

## NON MULBERRY FOOD PLANT CULTIVATION

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In this topic, non mulberry food plants viz., *T.arjuna*, *R. Communis* and *Macnilus bombycinat* and *Litsaea polyantha* are explained.

### TASAR FOOD PLANTS

With the exploration of the new potential belt, the Indian tasar culture now comes to hold two distinct entities - traditional tasar and oak tasar. The traditional tasar tract is dominated by *Terminalia* and *Shorea*, while the latter, as the name implies by oaks *Quercus*.

Though as a matter of fact the tasar silkworms are polyphagous, there is some specificity so far as affinity to particular food plant is concerned. The food plants of the insect's first choice are known as "Primary", and the others as "Secondary". It does not however, speak only of the preference of the silkworm but also of the properties of the plants in terms of productivity. The present chapter contains brief description of different aspects studied so far on primary and secondary tasar food plants.

### TAXONOMY

*A. mylitta* feeds primarily on *Asan* (*Terminalia tomentosa*), *Arjun* (*Terminalia arjunay* and *Sal* (*Shorea robusta*), while *A. proylei* is mainly reared on *Uyung* (*Quercus serrata*), *Banj* (*Quercus incana*), *Sahi* (*Quercus dealbata*) and *Moru* (*Quercus himalayana*). Being important for tasar industry, these three genera (*Terminalia*, *Shorea* and *Quercus*) merit elaboration.

### TERMINALIA ROXB.

(Order: Myrtales; Family: Combretaceae)

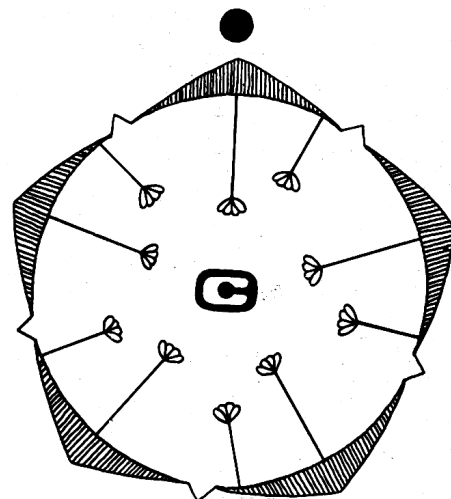
**Habit and Habitat** - Large, deciduous tree. **Leaf** - simple, alternate or sub-opposite, entire, petiolate, often with one or two glands on either side. **Flower** - small, bisexual dull yellow, sessile, bracts deciduous; Calyx-tube produced over the, ovary with constricted mouth, sepals 5, petaloid; Corolla - petal 0; Androecium -stamens 5+5, inserted on the calyx tube in two rows; Gynaecium - ovary inferior, pendulous, 1 celled; ovule - 2 to 3.

**Fruit** - 3 to 6 cm long a coriaceous drupe. 1 seeded with 5 broad transversely striated coriaceous wings. **Seed** - exalbuminous, fleshy, oily.

**Sprouting** - March to April.

**Flowering** - April to June after sprouting.

**Fruiting** - December to February.



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Floral diagram  
of the genus *Terminalia*

**Fig. Floral diagram of *Terminalia tomentosa*.**

The genus *Terminalia* consists of more than a dozen species but in India, *T. tomentosa* is most important food plant of tasar silkworm and is widely distributed as a common tree. *T. Tomentosa* is found in lower hills and valleys of the Northern India. *T. arjuna* is more common along small streams in Madhya Pradesh and southern Bihar.

### **PLANTATION**

In traditional practice tasar larvae are being fed on irregularly distributed food plants in forests or bunds of paddy fields. This creates management hazards resulting in heavy losses due to pests and diseases. Ardent changes are therefore essential and recent researches have revealed that systematic' plantations can reduce such losses.

#### **Climate and soil**

On the basis of scientific information available so far the soils of India have been grouped into alluvial, black, red, lateritic, mountain and hill, arid and desert, saline and alkaline and peaty soils. Soil can also be classified on the basis of texture and is measured according to clay content. Four main types are recognised viz., clay (50% or more), clayey loam (37.50-50%), sandy loam (12.50-25%) and sandy soils (12.50% or below) by farmers and soil workers.

*Terminalia tomentosa* and allied species are well suited to reddish or well drained lateritic soils. It flourishes well on loam, sandy loam and even on clayey loam soils. Red soils are predominant occupying a majority of tasar tracts and is derived from granites and allied rocks.

The soils are red in colour due to the presence of free iron oxides and generally shallow with low base exchange capacity. These are poor in plant food ingredients but respond very well to manuring and irrigation.

The lateritic soils are red and heavy but well drained. The depth of the lateritic *morrum*. layers varies considerably. Usually these soils are poor in nitrogen, phosphorus, potash, lime and other plant nutrients. This soil also responds to manuring. and good cultivation, In India, saline and alkaline, as well as arid and desert soils which are not well suited to have agricultural 'crop's can be profitably

diverted towards tasar industry.

### **Preparation of land**

Where regular plantations are intended it is always desirable to select a site in well established tasar belt which requires a careful and systematic planning. The land is prepared well by repeated ploughing, disking, levelling and terracing if necessary, Pits measuring 2' x 2' x 2' are dug well in advance before transplanting.

The experiments to raise bush type plantations of *T. arjuna* with closer spacings i.e., 4', 5' and, 6' in either direction, have indicated that with a decrease in spacing though the yield of foliage per plant goes down, the yield per unit area increases. Per hectare yield of leaf in 4 year old plantations with 4', 5' and 6' spacings was 136.52, 97.25 and 62.44 quintals respectively. Therefore plantations with closer spacings if raised for tasar culture may increase the rearer's income.

Under rain fed condition food plants spaced 10-12 apart are expected to support a tasar crop yielding a profit of Rs, 1000 - 1200 plus an extra income of Rs. 500 - 600 as inter-crop totalling a sum of Rs. 1500-1800 per hectare per annum. While with a closer spacing of 4' x 4' with many fold increase in foliage one can legitimately expect a tasar crop worth Rs. 3000-3500 and Rs. 300 - 400 as inter-crop, thus totalling Rs. 3300 - 3900 on per hectare basis.

### **Transplanting**

The pits prepared for transplantation are filled with a mixture of earth FYM / compost, 100-200 g each of *karanj* cake, bone meal, wood ash and Aldrin 5% dust. Robust and healthy seedlings are transplanted in June-July followed by one irrigation with a rosecan. Seedlings should be strengthened by the next day and basin should be made around each sapling. A second irrigation should be provided after 3-4 days if no rainfall occurs in between.

### **Manuring and Interculture**

In tasar food plants practically no manuring is practised but recent researches carried out in this direction resulted in significant increase in leaf yield, the appropriate dose per plant being 20 kg of FYM along with 14 g of N and 7 g of P<sub>2</sub>O<sub>5</sub> as chemical fertilizer. The manures are applied in basin prepared at the base of

each plant and are covered with earth to avoid loss due to heavy showers. Green manuring with Sunnhemp (*Crotalaria juncea*), Dhaincha (*Sesbania aculeata*), Horse gram (*Dolichos biflorus*) are also advocated to improve soil fertility.

The plantations are generally ploughed in a criss-cross fashion at least twice in a year: to suppress weed growth, soil pests and to have a fine tilth. This will ensure considerable root 'pruning' by cutting and tearing of fibrous roots which feed on top soil.

### **Irrigation**

Tasar food plants are seldom irrigated. However, recent researches have indicated beneficial effects of irrigation conducted during dry months at fortnightly intervals. Basin system of irrigation is advocated. These basins could be fed by shallow kacha wells which can be dug and maintained with rearer's family labour. Indigenous water lifts e.g., *mhote*, *rahat* etc. can be utilised at a very cheap rate.

Inter-crops and cover crops

### **TRAINING AND PRUNING**

The tasar food plants have a tendency of attaining height. However, in order to facilitate rearing, the plants of 10-12 ft height with well spread crowns, bearing rich foliage are ideal. It is therefore essential to train the plants from the very early stage. Though the modern concept of tasar culture advocates in favour of rearing on the plantations raised systematically, in absence of such possibilities in the immediate future it is proposed to utilise the flora of old trees already existing in the country by making them fit for rearing.

Horticultural trees are generally subjected to three systems of training viz., *Central leader*, *Open centre* and *Modified leader* systems. In the central leader system the dominance of the main trunk is maintained, while the lateral branches are not allowed to spread (leaving 1-2 branches at regular heights) to give the plant a linear shape with short and compact branches.

In the open centre system, the main trunk is never allowed to grow beyond a certain height, thereby inducing all subsequent growths by lateral branches. This results in a crown consisting of several shoots. All other scaffolds are nipped out.

This method has been found to be very successful with Asan and Arjun plants by polarding the big trees at the height of 6-8 ft. The branches which come out are very rich in foliage having leaves of bigger size and better quality. The harvesting of cocoons which involves cutting of small branches acts as light pruning and further adds towards training.

In the modified leader system, the central axis of the plant after attaining certain height is headed back. The lateral branches coming out from the point of cut are allowed to flourish.

### **CULTIVATION OF ERI FOOD PLANTS**

The eri silkworm feeds mainly on *Ricinus communis*. (bharenda or castor-oil plant).

#### **Distribution**

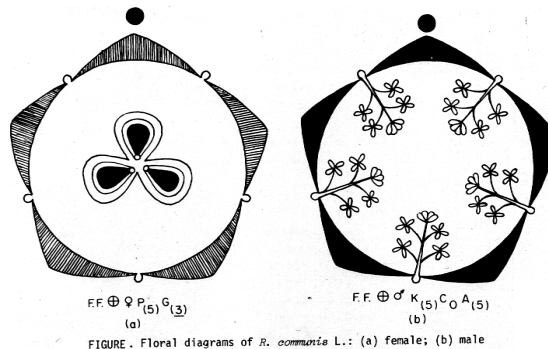
*R. communis* grown in many parts of the world, including Sudan, Egypt, India, Burma, Sri Lanka, Malaysia, Philippines, Indonesia, Brazil, the U.S.A. and Mexico. Widely distributed in India, it is used mainly for eri culture in Assam, Tripura, West Bengal, Bihar, Meghalaya, Arunachal Pradesh and Manipur, where it is grown as a self-generating crop on hillsides, bunds and other wasteland.

#### **Taxonomy**

The taxonomy of *R. communis* has been described as follows:

**Order:** Euphorbiales; **Family:** Euphorbiaceae **Habit:** evergreen shrub, annual, biennial or perennial. **Leaf:** simple, alternate. **Inflorescence:** terminal raceme. **Flower:** small, incomplete, unisexual, monoecious, upper female and lower male, actinomorphic, hypogynous; perianth in three to five whorls, united; male flower, many stamens, polyadelphous; female flower - carpels three, united; ovary, three-lobed, three-celled with one ovule in each cell; styles - three bifid, long or short, six stigma.

**Fruit:** globose capsule, generally echinate. **Seed:** albuminous.



In Assam and other North-Eastern States, there is no regular cultivation of castor or other food plants for the purpose of feeding *eri* silkworms. The two food plants-castor and *kesseru*-grow wild around the villages or near the houses of the village rearers. Thus, the rearer often collects leaf from scattered castor plants or *kesseru* trees. However, in other States in India, regular cultivation of castor is done for the production of oil seeds. In the following paragraphs, cultivation of food plants-castor is discussed.

### **CASTOR: TYPES AND SOWING METHODS**

Castor may be grown as annual or perennial and is commonly seen-one having pale green and the other with violet leaves. Both are equally suitable for feeding *eri* silkworms. September-October and March-April are the good sowing seasons. Even in the month of August, sowing may be done in any area where rainfall has become scanty. Preparation of land, including manuring, should be done beforehand. To prepare the land for sowing of castor seeds, ploughing ought to be done three times consecutively followed by *laddering* operation required for levelling the ground.



Germination of seeds and growth of the castor plants are greatly influenced by heat, light, moisture and aeration. So, it has to be cultivated like any other garden crops. Seeds are sometimes broadcast at the rate of 9 to 10 kg., per acre. But the best method is to put 2 to 3 seeds in a hole, either 3' to 4' apart in rows, 5' to 6' apart. Under optimum conditions of heat, light, moisture and aeration, seeds generally germinate in 7 to 10 days. It, however, takes longer when temperature is low and moisture less.

The first thinning operation is undertaken at the time the seeds are broadcast and the spacing is adjusted to 3' to 4' from plant to plant. Yet another thinning is resorted to, in the case of perennial plants, when the spacing is adjusted to 5' to 6' from plant to plant. If, due to some reason, the germination is not up to the mark or, the new plants appear weak, they should be uprooted and, in the gaps fresh, healthy seeds should be sown. To get more branches and leaves, the perennial variety requires light pruning when it attains a height of about 5'. The object of thinning is to cultivate the healthiest plants and give proper spacing plant to plant. Even a stick, about 1 1/2 inch thick and 8 inches long, may be used to drill holes and sow seeds. To feed the worms, leaves should be harvested from the healthy plants. Dry leaves and twigs must be removed from the plants and the plots should be weeded frequently to keep them clean.

### **SOIL AND MANURE**

An acre of trees, 12' X 12' apart, may yield about 20,000 kg. of leaf. For successful cultivation of castor trees, light clay soil is required. However, light sandy soil is always preferable to clay soil. Though potash is necessary in the soil, it is replenished by application of ash of the burnt weeds, leaves, stalk and stems. Cultivation of leguminous plants namely sun hemp, daincha, cowpea, mung, matkalai etc., may be done before undertaking the castor plantation in order to incorporate nitrogen and humus in the soil. Castor and mustard oil-cakes may be used as manure. A dose of lime is necessary, every two or three years, when any manure with oil contents is used. Well decomposed farm yard manure is the best and cheapest in some places. Inorganic manures may be applied as top dressing either at the beginning or at the middle of the crop. Green manure may be applied when



the plants have grown two to three feet high.

### **METHODS OF HARVEST**

The castor seeds do not become ready for harvesting, at a time, because all the capsules on the fruiting branch or spike do not mature uniformly. So, the crops should be harvested when a few fruits or capsules show signs of drying. In Khandesh and Saurashtra regions, the whole spike or fruiting branch of the castor plant is stripped off the capsules when it starts and they are dry. This mode of harvest is not, at all, good because a large number of immature, unripe and partially dried fruits or capsules will be harvested with the ripe fruits. Thereby, the quality and quantity of the produce are reduced. The kernels of the immature fruits will be lighter in weight and poorer in oil content. Experiments show that seed from matured capsules will yield five per cent more oil.

Delay in harvesting of castor seed on this account will not be helpful. Mature capsules will shed the seeds if the harvest is delayed until the fruits dry on the plants. If castor seeds are collected by means of hand-picking, when they are dry, more labour will be required for the frequent pickings, and the cost of collection will be quite high. So, an obvious solution to this problem is to grow strains, whose seed maturity comes, one at a time. Even then, it will be economic to harvest the crop only when the fruits in the spike are ripe. This way, more quantity of matured and better seed is obtained.

### **Muga Silkworm Food Plants**

Muga silkworm is a polyphagous insect which feeds on the leaves of several plants. The most important among them are *som* (*Macnilus bombycinat*) and *Soalu* (*Litsaea polyantha*) which grow abundantly throughout North Eastern India, and in particular in the Brahmaputra valley, foot hills of Naga, Khasi and Garo hills.

#### **Food Plants and Their Distribution:**

Almost all the muga silkworm food plants grow well under humid and warm climatic conditions with high rainfall. Most of the muga food plants belong to the family Lauraceae (order-Laurales). The survey indicates most of the plant species to be in natural state along the sub-Himalayan hill ranges particularly in the North

Eastern India.

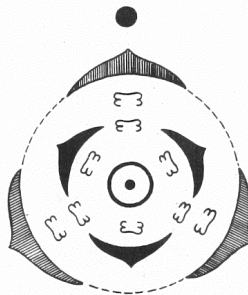
### Morphological Characters



Som Plant



Som leaves eaten by muga silkworm



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Floral diagram of *Machilus*

In order to facilitate proper identification of the primary food plants of muga silkworm the morphological characters of *som* and *soalu* are given below:

#### (1) *Som* (*Machilus bombycina*, King)

An evergreen, middle sized tree, with spreading branches, dark light or dark grey, rather rough; leaves - simple, ex stipulate, petiolate, alternate; entire, obtuse, upper surface glabrous, lower pubescent, length; breadth ratio of leaf is 2.5 to 5.0 X 0.8 to 2.0 inch, elliptic lanceolate to obovate lanceolate. Lateral nerves 6-8 on either side. Inflorescence: Panicle. Flower: Bisexual; hypogynous, regular small, yellow in colour; perianth 6 in 2 whorls, persistent, imbricate; stamens 12 in 4 whorls, stamens of third whorl bears a pair of lateral glandular outgrowths, inner most fourth whorl is

transformed into staminode. Filaments hairy at the base. Anthers adnate, opening by a valve from below upwards, Carpel one, ovary one celled with single ovule. Style terminal, stigma three lobed, placentation marginal, Fruit: fleshy berry, globose, size: 6mm-7.5mm; Flowering: December-March; Fruiting: March-May.

(2) *Soalu (Litsaea polyantha Juss.)*

Middle sized, evergreen tree, woody, bark rough, grey. Leaves-simple, exstipulate, petiolate, alternate, entire, obtuse, upper surface glabrous, lower pubescent, usually rusty brown when dry. Nerves strong beneath, 8-30 cm long. Petiole hairy, lateral veins 15-18. Inflorescence: umbel and in cluster. Flower buds born on a common peduncle covered with a whorl of bracts forming involucre. Bracts usually 5 in two whorls, concave and tomentose. Flower: unisexual but bisexual flowers also exist where one sex is abortive Perianth segment 4-6, small, thin, hairy and almost free. Stamens in male flower variable, usually 9-12 in 3 or 4 whorls. Filaments hairy. Filaments of first and second whorl aglandular while filaments in third and fourth whorls bear a pair of lateral glands. Glands stipitate. Anthers adnate, four celled, introse, opening by a valve. In female flower 9-12 staminodes present, arranged as in male flower. Carpel in female flower one, ovary superior, style thick, stigma irregularly lobed. Ovary free with single ovule. Placentation marginal. In male flower ovary absent or with a slender style and small stigma. Fruit: Fleshy berry, oblong or ovoid, Flowering: February-May; Fruiting: May-August.

### **Soil and Topography**

Muga plants grow well in sandy loam soil. The soil where the muga food plants grow are acidic with pH between 4.5 to 5.0. High and slopy land with good drainage system are suitable for muga plantation.

### **Propogation Methods and Nursery Techniques for Raising Muga Food Plants**

#### **Propagation through seeds:-**

In nature *som* and *soalu* plants are propagated through seeds. *Som* seeds are collected during March and April while *soalu* seeds are collected during May and June. The pulp of the seed is washed off by kneeding two or three times in water and dried under shade for a few hours. The seeds remain viable for a very short period.

Hence it is desirable to sow the seeds soon after collection. The seeds may, however, be stored in moist seed beds for six to eight weeks under low temperature to prolong their viability. Though seeds can be directly used for raising plantation, the present trend is to grow seedlings in the nursery and transplant them in the field to reduce the period of establishment and save wastage of precious seed material. Seed beds of convenient size are prepared. Seeds are sown in lines in the prepared beds at a spacing of 15cm in the row and 15cm between rows at a depth of about 2 cm. Germination starts after 4 weeks of sowing. Normally one seed gives rise to one seedling only but polyembryonate seedlings are also known to occur. In the polyembryonate seedlings, twins and triplets have been observed in *som* which are rare occurrences. Similarly the seedlings can also be raised in polythene tubes. The seedlings raised in nursery or polythene tubes are maintained for about 3 months till they attain a height of one foot. The seedlings from the nursery are transplanted to pits of 1 x 1 x 1 feet and manured with 0.5 cft, of farm yard manure along with 109 aldrin (5%) dust. The soil, manure and the insecticides should be thoroughly mixed before filling the pit covering the seedling. It is desirable to transplant the seedlings in the next monsoon season otherwise heavy watering would be required. The season from July to September is ideal for transplantation. Though the closer spacing of 2x2 mtr. gives more quantity of leaves and accommodates maximum number of plants per unit area in the initial stage, it is not suitable for the healthy growth and management of plants and also for muga silkworm rearing which suffer heavily due to high incidence of pests and diseases. Hence a spacing of 4x4 mtr. for *som* and 5x5 mtr. for *soalu* in square system of plantation is ideal which will accommodate 625 and 400 plants/ ha respectively.

#### **Package of Practices for Raising Som and Soalu Plantations:**

In the traditional practice, muga silk industry mainly depends on the plants grown near the houses, where no regular spacing is maintained. Further the plants are left uncared for and no attention is paid to improve the quality and quantity of leaves. This leads to wastage of land and management difficulties resulting in considerable loss of the muga worms particularly during the initial stages. If food

plants are grown on systematic lines with optimum spacing for adopting proper cultural operations and manuring, it will improve the quantity and quality of leaves of muga food plants leading to improvement in the effective rearing rate and increase in the productivity per unit area of land. Also several muga rearers depend on the scattered *som* and *soalu* trees in the foot hills and plantations maintained by the Sericulture Department in the Village Grazing Reserves (VGR). Here again the trees are not cared properly, resulting in wild growth of trees and heavy damage by pests and diseases. Particularly, the trees maintained by the department require maintenance of proper tree size and control of insect pests like leaf galls, leaf roller and stem borer and also diseases like leaf rust, leaf spot and wilt. Hence it is imperative to follow optimum spacing, regular weeding, adoption of pruning and pollarding with proper manure application wherever the seedlings are young. This is practicable in private plantations and Village Grazing Reserves and other plantations maintained in the Government Muga Farms.

**(i) Selection of Site and Layout**

The site for muga food plantations should not be low-lying and there should not be stagnation of water. The land should be high and well drained. In a forest land, the land has to be prepared by cutting down the trees, shrubs and other vegetation. Then the roots of all the trees have to be completely removed and the land has to be marked out into convenient plots. In the case of fallow land, it may become necessary to remove any small trees that may be growing in the site and mark out the land into convenient sites. In the hilly tracts, it is necessary to terrace the land, and raise bunds on all the sides to prevent erosion. The prepared land may be made into small plots; which will be more convenient for plantation.

**(ii) Selection of Food Plants**

Although muga silkworm is polyphagoeous it prefers *som* and *soalu*. *Som* is ideally suitable for muga culture, because it is evergreen and effective rate of rearing is always higher. Quantitative characters viz. shell weight, silk ratio and reelability are better in cocoons produced by *som* fed worms than *soalu* fed worms. However, muga silkworms fed with *soalu* leaves produce healthy moths which lay

more eggs. Hence *soalu* should be preferred for seed production purposes and *som* should be preferred for reeling cocoon production. *Soalu* is semideciduous and sheds the leaves during winter (Nov-Feb). Almost all the leaves during winter are over mature and unfit for muga rearing. Hence winter rearing on *soalu* for seed purpose is also not desirable which results in heavy loss of muga silkworm.

Keeping these facts in view, the rearers in upper Assam are recommended to plant *som* trees only and lower Assam rearers to plant more of *som* than *soalu*. However, the Government farms may adopt *som* and *soalu* plantations in the ratio of 3: 1 in upper Assam and 2: 1 in lower Assam respectively.

### **(iii) Digging and Filling of Pits**

After selection of site, lay-out and selection of plant, the next operation is pit digging and filling of the pits. Pits of one cubic foot (1x1x1) size are dug during dry spring season (February-March). The earth dug out may be exposed to the sun so as to dry up the weeds and seeds of these weeds thoroughly. The soil dug out in the pit should be mixed thoroughly with farm yard manure (FYM) and 10 gm. of Aldrin (5%) dust. The mixture is filled up in the prepared pits and kept ready for plantation with the onset of monsoon (July-September).

### **(iv) Planting Season**

The monsoon season (July to September) when the rainfall is high, is ideal for planting of muga food plants and the plants remain in active growth stage during the plantation period. The roots develop properly during this season.

### **(v) Manuring**

Farm yard manure at the rate of 0.5 cft/ plant is applied in the first year while from second year onwards FYM at the rate of 1 cft/ plant is applied. This should be followed at least for five years. A circular trench of 6" to 9" deep is dug around the weed frequently particularly when the seedlings are young. The best way to remove weeds is to destroy them before they flower and seed. Apart from weeding, soil loosening simultaneously is also essential so as to allow the rain water to percolate deep into the soil and this practice ensures better aeration in the soil. Weeding and soil loosening may be done at least thrice in a year during June, August and October.

### (viii) **Training and Pruning**

Muga food plants need proper training and pruning. The object is (1) to increase the foliage (2) to remove dead or diseased parts (3) to give desirable shape to the plant (4) to control the height of the plant (5) to establish a functional balance between different organs of the plant. In practice, the rearer allows the tree to grow freely, without training and pruning. In such case the leaves become rough, coarse and small and are often damaged by diseases and insect pests:

Besides, the plants become tall and inconvenient for management of silkworm rearing.

(a) **Training the seedlings:** When the seedlings attain a height of 12", the apical tips with 3 to 4 leaves are nipped by hand. The axillary buds become active and in about 20 days new branches will arise, by this technique seedlings with 4 to 5 branches may be obtained. This may be done in the nursery stage. After transplantation of these seedlings, periodical nipping of apical tips at the interval of six months will result in umbrella shaped crown, and the trees will have more branches, and vertical growth of trees will be slower.

(b) **Training of old trees:** *Som* and *soalu* plants grow taller in nature and some times grow upto 50 to 60 feet. Therefore, problems in rearing are bound to occur because of such tall trees. Usually leaf quality of such trees is poor and muga crop is not assured. Trees of 15 to 20 ft, height with spreading crown bearing rich foliage are ideal for management and muga silkworm rearing.

The ideal method recommended for training of older trees is to maintain 4 to 5 branches at the base and allow 2 to 3 branches on each of these branches subsequently to grow. This method should be continued year after year so that an umbrella shaped crown is secured. This results in more leaf yield and increases the muga rearing potential. Also the effective rearing rate of rearing of muga silkworm is enhanced in the trees which are maintained properly.

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