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Host plant diversity of non-mulberry silkworms: A review

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Abstract
Based on the feeding behaviour of silkworms, sericulture can be broadly classified into mulberry and non-mulberry. Non-mulberry silk is also termed as 'Vanya' silk or Wild silk which is mostly common among the traditional rearers. Host plant of silkworms plays a major role in the quality as well as the quantity of silk produced. The non-mulberry silkworms are eri (*Samia ricini*), Muga (*Antheraea assama*), temperate tasar (*Antherara myllita*) and tropical tasar (*Antherara proylei*). Since non-mulberry silkworms are polyphagous in nature, thus on the basis of host plant preference the host plants can be classified as primary, secondary and tertiary. Non-mulberry sericulture is mostly practised by the tribal and local community. They depend upon this sector for their livelihood. Therefore, a keen knowledge of the host plants will help the farmers to increase the number of rearing cycles in a year which in turn will lead to increase in the productivity and yield.

Keywords: Sericulture, mulberry, non-mulberry, eri, muga, tropical tasar, temperate tasar, host plants

Introduction
Sericulture is an agro-based cottage industry which involves cultivation of host plants, rearing of silkworms, reeling and spinning of cocoons for quality silk yarn. It has been acknowledged as an important sector of economy, particularly because of its potential for quicker returns within a shorter duration of time. Based on the feeding behaviour of the silkworms, sericulture is broadly classified into two distinct sectors *viz*. mulberry and non-mulberry. Mulberry sericulture is concerned with the rearing of mulberry silkworm for production of pure silk and non-mulberry sericulture is concerned with the production of different varieties of 'Vanya' or wild silks by rearing eri (*Samia ricini*), muga (*Antherea assama)*, tropical tasar *(Antheraea myllita)* and temperate tasar (*Antheraea proylei*) silkworms.
Non-mulberry sericulture is also known as forest or 'vanya' or wild sericulture which holds a great promise for the agro industries. It is uniquely suited to the economy and social structure of developing countries because of its minimum investment requirement, high employment and foreign exchange earning potential. Food plant plays a major role in silk production. The growth, development and economic characters of silkworms are influenced to a great extent by a variety of food plants and nutritive contents of the foliage [1].

Host plants
Host plant is a primary factor in sericulture industry. The availability of the host plant with quality leaves play a very important role in the rearing of silkworm. The numbers of cycle to be reared in a year and the total number of silkworms or disease free layings (dfls) to be reared per batch depends greatly upon host plant leaf availability in that area. Good agronomic practices play a vital role in the production of quality leaves. The host plant selection behaviour or feeding preferences are largely mediated by the presence and distribution of secondary metabolites in plants [2, 3]. These chemicals in the foliage are classified according to their effect on the behaviour and host-plant selection by insects. The host plants have profound effect on survival, rate of food intake, digestion and assimilation. The amount and quality of food intake by the silkworm larvae influence different parameters like growth rate, larval duration, survival rate and reproductive potential [4]. It was stated that the quality of leaf influences the growth and development of silkworm and overall silk production [5].

Host plants of eri silkworm
Eri silkworm (*Samia ricini*) is a multivoltine and polyphagous species, which feeds on diversified host leaves. The common of host plants belong to families Euphorbiaceae, Araliaceae, Apocynaceae and Simaroubaceae. It feeds over 29 species of host plants [18]. Castor (*Ricinus communis* L.) and Kesseru (*Heteropanax fragrans* Seem.) are the major food plants

of eri silkworm. There are several secondary host plants also *viz*., tapioca (*Manihot esculenta*), Barpat (*Ailanthus grandis* Baiu.), Barkesseru (*Ailanthus excelsa* Roxb.), Payam (*Evodia flaxinifolia* Hook.), etc. which are used for rearing of eri silkworms during the scarcity of primary host plants. Although mulberry dominates the global silk market, among the non-mulberry silks, eri is extensively utilized as a dazzling white natural fibre with thermal properties. India is the largest producer of eri silk in the world as 96% of total eri silk is produced in India [7]. The primary, secondary and tertiary host plants of eri silkworm are listed clearly in Table 1 [18, 8, 9, 10, 11].

Table 1: Host plants of eri silkworm

Status of Food Plants	Host Plants	Family
Primary	*Ricinus communis* L.	Euphorbiaceae
	Heteropanax fragrans (Roxb.) Seem.	Araliaceae
Secondary	*Manihot esculenta*, Crantz.	Euphorbiaceae
	Evodia fraxinifolia, Hook.	Rutaceae
	Ailanthus excelsa, Roxb.	Simaroubaceae
	Ailanthus grandis, Prain.	Simaroubaceae
Tertiary	*Ailanthus glandulosa*, Desf.	Simaroubaceae
	Ailanthus tryphysa, (Dennst.) Alston.	Simaroubaceae
	Carica papaya, L.	Caricaceae
	Celastrus monospermus, Roxb.	Celastraceae
	Cinnamomum cecicodaphne, Meissn.	Lauraceae
	Cinnamomum glanduliferum, (Wall) Meissn.*Coriaria nepalensis*, Wall.	Lauraceae
	Gmelina arborea, Roxb.	Coriariaceae
	Hodgsonia heteroclite, (Roxb.) Hook	Verbenaceae
	Jatropha curca, L.	Cucurbitaceae
	Jatropha multifida, L.	Euphorbiaceae
	Micromelum pubescens, Blume.	Euphorbiaceae
	Oroxylum indicum (L.) Benth. ExKurz.	Rutaceae
	Plumeria acutifolia, Poir.	Bignoniaceae
	Plumeria rubra, L.	Apocynaceae
	Sapium eugenifolium, Buch.-Ham. Ex Hook.	Apocynaceae
	Sapium sebiferum, Roxb.	Euphorbiaceae
	Zanthoxylum alatum, Roxb.	Euphorbiaceae
	Zanthoxylum rhesta, Roxb.	Rutaceae
	Zizyphus mauritiana, Lamk.	Rutaceae
	Mechelia champaca, L.	Rhamnaceae
	Artocarpus heterophyllus, Lam.	Magnoliaceae
	Spathodea companuclata P Beauv.	Moraceae
	Ficus benghalensis, L.	Bignoniaceae
	Terminalia catappa, L.	Moraceae
	Daucus carota, L.	Combertaceae
		Umbelliferae

Host plants of muga silkworm

Muga silk is produced by the silkworm *Antheraea assamensis* Helfer. It is a polyphagous insect feeding on a wide range of plants. The food plants have wide distribution throughout the North-eastern India and in some parts of Northern India. These plants are widely available in the states of Assam, Meghalaya, Manipur, Mizoram, Nagaland, Tripura, Sikkim, Himachal Pradesh, Uttaranchal, Uttar Pradesh, Gujarat, West Bengal and Pondicherry and sporadically available in Arunachal Pradesh. Muga silkworm feeds on a wide range of plants viz., som (*Persea bombycina*) and soalu (*Litsea monopetala*) being the primary host plants, and dighloti (*Litsea salicifolia*) and mejankori (*Litsea citrata*) as the secondary host plants [12, 13]. A few other minor host plants viz., *Cinnamomum glaucescens*, *Actinodaphne obovata*, *Michaela champa*, *Zizyphus jujuba*, *Xanthoxylum rehsta*, *Celastrus monosperma* are also available and are considered tertiary in nature [14]. The list of host plants of muga silkworm is mentioned in Table 2[15].

Table 2: Host plants of muga silkworm

Status of Food Plant	Host Plants	Family
Primary	*Persea bombycina*	Lauraceae
	Litsea monopetala	Lauraceae
Secondary	*Cinnamomum camphora*	Lauraceae
	Cinnamomum tamala	Lauraceae
	Litsea citrata	Lauraceae
	Litsea salicifolia	Lauraceae
Tertiary	*Actinodaphne augustifolia*	Lauraceae
	Actinodaphne obovata	Lauraceae
	Celastrus monosperma	Celastraceae
	Cinnamomum cecicodaphne	Lauraceae
	Cinnamomum glanduliferum	Lauraceae
	Cinnamomum obtusifolium	Lauraceae

	Gmelina arborea	Verbenaceae
	Litsea nitida	Lauraceae
	Litsea salicifolia	Lauraceae
	Machilus odoratissima	Lauraceae
	Magnolia pterocarpa	Magnoliaceae
	Michelia champaca	Magnoliaceae
	Michelia oblonga	Magnoliaceae
	Symplocos grandiflora	Symplocaceae
	Symplocos paniculata	Symplocaceae
	Symplocos ramosissima	Symplocaceae

Host plants of tropical tasar silkworm

Antheraea mylitta Drury is a semi-domesticated sericigenous insect which produces the world famous Indian tropical tasar silk. It is widely distributed in the natural forests located at different altitudes over central India. Being polyphagous, the silkworm usually feeds on the leaves of primary food plants such as Asan (*Terminalia alata* W. & A.), Arjun (*Terminalia arjuna* W. & A.) and Sal (*Shorea robusta* Gaertn). However, more than two dozens of secondary host plants are also available in the natural forests of Indian tropical tasar belt of which Ber (*Ziziphus jujuba* Gaertn), Sidha (*Lagerstroemia parviflora* Roxb.), Axlewood (*Anogeissus latifolia* Wall.), Bahada (*Terminalia belerica* (Gaertn) Roxb.) and Jamun (*Syzygium cumini* (L.) Skeels) are the most abundant species [16]. Since feeding of nutritionally enriched leaves directly influences better growth and development of silkworm larva as well as the quality and quantity of silk production, establishment of food plant specificity of silk insect along with evaluation of the commercial parameters in each food plant during different seasons is highly essential for increasing the production of raw silk and seed cocoons. The list of host plants of tasar silkworm is mentioned in Table 3 [17].

Table 3: Host plants of tropical tasar silkworm

Status of Food Plant	Host Plants	Family
Primary	*Terminalia arjuna*	Combretaceae
	Terminalia tomentosa	Combretaceae
	Shorea robusta	Dipterocarpaceae
Secondary	*Anogeissus latifolia*	Combretaceae
	Hardwickia binata	Fabaceae
	Lagerstroemia parviflora	Lythraceae
	Zizyphus jujube	Rhamnaceae
	Zizyphus mauritiana	Rhamnaceae
Tertiary	*Artocarpus lakoocha*	Moraceae
	Bauhinia variegata	Fabaceae
	Bombax ceiba	Malvaceae
	Buchanania latifolia	Anacardiaceae
	Canthium didymum	Rubiaceae
	Careya arborea	Lecythidaceae
	Carissa carandas	Apocynaceae
	Celastrus paniculatus	Celastraceae
	Chloroxylon sweitenia	Rutaceae
	Cipadessa fruticosa	Meliaceae
	Dalbergia sissoo	Fabaceae
	Diospyros lanoxylon	Ebenaceae
	Dodonea viscosa	Sapindaceae
	Embelica officinalis	Phyllanthaceae
	Ficus bengalensis	Moraceae
	Ficus benjamina	Moraceae
	Ficu hispida	Moraceae
	Ficus religiosa	Moraceae
	Ficus retusa	Moraceae
	Ficus tsjakela	Moraceae
	Ficus tsiela	Moraceae
	Gardenia lucida	Rubiaceae
	Garuga pinnata	Burseraceae
	Lagerstroemia indica	Lythraceae
	Lagerstroemia speciosa	Lythraceae
	Madhuca indica	Sapotaceae
	Melastoma malabathricum	Melastomataceae
	Messua ferrea	Calophyllaceae
	Mimusops elangi	Sapotaceae
	Prynus domestica	Rosaceae
	Pterocarpus marsupium	Fabaceae
	Rhizophora caseolaris	Lythraceae
	Semecarpus anacardium	Anacardiacea
	Shorea talura	Dipterocarpaceae

	Syzyzium cumini	Myrtaceae
	Syzyzium jambos	Myrtaceae
	Tectona grandis	Lamiaceae
	Terminalia bellerica	Combretaceae
	Terminalia catappa	Combretaceae
	Terminalia chebula	Combretaceae
	Terminalia paniculata	Combretaceae
	Zizyphus rugosa	Rhamnaceae
	Zizyphus xylopyrus	Rhamnaceae

Host plants of temperate tasar silkworm

The temperate tasar silkworm, known as *Antheraea proylei*, feeds on a variety of food plants like *Quercus incana, Q. himalayana, Q. semicarpifolia, Q. grifithi, and Q. serrata*. These food plants are available in the entire sub-Himalayan belt of the country bounds Jammu and Kashmir in North-West to Manipur in the North-east comprising of many other states in between including Himachal Pradesh and Uttarakhand in North-western part of the nation. The topography of these regions is different from other parts of the country comprising of high terrains, deep gorges and dense forests. Agro climatic conditions of this region are characterized by severe and prolonged winter. Distribution and cultivation of the oak species varies with the altitude. Sometimes the same species sprouts at different times at different altitudes. Indian oak provides a unique ecosystem having both deciduous and evergreen forests. Among the various species of oak, 16 species are popular and widely distributed in different parts of the country. A total of 10 species are growing in eastern part of the country and 6 species in the Western Himalayas.

Table 4: Host plants of temperate tasar silkworm [17]

Status of Food Plant	Host Plants	Family
Primary	*Lithocarpus dealbata*	Fagaceae
	Quercus acutissima	Fagaceae
	Quercus floribunda	Fagaceae
	Quercus griffithii	Fagaceae
	Quercus leucotrichophora	Fagaceae
	Quercus semecarpifolia	Fagaceae
	Quercus semiserrata	Fagaceae
Secondary	*Castanopsis indica*	Fagaceae
	Castanopsis lancaefolia	Fagaceae
	Castanopsis purpurella	Fagaceae
	Lithocarpus fenestrate	Fagaceae
	Lithocarpus xylocarpa	Fagaceae
	Quercus baloot	Fagaceae
	Quercus glauca	Fagaceae
	Quercus kamroopi	Fagaceae
	Quercus lamellosa	Fagaceae
	Quercus lanata	Fagaceae
	Salix viminalis	Salicaceae

Conclusion

Sericulture plays a major role in the economy and social structure of a developing country. The success of sericulture industry primarily depends upon various rearing practices. Among them, host plant maintenance and availability is of utmost importance to increase the productivity as well as the quality of silk produced. This in turn also determines the number dfls to be reared per batch and per year. The growth, development and the commercial characters greatly depend on the type and nutritive content of the host plants. Most of the tribal and local people depend upon the non-mulberry or wild silkworm rearing as their livelihood. Therefore, a keen knowledge of the primary, secondary and the tertiary host plants will help the farmers to increase the number of rearing cycles in a year. Thus, the study of non-mulberry host plant will help the 'Vanya' silk industry to increase production and productivity round the year.

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