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# Beginner's Guide to Sericulture Farmers

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Sericulture represents one of humanity's most ancient agricultural traditions. This intricate practice involves cultivating mulberry trees, rearing silkworms (*Bombyx mori*), and processing cocoons into luxurious silk thread. For new farmers, sericulture offers a **unique opportunity** to engage in a low-capital, high-yield practice that provides economic sustainability while connecting with cultural heritage. The global silk market remains strong, with prices for quality cocoons ranging from 400-850 Rupees **per kilogram**, making it an economically viable venture for small-scale farmers.

The sustainability of sericulture lies in its **closed-loop ecosystem**: mulberry leaves feed silkworms, silkworm waste fertilizes mulberry trees, and cocoons yield valuable silk fiber. This circularity makes it particularly attractive for farmers seeking environmentally sustainable practices. Modern sericulture has evolved with technological advancements, but still retains its fundamental biological processes, making it accessible to farmers in diverse economic contexts. This guide provides comprehensive instructions for first-time sericulture practitioners, covering all aspects from mulberry cultivation to silk harvest, with emphasis on sustainable practices that ensure both productivity and environmental stewardship.

## Climate and Soil Requirements

Mulberry (*Morus* spp.) serves as the **sole food plant for the domesticated silkworm, *Bombyx mori***, making its cultivation the cornerstone of successful sericulture. The quality of mulberry leaves directly influences silkworm growth, cocoon yield, and silk filament quality; therefore, understanding the climatic and soil requirements of mulberry is essential for establishing and maintaining productive plantations.

### Climatic Requirements

Mulberry is a **hardy and adaptable perennial**, capable of growing under diverse climatic conditions. However, it performs best under **warm and moderately humid environments**, which promote rapid vegetative growth and enhance leaf succulence and nutritive value.

**Altitude:** The ideal elevation for mulberry cultivation is **up to 800 meters above mean sea level**. However, certain varieties can tolerate higher altitudes with appropriate management practices.

**Temperature:** Optimum growth occurs between **22°C and 30°C**. Temperatures below 15°C retard growth, while those exceeding 38°C can lead to leaf scorching, reduced chlorophyll content, and poor palatability for silkworms.

**Humidity:** Relative humidity levels of **65–80%** are most favourable. High humidity combined with poor ventilation can encourage fungal diseases, while very low humidity can cause leaf drying and reduced feeding efficiency in silkworms.

**Rainfall:** Annual rainfall ranging from **600–2,500 mm** is suitable for mulberry cultivation. In areas with irregular or insufficient rainfall, **supplemental irrigation** is essential to sustain growth, especially during the dry season.

**Soil Requirements**

**Soil Type:** Mulberry grows best in **deep, fertile, well-drained loamy soils** with good moisture retention capacity.

**Soil Reaction (pH):** A **slightly acidic soil with a pH of 6.2–6.8** is ideal. Soils that are highly **saline or alkaline** should be avoided, as they restrict nutrient uptake, stunt growth, and deteriorate leaf quality.

**Soil Fertility:** Incorporating **organic matter** enhances soil structure, microbial activity, and nutrient availability.

**Land Preparation and Soil Management**

Proper land preparation is vital for the establishment of a healthy mulberry plantation. The following steps are recommended:

**Field Cleaning:** Remove weeds, stubble, and stones from the site to reduce pest and disease incidence.

**Ploughing:** Plough the field **two to three times** to achieve a fine tilth and ensure proper aeration and root penetration.

**Organic Manuring:** Incorporate **farmyard manure (FYM)** at the rate of **20 tonnes per hectare in irrigated areas** and **10 tonnes per hectare in rainfed areas**. FYM improves soil texture, water-holding capacity, and nutrient balance.

**Varieties and Propagation**

Selecting appropriate mulberry varieties according to local conditions is crucial for success. For irrigated conditions, recommended varieties include **V1, S 30, S 36, S 54, DD (Viswa), G4 and G2** while rainfed areas do better with **S 13, S 34, RFS 135, and RFS 175**.

Mulberry is typically propagated through **semi-hardwood cuttings** rather than seeds to maintain genetic consistency. Select cuttings from **8–12-month-old** plants, with a diameter of **10-12 mm**, length of **15-20 cm**, and **3-4 active buds**. The bottom cut should be slanting at **45 degrees** to maximize surface area for root development. Pre-treatment with **Azospirillum culture** (1kg in 40L water) for 30 minutes stimulates root formation. Before planting, disinfect the cuttings to minimize fungal infection risk: Dip in 0.2% Bavistin solution for 15 minutes or dip in 0.1% Dithane M-45 solution for 30 minutes.

Cuttings are then planted in nursery beds at **20×8 cm spacing** at a **45-degree angle**, ensuring one bud remains exposed.

**Planting and Maintenance**

Transplant saplings during the **rainy season** for optimal establishment, avoiding harsh summer and winter months. Planting methods include:

- **Ridges and furrows**: 60×60 cm or 90×90 cm spacing
- **Pit system**: 90×90 cm spacing
- **The paired row system** (**(90+150cm) ×60cm**) allows for mechanization and intercropping. Nutrient management varies with irrigation status
- **Irrigated conditions**: 300:120:120 kg NPK/ha annually, applied in 5 split doses for shoot harvest (6 split doses for leaf harvests)
- **Rainfed conditions**: 100:50:50 kg NPK/ha annually, applied in 2 doses coinciding with monsoons
- **Biofertilizers** like **azotobacter** and **phosphate solubilizing** biofertilizer enhance nutrient availability and reduce chemical fertilizer requirements.

**Irrigation methods significantly impact water efficiency:**

- **Drip irrigation**: Most efficient, suitable for undulating terrain, enables fertigation
- **Ridges and furrows**: Efficient water use, furrows serve as drainage channels
- **Flat beds**: More water-intensive, greater land wastage

**Pruning strategies vary based on production goals:**

- **Bottom pruning**: Cut at ground level, leaving 10-30 cm stump, done annually

- **Middle pruning**: Cut at 60-70 cm height, after bottom pruning
- **Kolar system**: Pruning at ground level multiple times annually, requires heavy fertilization.

**Weed Management** combines cultural (proper land preparation), mechanical (hand weeding), and chemical methods. Intercropping with short-duration pulses like black gram, green gram, or cowpea (**10 kg seeds/ha**) provides additional income and enriches soil nitrogen

## Silkworm Rearing: From Egg to Cocoon

Silkworm rearing, or sericulture, is the systematic process of nurturing silkworms (*Bombyx mori*) from the egg stage through to cocoon formation. The entire process requires careful environmental management, hygienic conditions, and timely feeding with quality mulberry leaves. The rearing process is generally divided into three stages: rearing house preparation, early-age rearing (Chawki rearing), and late-age rearing leading to cocoon production.

**Rearing House Preparation and Disinfection**

A clean, well-designed rearing house is the foundation of successful silkworm cultivation. The rearing space must ensure optimum temperature, humidity, and ventilation, as silkworms are highly sensitive to environmental fluctuations.

A rearing house measuring approximately 18 × 12 × 10 feet can accommodate around 100 disease-free layings (DFLs). To maintain a pest-free environment, ensure that windows and ventilators are covered with fine nylon netting to prevent the entry of insects, particularly Uzi flies (*Exorista bombycis*), which are major pests of silkworms.

**Disinfection and Sanitation**

Disinfection plays a vital role in preventing disease outbreaks. All surfaces, walls, trays, stands, and equipment should be disinfected 3 days before the commencement of rearing using one of the following solutions:

- 2% Bleaching powder solution + 0.3% slaked lime
- Sanitech 2.5% + 0.5%slaked lime

After disinfection, keep the rearing room closed for at least 24 hours, followed by thorough ventilation to remove any residual fumes.

**During rearing, maintain strict hygiene protocols:**

- Wash hands with disinfectant before entering the rearing area.
- Restrict entry of non-essential personnel.
- Sprinkle 5% bleaching powder or slaked lime around the rearing house to deter crawling pests and maintain dryness.

**Essential Rearing Equipment**

- Successful rearing requires the use of specific appliances to ensure cleanliness, temperature regulation, and proper handling of worms and leaves. Common appliances include:
- Power sprayer (for disinfection)
- Rearing stands and trays
- Foam pads and paraffin paper (for moisture control)
- Nylon nets (for bed cleaning)
- Chandrika or plastic collapsible mountages (for cocoon spinning)
- Drier (for cocoon preservation)
- Ant wells (to prevent ant entry)
- Chopsticks and feather (for handling worms)
- Chopping board and knives (for leaf cutting)
- Leaf chamber (for leaf storage)
- Hygrometer and wet–dry thermometer (for monitoring humidity and temperature)

**Egg Incubation and Early-Stage Rearing (Chawki Rearing)**

The egg incubation and Chawki stage (1st and 2nd instars) form the most delicate and crucial part of silkworm rearing. The health, uniform growth, and future productivity of silkworms depend largely on the care taken during this phase.

**Egg Incubation**

- Silkworm eggs (DFLs) require controlled environmental conditions for proper hatching:
- **Temperature:** 25°C
- **Relative humidity:** 80%
- When the eggs develop a "**pinhead"** blue appearance, they are ready for hatching. Keep the eggs in complete darkness for 48 hours using black boxes to synchronize embryo development. After this period, expose them to diffused light to induce uniform hatching.
- Upon hatching, the newly emerged larvae (Chawki worms) are delicate and should be transferred gently to paraffin-coated trays using a soft feather to prevent injury.

**Feeding During Chawki Stage**

- Recommended feeding quantities per 100 DFLs are:
- **1st instar:** 6 kg leaves for bivoltine (BV) or 5 kg for crossbreed (CB) varieties.
- **2nd instar:** 17 kg leaves for BV or 13 kg for CB varieties.
- Leaves should be finely chopped for the 1st instar and moderately chopped for the 2nd instar to enable easy feeding and prevent wastage.

**Environmental Conditions and Hygiene**

- Maintain 27–28°C temperature and 80–90% relative humidity for the Chawki stage.
- When about 95% of the worms settle for moulting, stop feeding and apply slaked lime over the bed to absorb excess moisture and maintain dryness.

**Late Age Rearing and Cocoon Production**

The late age rearing stage, comprising the third, fourth, and fifth instars of silkworm development, is a critical period that determines the success of cocoon production.

**Feeding and Space Management**

- **Quality of Leaves:** Use leaves obtained from 60-day-old mulberry plants, as these contain balanced moisture, nutrients, and sugars essential for larval development.
- **Feeding Schedule:** Offer tender and medium-aged leaves immediately after moulting, and gradually shift to mature leaves as the worms grow larger. This helps in proper digestion and prevents overfeeding stress.
- **Density Adjustment:** Reduce the rearing density to around 60–70 larvae per square foot by transferring worms to additional trays. Overcrowding can lead to heat buildup, uneven feeding, and disease outbreaks.
- **Environmental Conditions:** Maintain the rearing room temperature between 24–26°C and relative humidity between 65–75%, ensuring good cross-ventilation. Proper air circulation helps maintain uniform conditions and prevents fungal growth.
- **Disinfection:** Apply a recommended bed disinfectant such as Vijetha after each moulting to prevent microbial infections and maintain a clean environment.

**Recognition of Ripe Worms**

Silkworms become ripe and ready for spinning approximately 6-7 days after the final moult. Recognizing the correct stage of ripeness is essential to ensure timely transfer to mountages.

- **Physical Signs:** Ripe worms appear translucent or yellowish-white, showing a reduction in body elasticity.
- **Behavioural Signs:** They cease feeding, become restless, and begin wandering in search of suitable sites for cocoon formation.

**Mounting for Cocoon Formation**

- **Density:** Place approximately 40–45 worms per square foot on the mountage to allow adequate space for spinning.
- **Environment:** Maintain a temperature of 25–26°C and a relative humidity of 60–70% during cocoon formation.

- **Precautions:** Avoid temperatures above 28°C or humidity exceeding 80%, as such conditions can result in soft cocoons, improper spinning, and fungal infections.

**Cocoon Harvesting**

Cocoons are generally ready for harvest 5–7 days after spinning. Proper timing ensures that the pupae have hardened but have not yet begun to emerge as moths.

**Indicators of Harvest Maturity:**

Cocoons feel firm and compact when pressed lightly.

- They produce a distinct rattling sound when shaken, indicating that the pupa inside is dry and well-formed.
- The surface of the cocoon appears smooth, uniform, and free from stains or loose silk.

## Mulberry diseases and pests

Mulberry is affected by several important diseases and insect pests throughout the year, causing significant quantitative and qualitative loss.

**Mulberry diseases**

**1**. **Leaf Spot** caused by ***Cercospora moricola*** occurs mainly during the rainy and humid seasons. It shows brownish necrotic, irregular spots appear on the leaf surface. Spots enlarge, extend and joins together leaving characteristic 'shot hole'. Leaves become yellow and wither off as disease become severe. To control it, infected leaves should be collected and destroyed, and Hexaconazole 5% SC (1 ml/L) should be sprayed.

**2. Powdery Mildew** caused by ***Phyllactinia corylea*** occurs winter and rainy seasons. It appears as white powdery patches on lower surfaces leaves, on severity of the disease, white powdery patches turn to brownish-black; the leaves become yellow, coarse and lose their nutritive value. To control it, wider spacing of plantation should be followed and Hexaconazole 5% SC (1 ml/L) should be sprayed.

**3. Leaf rust** in mulberry is mainly of two types—black rust and red rust.

**Black leaf rust**, caused by ***Cerotelium fici***, occurs mostly during the winter and rainy seasons, it affects mainly mature leaves, showing small brown pinhead-like spots that later turn the leaves yellow and cause them to dry and fall. It can be controlled by wider spacing of mulberry plants, timely leaf harvesting, and spraying 0.2% Kavach.

**Red rust**, caused by ***Aecidium mori***, appears in rainy and winter seasons, commonly in states like Himachal Pradesh, Uttar Pradesh, West Bengal, the North-East, and parts of Karnataka. It affects young buds, leaves, shoots, and petioles, causing swelling, curling, and golden-yellow powdery spots. Control measures include wider spacing, avoiding delay in leaf harvest, and spraying 0.2% Bavistin or applying sulphur dust.

4. **Bacterial leaf blight** of mulberry is caused by ***Pseudomonas syringae pv. mori*** or ***Xanthomonas campestris pv. mori***. The disease commonly occurs during the rainy and winter seasons. The main symptoms include blackish-brown, irregular, water-soaked patches on the leaves, which later cause leaf curling and rotting. Control measures include wider spacing of mulberry plants (90 × 90 cm or paired row system) and spraying 0.2% Streptomycin or 0.2% Dithane M-45 on the leaves.

**5. Root knot** disease in mulberry is caused by the nematode ***Meloidogyne incognita***. The disease occurs throughout the year, especially in sandy or sandy-loam soils under irrigation. Infected plants show stunted growth, marginal chlorosis, and necrosis of leaves, while roots develop spherical galls that are yellowish-white when young and pale brown when mature. Nematode infection disrupts vascular tissues, reducing water and nutrient uptake, though plant death is rare unless secondary pathogens are involved. Integrated management includes soil application of *Bionema* (**Verticillium *chlamydosporium*** mixed with neem oil cake and FYM) at 200 g/plant three times a year, along with removal and burning of root galls. Bionema is safe for mulberry and silkworms.

**6. Root rot** diseases in mulberry are of two main types—white root-rot caused by ***Rosellinia necatrix*** and violet root-rot caused by ***Helicobasidium mompa***. In white root-rot, infected plants become weak, leaf buds grow poorly, leaves wither, and plants die quickly; the stump

region is covered with a whitish-grey fungal mat. In violet root-rot, sudden leaf withering and plant death occur, and the roots are covered with a violet-colored mycelial growth. These diseases spread rapidly through soil and root contact. Control measures include uprooting and burning infected plants along with remaining root portions, ploughing and disinfecting the soil with chloropicrin (applied in 3–4 ft deep holes at ½ kg per 108 sq. ft), or using calcium cyanamide (75.2 g per 36 sq. ft) in shallow soils. Care must be taken to avoid using leaves from chemically treated plants for silkworms. In severe cases, the entire plantation should be removed, soil sterilized, and a fresh plantation established to prevent further spread.

**Mulberry Pests**

**1. Pink mealybug** (***Maconellicoccus hirsutus***) feeds on tender shoots, causing leaf curling, shortening of internodes, thickened stems, and black sooty mold; it can be managed by pruning infested shoots, insecticide sprays (0.05% Dimethoate, 0.2% DDVP), and release of predators like ***Cryptolaemus montrouzieri*** **or** ***Scymnus coccivora***.

**2. Mulberry thrips (*Pseudodendrothrips mori*)** damage leaves by lacerating the epidermis, forming silvery blotches that later turn brown; control includes field sanitation, irrigation, insecticide spray (0.1% Dimethoate), and release of predators like ***Scymnus coccivora*** **or** ***Chrysoperla***.

**3. Jassid** (***Empoasca flavescens***) causes hopper burn, leaf curling, and yellowing; controlled by light traps, irrigation, neem oil spray, intercropping to attract natural enemies, and 0.1% Dimethoate application.

**4. Leaf webber** (***Diaphania pulverulentalis***) is major defoliator feeding on apical shoots and leaves; management includes clipping and burning infested parts, light traps, insecticide sprays, and release of parasitoids (***Trichogramma, Bracon, Tetrastichus***).

**5. Bihar hairy caterpillar** (***Spilosoma obliqua***) skeletonizes leaves and causes defoliation; controlled by collection and destruction, deep ploughing, flood irrigation, insecticide sprays, and release of ***Trichogramma chilonis***.

**6. Stem girdler** (***Sthenias grisator***) girdles young stems, leading to wilting; management involves cutting and burning affected branches and applying 0.1% malathion paste on trunks. Proper cultural practices, timely pruning, and biological control along with selective insecticides are key to minimizing pest damage and maintaining leaf quality for silkworm rearing.

## Silkworm Diseases and pests

**Silkworm diseases**

**1.Flacherie (Bacterial Disease):**

Caused by bacteria such as ***Serratia marcescens*****,** ***Streptococcus*****,** **or** ***Bacillus*** species, Flacherie often occurs due to poor sanitation, irregular feeding, or sudden environmental changes. Infected larvae appear soft, emit a foul odour, and eventually disintegrate.

- **Prevention:** Maintain optimal temperature (around 25–27°C) and humidity (75–80%), avoid overcrowding, and ensure proper ventilation.

**2. Grasserie (Viral Disease):**

Caused by ***Nuclear Polyhedrosis Virus (BmNPV)***, Grasserie affects larvae during the later instars. The body becomes swollen and shiny, with the skin eventually rupturing to release a milky fluid full of virus particles .

- **Prevention:** Maintain hygienic conditions, control temperature, and avoid feeding mulberry leaves that have been exposed to contaminated surfaces or dead larvae and dust bed disinfectant (like Vijetha, or Amruth or Sanjivani).

**3. Pebrine (Protozoan Disease):** This disease, caused by ***Nosema bombycis***, is one of the most serious and transmittable diseases in sericulture. Infected moths produce diseased eggs, which spread the infection to the next generation. Symptoms include irregular feeding, sluggish movement, and black spots on the body.

- **Prevention:** Always use disease-free layings (DFLs) obtained from certified grainage centers. Conduct regular microscopic examination of moths to detect infection early.

**4. Muscardine (Fungal Disease):**

Caused mainly by ***Beauveria bassiana*,** Muscardine results in white fungal growth on the dead larvae. It spreads rapidly under humid and poorly ventilated conditions.

- **Prevention:** Keep rearing rooms dry and well-ventilated, dust bed disinfectant (like Vetcare vijetha or Resham Keet Oushad or Suraksha), and avoid overfeeding.

**General Preventive Measures**

Preventive care is far more effective and economical than attempting to cure diseased worms. The following hygiene practices are strongly recommended:

- **Disinfection:** Rearing houses, trays, mountages, and other appliances should be thoroughly cleaned and disinfected before each rearing cycle using recommended disinfectants such as 2% bleaching powder or 2% formalin.
- **Sanitation:** Remove diseased or dead worms promptly and destroy them by burning or deep burial away from the rearing house.
- **Environmental Control:** Maintain suitable temperature and humidity levels specific to each instar to minimize stress and disease susceptibility.
- **Bed Disinfection:** Apply bed disinfectant after every moulting to prevent microbial buildup.
- **Egg Quality:** Use only disease-free eggs from recognized or government-certified suppliers to prevent vertical transmission of pathogens.

**Silkworm Pests**

In addition to diseases, several pests attack silkworms during the rearing period. The **Uzi fly** (*Exorista bombycis*) is one of the most destructive, laying eggs on the silkworm body. The fly larva feeds internally on the silkworm, leading to death before cocoon formation.

**Control Measures:**

- **Physical Barriers:** Cover all windows and ventilators of the rearing house with fine nylon netting to prevent entry of Uzi flies and other insects.
- **Chemical Control:** Spray safe insecticides Uzi trap(chemo trap), Uzicide, Uzi powder
- **Biological Control Agents** : *Nesolynx thymus* to manage Uzi fly infestation.
- **Post-Rearing Care:** After cocoon harvest, clean the rearing room thoroughly to remove any residual pest stages such as pupae or eggs.

## Conclusion

Successful sericulture hinges on meticulous management of both **mulberry cultivation** and **silkworm rearing**, as the two are interdependent and equally vital for achieving high-quality silk production. For beginners, it is advisable to start on a **small scale (50–100 disease-free layings)** to gain practical experience before expanding operations. The **availability of nutritious mulberry leaves in sufficient quantity** forms the foundation of sericulture; hence, establishing and maintaining healthy mulberry plantations **6–12 months prior** to silkworm rearing is essential.

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