UNIT 2 CULTIVATION OF MUGA FOOD PLANTS

Structure

2.0 OBJECTIVES

After reading this unit, you will be able to:

- identify the food plants of Muga silkworms;
- explain the nursery raising, cultivation and propagation practices of Muga food plant;
- describe cultivation and management practices of Muga food plants;
- discuss the pests of Muga food plant and their control; and
- support the need and practice of bush plantation for chawki rearing.

2.1 INTRODUCTION

India is the only country producing the shimmering golden Muga silk. It is produced mainly in Assam, and few other North-eastern states. Muga silk is produced by the

Muga silkworm, *Antheraea assama.*

Muga silkworm is a polyphagous insect which feeds on several host plants. Primarily, it feeds on leaves of Som (*Machilus bombycina*) and Soalu (*Litsaea polyantha*) plants. They grow abundantly throughout North-eastern India and in Brahmaputra valley and Garo hills in particular. The other host plants of Muga are of less importance. They are called secondary host plants like, Mejankari (*Litsaea citrala*), Digloti (*Litsaea salicifolia*), Choa (*Magnolia sphenocarpa*), Bhumloti (*Symploces gradifflora*), etc. The Muga host plants are perennial, Som in Upper Assam and Soalu in Lower Assam. The Som plants are preferred for silkworm rearing due to their long life span and greater resistance to pest attack.

The **Som** plant called *Persea (Machilus bombycina)* and **Soalu** plant, scientifically known as *Litsaea polyantha* are evergreen, medium sized tree with spreading branches. Som is identifiable by its rough, dark gray bark, extensively distributed in India, Nepal, Burma, Malaysia and Indonesia. It is profusely grown in hill ranges and valleys with humid, warm climatic conditions and also belongs to the family Lauraceae under order Laurales. Soalu differs with a woody trunk and rough bark, well distributed in India (lower Assam, Arunachal Pradesh, Meghalaya, Mizoram and Nagaland), Nepal, Burma, Khmer, Malaysia and Indonesia. The tree prefers sub-Himalayan regions having humid, warm climatic conditions with heavy rainfall. It prefers sandy loam acidic soils (pH ranging from 4.5 to 5.0).

2.2 PROPAGATION

Muga plants are propagated through stem cuttings, layering and through seed nursery.

2.2.1 Through Seeds and Seedlings

Propagation is done through seeds. Seeds are collected directly from the plants before their natural shedding. Som seeds are collected during March-April and the Soalu seeds are collected during May-June. The seeds are washed to remove the pulp and dried under shade. The seeds can be sown directly for raising the plantation.

Propagation is also done through raising seedlings. In this method, seedlings are raised in the nursery and then transplanted in the field. This is the current method of propagation to reduce the period of establishment and wastage of the material. The seeds are immersed in water. The bottom settled seeds are used for sowing in the nursery beds for raising the seedlings. The seeds are sown in the nursery bed (prepared as described in previous chapter) at a distance of 15-20 cm per bed and covered by a thin layer of thatch grass i.e. mulching grass. The bed is made wet by sprinkling water. Repeat watering at 4 to 5 days interval. The seedlings thus raised are transplanted in the field.

Seedlings are also raised in polythene bags. The seeds are collected and heaped under a shade covered by gunny cloth with regular water sprinkling to keep them moist. The germination starts after 4 weeks. The germinated seeds are collected and sown in polythene tubes of size 9 x 6 inches size filled with a mixture of soil, sand and FYM at a ratio of 1:1:1 as the rooting medium and allowed for growing.

Two to three selected seeds are sown in each polythene tube (15 × 20 cm) filled with the growing medium. After germination on 6^{th} to 8^{th} week from sowing, keep one seedling in each tube and transfer the others. The seeds are kept heaped on moist beds in a shed and covered with wet gunny bags to maintain the moisture and to induce early germination. Then, sowing of germinated seeds into the polythene

bags is taken up. Provide a shed over the seedlings to protect them from direct sunlight and hail storm. Remove the shade after the onset of monsoon.

2.2.2 Through Vegetative Parts

With the increasing demand of true type varieties and also for optimizing biomass production, the importance of vegetative propagation was felt.

2.2.3 Through Single Leaf and Shoot Bud Cutting

Propagation from stem cuttings is the easiest, most convenient and economic method of vegetative propagation. Vegetative, also called asexual propagation gives very quick growth to the plants. The plants would be dwarfs with abundant branches and leaves. They inherit all the true characteristics of the parents.

Cuttings from the branches of 1-1½ years old (but not too old) plants or leaf bud cuttings from the apical portions of tender shoots having a small piece of branch about 4 cm long with only one node and a leaf with 1-active bud are selected for the propagation. Many cuttings may be prepared from a single branch too. It is advisable to prepare cuttings early in the morning from suitable healthy young plants during February to April. In some cases, cuttings may even be prepared during September-October also. The upper cut ends of the cuttings are to be sealed with wax or fresh cow dung to avoid drying or rotting. About 3 cm portions of the cuttings are inserted into the rooting medium consisting of clean river sand in polythene tube (22 x 15 cm). The polythene tubes are arranged in pits measuring 2 x 1 x 0.50 m under a thatched shed. Watering is done regularly and continuously for a period of about 2 months. Nearly 60 % rooting takes place after 55-60 days with 90% post transplantation survival. The seedlings or saplings are allowed to grow in the nursery beds for about 2 years before transplantation.

2.2.4 Through Juvenile Shoot Cuttings

Juvenile shoot cuttings are prepared from 30-40 days sprouted shoots from basal portion along with some trunk bark tissues of the pollarded / pruned plants. Such cuttings are treated with 0.10 % Bavistin by dipping in the solution for 2 minutes. The juvenile cuttings are inserted in the rooting medium about 3 - 4 cm deep. Then, the cuttings are sown in the nursery. The nursery beds are kept wet by regular watering for maintaining the desired moisture inside the bed. Initiation of rooting takes place at about 30-40 days with maximum rooting.

2.2.5 Through Air Layering

Air layering is generally done during April-June (though it may be prepared in other season also). As air layering method records 81 % and 85 % rooting in Som and Soalu respectively, this method is also adopted. Usually 1-2 year old shoots of 4-5 year old plants are more suitable for air layering. The leaves are removed from the base of the shoot and then a ring of bark about 2 – 3 cm width is removed without damaging the cambium. The cut surface is treated with 500 ppm Indole Butyric Acid (IBA) for further improvement in rooting. The cut portion is then covered with a mixture of compost, cow dung and soil in 1:1:1 proportion adding some saw dust soaked in water for 24 hours and wrapped with polythene paper. The ends are then tied. Rooting takes place within 50-60 days in Som and 40-50 days in Soalu.

The portion of the branch below the layering is cut and planted in the nursery. It may also be planted directly in the pot. It is advisable not to select big branches or old trees for preparation of air layering. More number of layers will survive, if 50 % of

leaves are removed from them at the time of plantation. The cost of raising layers in nursery is higher than the cuttings.

Check Your Progress 1

Note: a) Use the spaces given below for your answers.

b) Check your answer with those given at the end of the unit.

1) Mention the primary food plant species of Muga silkworm and its distribution in the world and different parts of India.

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2) Describe in brief different propagation methods of Muga food plant.

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3) Write down the method of propagation of Muga food plant through air layering.

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2.3 CULTIVATION AND MANAGEMENT OF MUGA FOOD PLANTS

2.3.1 Cultivation of Muga Food Plants

Generally, the Muga silkworm is reared on unorganized tall Som and Soalu trees, due to the lack of proper plantation technique. Also, Som and Soalu plants show long gestation period. To overcome these problems and to produce quality foliage, a technique has been evolved for systematic plantation of Som under closer spacing.

Well-drained high land is chosen for raising Muga host plants. Healthy saplings are to be transplanted from the nursery during monsoon (May-August) when no watering is required without injuring their main roots. Saplings are removed along with the ball of earth before two weeks of transplantation. It will help in sticking the ball of earth to the root system and settling of the terminal roots at the time of transplantation. While transplanting, the position of the sapling/clone in the nursery is to be maintained as far as possible to avoid physiological imbalance. Transplantation may also be done in other seasons where irrigation facility is available. Ring system of watering during dry months is necessary for better growth of plants. Periodical removal of apical tips is necessary for seedlings/layers/saplings after transplantation.

The land is deeply ploughed and pits of 30 cm x 30 cm x 30 cm size are prepared at 3 m x 3 m spacing. The pits are filled with soil mixture prepared by mixing sand, soil and FYM in the ratio of 1:1:1, besides 5 -10 g of 10 % Aldrine dust to prevent termite and ant attack. About 6 month old seedlings are transplanted into these pits.

Plantation at 3 m x 3 m spacing can accommodate 1111 plants per hectare under new technology as against 156 plants under 8 m x 8 m spacing under traditional practice at farm and rearers' level.

The technology on Muga food plant cultivation has been adopted widely throughout the North- East and West Bengal. Spacing may vary from 3 – 6 m depending on the slope of the land and its fertility. Plantation with closer spacing will produce more leaves and increase the income of the rearers. Plantation should usually be in the north-south direction so as to obtain direct sunshine for different rows of plants. The wind direction is also to be noted. Diglot plants (a shrub) may be planted in between the rows of Som/Soalu to protect the Muga silk worms falling from Som/ Soalu plants due to strong wind and hailstorm during the rearing period. A separate dwarf plantation (Chawki garden) with some shade trees should also be there to rear the early stages of the Muga worms. Quick growing trees may be planted on western and southern sides of the Muga food plantation to serve as a windbreaker to protect the silkworms. Appropriate compound fencing is also provided for regular systematic plantation. Individual enclosure (ghera) is needed for other plants to protect them from cattle, etc., in young age.

Fig.2.1: Method demonstration of fertilizer application

2.3.2 Management of Muga Food Plants

Quality cocoon production largely depends on availability of quality foliage. Proper management of Muga host plant during cultivation yields more production of quality leaves. Light hoeing or ploughing is to be done twice a year in criss-cross manner to control weeds. The fibrous roots which feed on top of soil are pruned out to help the growth of short and healthy shoots of the plants. Regular cultural operations like weeding and loosening of soil around the plant (2 times per year) are carried out. Loosening of soil allows the rain water to percolate deep into the soil and ensures for better aeration in the soil.

Plant management packages evolved are discussed below:

a) Application of FYM

Plant nutrients improve the texture of soil, and increases water retention capacity besides multiplication of microbes in the soil. The FYM should be applied by making 15 – 20 cm deep ring around the plant at a distance of 60 cm @ 15 cm^3 / plant up to 4^{th} year and 30 cm^3 from 4^{th} year onwards. The ring full of FYM is covered with soil to avoid loss of nutrients due to heavy showers and to help in increasing the production of quality leaves. The application of 30 cm^3 FYM / year yields 48 %

more leaf as compared to control. Thus, fertilizers are used in appropriate doses for better growth of plants and production of more leaves.

b) Application of NPK

Increased supply of nitrogen increases the crude protein percentage and improves the quality of leaf. Potassium and Phosphorus help in increasing the utilization of Nitrogen resulting in increased production of quality foliage. Application of N:P:K @ 50:25:25 up to 4th year of plantation and @100:50:50 from 4th year onwards is done through ring method during February- March and September- October months. Application of 100:50:50 kg NPK per hectare per year has been found to yield 66 % more leaf as compared to traditional practices. In traditional practices, the plants are always deprived of these inputs. Application of 40 g Nitrogen, 60 g Phosphorus and 15 g Potassium per plant during 1st to 4th year and 80 g N, 120 g P and 30 g K per plant from 5th year onwards in two split doses should be done at the interval of 6 months during March and August every year. NPK can be applied by making rings as in the case of FYM or through holes in the ground (5-6 oblique holes 20 – 30 cm deep made at a distance of 60 cm around the plant). After NPK application, irrigate the plot if there is no rain.

2.4 INTER-CROPPING DURING GESTATION PERIOD OF MUGA FOOD PLANTS

a) Upper Assam

To generate additional income from Muga culture, suitable inter-crops can be raised in first two years of plantation without any adverse affect on the growth of Som plants. Inter-crops, such as Corn in Summer and Potato (returns per acre are Rs. 2,379 to Rs. 6,757, respectively under 2 x 2 and 3 x 3 m spacing) and Tomato (returns per acre are Rs.3,826 to 4,382, respectively under 2 x 2 m and 3 x 3 m spacing) in winter have been found to give highest returns under upper Assam conditions.

b) Lower Assam

Cultivation of inter-crops like local vegetables, *viz.* Lady's finger, Brinjal etc. in Som gardens during gestation period of Muga food plant improves the soil conditions and generates additional income from the land. Cultural operations carried out for inter-cropping also facilitates growth of the main crop. Further, the beneficiary or farmer can earn a sum of Rs. 4,000 to 5,000 per annum from inter-cropping with enhanced productivity per unit area.

2.5 CULTURAL PRACTICES

2.5.1 Pruning

Pruning means to cut-off parts of a tree to make it to grow better in a systematic manner. Pruning schedule for Som to obtain quality foliage for six different crops for Muga has been evolved. Muga food plants usually grow as tall trees. But, you need dwarf trees with more branches and leaves for rearing Muga silkworms. So, they are to be pruned from an early stage to keep them at a height of about 3 – 4 m.

Fig.2.2: Pruning in the economic plantation

To get the required shape and height, pruning at height of about one meter would give us the necessary branching and leaves. Removal of terminal buds twice a year at a height of about two meters would also help to get more branches and leaves. Plants pruned during summer become ready for early and late age rearing after 3- 4 months and after 4-5 months in winter pruned plants. Pruning should not be done during unfavourable seasons. Fresh cow dung is to be applied at the cut end to save them from drying. By pruning in advance, trees will produce leaves of required age and newly hatched worms will start eating tender leaves. As the worms grow, the leaves too will grow and thus worms will get suitable leaves at each stage of their growth. Dry branches and nests of ants, etc., are to be removed from time to time for proper growth of the plants.

Fig. 2.3: Growth pattern after pruning (Up/Down)

2.5.2 Pollarding

Pollarding means cutting-off thick tree trunks to allow a thick crown of branches. Pollarding is defined as removal of bio-mass leaving only tree trunk after 6 to 7 years. Pollarding should be done at specific periods so as to synchronize quality leaf production with the rearing period.

The main objective of pollarding is :

1) To increase the foliage.
2) To remove dead or diseased parts.
3) To maintain desirable height and shape of the plant.
4) To establish a functional relationship between different organs of the plant.

Pollarding at a height of 1.50 m above the ground level in Soalu and 2 m in Som at the age of 7 years has been found ideal in March-April and September-October. Clip-off light branches after each rearing. The cut at the time of pruning should be a slanting one to avoid water deposition. Apply cow dung on the pruned/pollard surface of the branches /trunk. Pollarding is also essential to rear the early stage worm for

better rearing results in every brood. Old trees without pollarding and maturing will not yield healthy and nutritious leaves. Leaves will be hard and do not suit their (worms) digestion.

2.6 WEED MANAGEMENT

Weeds occur at a maximum density of 948 per sq. m in the month of July and minimum density of 291 per sq. m during February-March. The common weeds in Som and Soalu plantations are *Imperata cylindrica, Saccharum spontaneum* and *Borreria sp*. Uprooting of weeds manually is the best way to control the population. Inter-cropping between Som and Soalu plantation also controls the weeds, provides additional income, ameliorates the soil conditions and helps in growth of main plant because of regular cultural operations they receive. The application of weedicides like Glyphosate (41 %) @ 1.60 in 180 litres of water during sunny days with 6 hours post application exposure is found effective in controlling the thatch grass particularly in Som and Soalu plantations. Weeding and loosening of the soil are to be done before the weeds flower and bear seeds.

2.7 CONTROL AND MANAGEMENT OF DISEASES AND PESTS

It is advisable to adopt clean culture practices to protect a Muga food plant from diseases and pests. Timely removal of weeds, dead leaves and unwanted materials from the plantation/rearing site helps to control disease and pest population. Spraying of chemicals is normally avoided because the agro-chemicals that decompose slowly into the soil contain pesticide residues that cause damage to Muga silkworm cocoon crop. The major insect pests and diseases of Muga food plant and their control are listed below:

Pest/disease	Damage	Control
Gall insect *(Peuropsylla besooni)*	Ugly galls form on both sides of leaf.	Application of 0.05% Dimethoate twice at an interval of 15 days before 20 days of rearing.
Stem Borer	Bores through the main trunk penetrating the innermost layer and moves upwards causing heavy damage to foliage.	Plugging the Borer holes on trees with cotton plugs dipped in 1.50% Nuvan and plastering the same with mud. Light traps for adults in night also are very helpful.
Ants/ white Ants	Attacks the food plants at all stages of growth. The ants even take away the young silkworm larvae.	Pouring crude oil emulsion/ Aldrine 30 EC, Aldrine dust (5 %) should be mixed with soil @ 20 kg/ha. The ants can also be controlled by tying a grease coated polythene sheet around the tree trunk.
Rust Fungus	Leaves become yellow and unhealthy when the pustules become mature with dark coloured patches on the upper surface and are not suitable for silkworm feeding.	Collecting infected leaves and burning them away from the field. Dusting of Sulphur @ 10-12 kg/ha would serve the purpose.

2.8 BUSH PLANTATION FOR CHAWKI REARING

Muga silkworm rearing suffers heavy larval mortality during early stages in seed and pre-seed crops due to inclement weather conditions. Therefore, special care needs to be taken during such periods. Improved rearing technology on bush plantation under nylon net has been developed for reducing early instar mortality. This involves maintenance of 15 – 20 % plants at a height of 180 cm with NPK application @ 200:100:100 per hectare and rearing of chawki worms on 120 days old foliage during 'Chotua' crop (February-March) and 90 days old during 'Bhodia' crop (July-August) under nylon net. Rearing of the late-age worms in the remaining 80 % plants results in 40 % and 70 % gain in cocoon production during Chotua and Bhodia crops. The technology has been effectively used under Muga Seed Production Units and United Nations Development Programme (UNDP) sponsored schemes by adopted seed rearers.

Check Your Progress 2

Note: a) Use the spaces given below for your answers.

b) Check your answer with those given at the end of the unit.

1) What do you mean by inter-cropping? Describe inter-cropping pattern in Muga plantation.

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2) Define pollarding and its main objectives.

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2.9 LET US SUM UP

Muga silk is the most expensive silk known for its shimmering golden colour. The polyphagous Muga silkworm feeds primarily on leaves of Som (*Machilus bombycina*) and Soalu (*Litsaea polyantha*) plants. Som and Soalu are widely distributed throughout India especially in hilly regions with high amount of humidity. Muga food plants can be propagated through methods like propagation through seeds, vegetative shoots, single leaf and shoot bud cuttings, juvenile shoot cuttings and Air Layering. To generate additional income from Muga culture, suitable inter-crops like corn and local vegetables like lady's finger, brinjal etc. can be raised in the gestation period of plantation without any adverse affect on growth of food plants. Cultivation of intercrops improves soil condition and generates additional income from land under utilization for Som and Soalu plantation.

Common weeds in Som and Soalu plantation are *Imperata cylindrica, Saccharum spontaneum* and *Borreria sp*. Manual weeding is the best way to control weed population and is to be done before the weeds flower and bear seeds. The application of weedicide, Glyphosate (41%) @ 1.60 litres in 180 litres of water during sunny days with 6 hours of post application exposure is found effective in controlling the weeds, particularly thatch grass in Som and Soalu plantations. It is advisable to adopt clean culture practices to protect a Muga food plant from diseases and pests.

Timely removal of weeds, dead leaves and unwanted materials from the plantation/ rearing site helps to control disease and pest population.

2.10 GLOSSARY

Chawki Rearing : Silkworm rearing in early stages is called chawki rearing. Early stage of Silkworm rearing suffers heavy larval mortality during the seed and pre- seed crops due to inclement weather conditions. Special care is required for rearing young silkworms.

Pollarding : Pollarding is cutting-off thick tree trunks so as to develop a thick crown of branches. It is also defined as removal of bio-mass leaving only the tree trunk.

2.11 SUGGESTED FURTHER READING

Chathopadhyay, S.B. *Principles and Procedures of Plant Protection*, Oxford & IBH Publishing Co. Pvt. Ltd.

FAO. 1976. FAO *Manuals on Sericulture*, Food and Agriculture Organization of the United Nations, Rome.

Gupta, P. K. *Handbook of Soil Fertilizer & Manure*, Agro Botanica Publishing Co.

Jisdale, L. and Nelson, W.C. *Soil Fertility and Fertilizers*, Prentice Hall of India Pvt. Ltd.

Sathe, T.V. *Agrochemicals and Pest Management*, Daya Publishing House.

2.12 REFERENCES

Chathopadhyay, S.B. *Principles and Procedures of Plant Protection*, Oxford & IBH Publishing Co. Pvt. Ltd.

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Sathe, T.V. *Agrochemicals and Pest Management*, Daya Publishing House.

2.13 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress 1

1) The primary food plant species of Muga silk worm are commonly called Som *(Machilus bombycina*) and Soalu (*Litsaea polyantha)* belonging to the family Luraceae under order Laurales.

Som: This plant is extensively distributed in India, Nepal, Burma, Malaysia and Indonesia. It prefers humid warm climatic conditions with high rainfall. The steep hill ranges with narrow valleys falling under tropical rain forests receiving

annual rains between 1,000 – 4,300 mm are ideal for this plant. It is distributed in the lower Himalayas starting from Almora in Uttaranchal up to Nepal. This plant is widely prevalent in North East India and most common in Assam, Meghalaya, Arunachal Pradesh, Tripura, etc. up to altitudes of 1500 m ASL.

Soalu: The Soalu plant is also well distributed in India, Nepal, Burma, Khmer, Malaysia and Indonesia. It prefers sub-Himalayan regions having humid, warm climatic conditions with heavy rainfall. It is also found in foothills of Himalayas having ASL up to about 1,000 m and eastwards extending to North-eastern India. It is well distributed in lower Assam, Arunachal Pradesh, Meghalaya, Mizoram and Nagaland.

2) Muga food plants can be propagated through following methods:
   a) Propagation through seeds.
   b) Propagation through vegetative means.
      i) Through single leaf and shoot bud cuttings.
      ii) Through juvenile shoot cuttings.
      iii) Through Air Layering.

3) Propagation of Muga food plant through air layering method should be done during April-June (though it may be prepared in other seasons also). One to two year old shoots of 4-5 years old plants are more suitable for air layering. The leaves are removed from the base of the shoot to be layered. About 2-3 cm wide ring of bark is removed without damaging the cambium. The cut surface is treated with 500 ppm. Indole Butyric Acid for further improvement in rooting. The cut portion is then covered with a mixture of compost, cow dung and soil in 1:1:1 proportion adding some moss/saw dust soaked in water for 24 hours and wrapped with polythene paper cloth. The ends are then tied. The portion of the branch below the layer is cut and planted in the nursery. Rooting takes place within 50-60 days in Som and 40-50 days in Soalu plants. It may also be planted directly in the pot. It is advisable not to select big branches or old trees for preparation of air layering.

Check Your Progress 2

1) To generate additional income from Muga culture, suitable inter-crops can be raised in the first two years of plantation without any adverse affect on growth of food plants. Cultivation of intercrops like corn and local vegetables like lady's finger, brinjal etc. in gardens during gestation period improves soil condition and generates additional income from land under utilization for Som and Soalu plantation. Cultural operations carried out for inter-cropping facilitates growth of the main crop also. Further, a farmer can earn Rs. 4,000/- to 5,000/- per annum from intercropping with enhanced productivity per unit area.

2) Pollarding is defined as removal of bio-mass leaving only tree trunk after 6th-7th year. The main aim is to cut off thick tree trunks so as to allow a thick crown of branches to grow. Pollarding should be done at specific periods so as to synchronize quality leaf production with the rearing period. Pollarding at height of 1.50 m above the ground level in Soalu and 2.00 m in Som at the age of 7 years has been found ideal in March-April and September-October. Clip-off the light branches after each rearing. Pollarding helps in:
   i) increasing the foliage,
   ii) removing the dead or diseased parts,
   iii) maintaining a desirable height and shape of the plant, and
   iv) establishing a functional relationship between different organs of the plant.