; Sarmah, M.C.; Ahmed, M. and Singh, N.I. (2015). Rearing performance and reproductive biology of eri silkworm, *Samia ricini* (Donovan) feeding on *Ailanthus* species and other promising food plants. *Advances in Biological Researches,* 9(1): 07-14.

Ahmed, S.A. and Rajan R.K. (2011). Exploration of *vanya* silk biodiversity in North Eastern Region of India: Sustainable livelihood and poverty alleviation.

Proceedings of International Conference on Management, Economics and Social Sciences (ICMESS'2011), December 23-24, 2011 at Bangkok, Thailand, pp: 485-489

Anonymous (2021). Statistical Handbook of Assam-2021. Chapter-11, Sericulture, Directorate of Economics and Statistics, Govt. of Assam*,* pp. 197-202.

Borah, R.R. and Saikia, M. (2021). Assessment of cocoon characters of eri silkworm, *Samia ricini* reared on *Ailanthus* species in different seasons. *Journal of Entomological Research*, 45: 1024-1029.

Borah, D.S.; Saikia, M. and Boro, P. (2020). Rearing performance of two selected eco-races of eri silkworm (*Samia ricini* Donovan) fed with castor and borpat leaves during spring and autumn season in Assam. *Journal of Entomology and Zoology Studies,* 8(3): 2024-2028.

Borah, R.R.; Saikia, M.; Saikia, H.; Borgohain, A. and Borah, D.R. (2021) Seasonal variation in larval growth of Eri silkworm (*Samia ricini* Boisduval) reared on two *Ailanthus* species. *Environment Conservation Journal*, 22: 199-204

Chowdhury, S.N. (2006). Host Plant species of Non-mulberry (Vanya) Silkworms. Non-Mulberry Silkworm and Host Plants Germplasm, pp: 67-73

Chutia, P.; Kumar, R. and Khanikar, D.P. (2014). Host Plants Relationship in terms of Cocoon Colour and Compactnessof Eri Silkworm (*Samia ricini*). *Biological Forum–An International Journal,* 6(2): 340-343.

Naik, C.M.; Patil, G.M.; Murthy, C.; Awaknavar, J.S.; Shekharappa and Alagundagi, S.C. (2010). Development and economic cocoon parameters of eri silkworm *Samia ricini* Boisduval (Lepidoptera: Saturnidae) as influenced by new hosts*. Karnataka Journal of Agricultural Sciences,* 23(5): 716-721.

Saikia, A. and Yadav, R.N.S. (2015). Larval and cocoon characters of eri silkworm, *Samiacynthia ricini* (Lepidoptera: Saturniidae) as influenced by different hosts. *Current Advances in Agricultural Sciences,* 7(2):171

Sarmah, M.C.; Sarkar B.N.; Ahmed S.A. and Giridhar K. (2015). Performance of C2 breed of eri silkworm, *Samia ricini* (Donovan) in different food plants. *Entomology and Applied Sciences Letters,* 2(1): 47-49.

Shaw, C. (1998). Evaluation of *Ailanthus* species in relation to nutrition, growth and cocoon characters of eri silkworm, *Philosamia ricini* Hutt. M.Sc. (Agri.) Thesis submitted to Assam Agricultural University, Jorhat, Assam.