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Propagation Methods of Mulberry: Seedling and Vegetative Approaches

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Propagation of mulberry is a fundamental aspect of sericulture, as the quality and quantity of leaves directly influence the growth and productivity of silkworms. Since mulberry is the sole food source for the silkworm *Bombyx mori*, establishing healthy and true-to-type plantations is essential. Mulberry can be propagated through two major methods—seedling propagation and vegetative propagation. Seed-based propagation, though valuable in breeding programs and for exotic varieties, is rarely practiced commercially because it leads to genetic variation and slow maturity. In contrast, vegetative propagation is widely adopted by farmers, as it preserves the desirable genetic traits of parent varieties, enables large-scale multiplication, and ensures uniformity in plantations. Common vegetative techniques include cutting, grafting, and layering, each with its own applications, advantages, and limitations. A systematic understanding of these propagation methods is therefore vital for sustaining mulberry cultivation and improving sericulture practices.

Methods of Propagation

Mulberry can be propagated in two main ways: **(1) seedling propagation** and **(2) vegetative propagation**.

1. Seedling Propagation

Seed-based propagation is rarely adopted in commercial mulberry farming since the desirable varietal qualities cannot be maintained. This is because mulberry is predominantly pollinated by wind, which results in genetic variation. Additionally, seedlings take a long time to mature before their leaves can be harvested for silkworm feeding. Despite these drawbacks, this method is widely used in research institutions for breeding programs. In such cases, flowers are safeguarded from cross-pollination, and controlled pollination is practiced to obtain specific hybrids. Seed propagation is also the only viable option for some exotic mulberry varieties that cannot be multiplied vegetatively.

For raising seedlings, nurseries are usually established in partially shaded areas to shield young plants from intense sunlight and excessive heat. The soil is prepared to a fine tilth by ploughing and breaking clods, followed by the incorporation of equal proportions of red soil and farmyard manure. Seedbeds, typically about 0.9 m square, are then prepared.

Seeds are collected from ripe fruits, which mature around March–April in tropical regions and May–June in temperate areas. Since mulberry seeds do not have a dormancy period, freshly harvested seeds exhibit high germination potential. Their viability, however, decreases rapidly, making long-term storage undesirable. If preservation is necessary, seeds should be kept for no more than three months, preferably in airtight containers placed in cool conditions.

Before sowing, seeds are soaked in water for 24 hours. This process softens the seed coat and helps eliminate non-viable, insect-damaged, or unfertilized seeds, which usually float. This is known as the **floatation test** for viability. Other methods for viability

assessment include (1) vital dye tests, (2) electrical conductivity tests, and (3) embryonic behaviour studies.

Viable seeds may be broadcast on the seedbed or sown in rows using a rope marker, at a shallow depth not exceeding 25 mm, as deeper placement reduces oxygen supply and hinders germination. Germination success is strongly influenced by temperature and light.

The minimum, optimum, and maximum temperature ranges are 18–21°C, 33–36°C, and 36–39°C, respectively. Exposure to violet-blue or bright light is harmful, while in darkness, temperature alone governs germination. Under controlled dark conditions, seeds typically germinate within 10 days at 27°C, 8 days at 30°C, and 6 days at 33–36°C.

Irrigation should be done using a watering can to prevent seeds from being displaced or buried too deeply. Seedbeds are often covered with bamboo mats or pleated coconut leaves, positioned about 30 cm above, to protect young seedlings from harsh sunlight. Germination usually occurs within 10 days. After about three months, seedlings are transplanted to allow wider spacing of about 22.5 cm. After two years, they are again transplanted either to permanent fields, used for cuttings, or as rootstocks for grafting.

2. Vegetative Propagation

Vegetative propagation is the most widely practiced method for establishing commercial mulberry plantations. This approach is preferred because of several advantages:

1. It ensures that the genetic traits of the parent variety are preserved without variation.
2. A large number of plants can be produced within a short time at relatively low cost.
3. It enables the multiplication of varieties that possess resistance to pests and diseases.
4. Plants well-suited to particular environmental conditions can be propagated and maintained effectively.

Vegetative propagation in mulberry is generally carried out through three principal techniques:

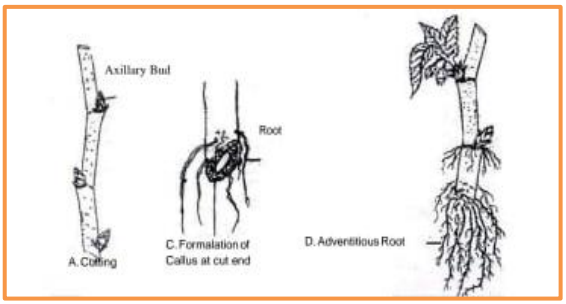
1. **Cutting**
2. **Grafting**
3. **Layering**

1. Cutting

Cutting is one of the most common techniques for propagating mulberry, particularly in South India, where varieties are well adapted to the local environment.

For this method, shoots of the right maturity and thickness are selected. The best cuttings come from branches about pencil-thick (10–12 mm diameter), taken from 8–10-month-old plants of the chosen variety. Very tender shoot tips and overly mature basal parts of branches are avoided. Cuttings are usually prepared 18–20 cm (7–8 inches) in length, containing at least three healthy internodes for irrigated plantations, and 5–6 internodes for rain-fed conditions. The ends must be cut cleanly with a sharp blade to avoid splitting or bark peeling.

In the nursery, cuttings are inserted so that about 2.5 cm with one node remains above the soil surface. Within about 10 days, roots begin to form from buds below the soil, while shoots develop from buds above. It is observed that cuttings with a higher carbohydrate reserve root more effectively than those richer in nitrogen.



Some temperate-origin varieties, however, do not root easily. For these, rooting hormones and growth regulators such as Indole-3-acetic acid (IAA), Indole-3-butyric acid (IBA), L-Naphthalene acetic acid (NAA), 2,4-dichlorophenoxy acetic acid (2,4-D) or commercial preparations like Rootone and Seradix are used. These substances stimulate callus development and root initiation by enhancing cell division. They can be applied as lanolin-based pastes, powders, or through short dips in concentrated solutions or longer dips in diluted ones before planting.

Cuttings may either be planted directly in the field or raised in a nursery for two to three months before transplanting. State and Central Sericulture Departments supply cuttings to farmers at subsidized rates. During transport, they are wrapped in moist gunny sacks or polythene sheets to prevent drying. If fields are not immediately ready, cuttings are temporarily stored in 30 cm-deep pits, kept in bundles, and watered until planting time.

In India, cuttings are typically prepared from young shoots and are known as *softwood cuttings*. In contrast, Japan often uses *hardwood cuttings*. Due to the slower rooting and establishment under temperate climates, cuttings were once less favoured in Japan, but the use of rooting promoters has now made the method more common.

2. Grafting

Grafting is a propagation method in which parts of two plants are joined so that they grow together as a single plant. It is generally used in cases where propagation through cuttings is unsuccessful because of poor rooting ability.

In this technique, the **scion** (the upper portion that forms the shoot system of the new plant and carries the desirable traits) is united with the **stock** (the lower portion that develops into the root system and provides vigour and adaptability). The scion is chosen from the required variety, while the stock is usually taken from a hardy local type that roots well. For successful grafting, the stock should be at a slightly more advanced growth stage than the scion, since the strength and establishment of the grafted plant largely depend on the stock.

Key Principles of Grafting

For a successful graft union, the following factors are essential:

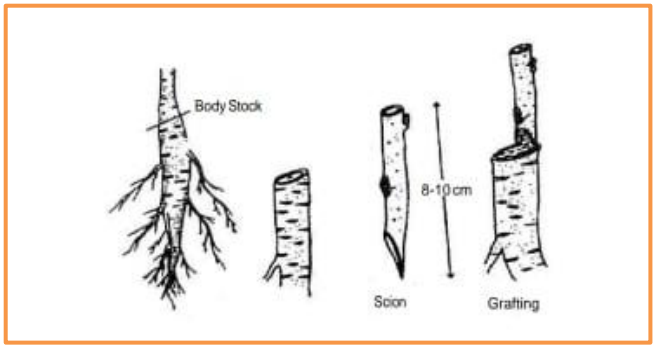
- The stock must be locally adaptable, and the scion must possess the desired superior traits.
- Both stock and scion should be physiologically compatible.
- The cambial layers of the two parts must have maximum contact to enable successful union.
- Callus tissue should develop at the junction through the interlocking of parenchyma cells from both partners.
- A new cambium should differentiate across the callus bridge.
- Vascular tissues (xylem and phloem) must form from this new cambium to establish functional continuity between stock and scion.

Depending on the part used as scion, grafting may be classified as **root grafting**, **shoot grafting**, or **bud grafting**. In all cases, the stock is selected from hardy indigenous varieties, while the scion is taken from the high-yielding or desirable variety.

Root Grafting

In this method, roots measuring 0.6 to 2.5 cm in diameter are collected from 1–2-year-old seedlings of hardy, indigenous mulberry varieties. These roots are cut into sections 5–7.5 cm long, with the upper ends trimmed at an oblique angle.

Scions are prepared from the desired variety, usually 8–10 cm long and bearing two to three healthy buds. The basal end of the scion is cut obliquely to match the cut surface of the rootstock. The scion is then carefully inserted between the bark and wood of the root section, ensuring that the cambial layers of both stock and scion are in close contact. The bark of the scion is trimmed slightly before insertion to promote union. The joint is secured with a tie and coated with grafting wax to prevent desiccation. Once union occurs, the buds of the scion develop into shoots that retain the characteristics of the parent variety.



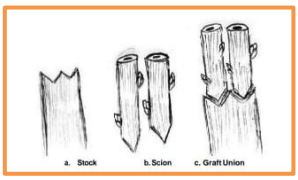
Among the grafting techniques, root grafting is considered the most efficient. It is relatively simple, requires little bandaging, and can be performed quickly. From a single one-year-old

seedling, about 5–6 root sections can be obtained, each capable of producing an independent plant.

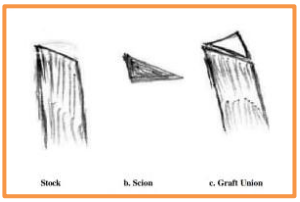
When grafting is performed directly on the root system of a plant in its natural position, without uprooting, and at the transitional zone below ground level, the practice is referred to as **"in situ root grafting."**

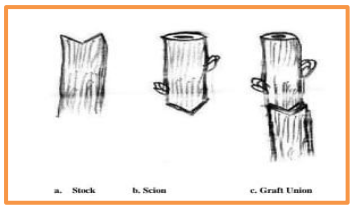
Shoot Grafting

When the scion is grafted onto the stem portion of the stock, the process is known as **shoot grafting** or **stem grafting**. Depending on the technique used, several variations exist:



- **Crown Grafting**: In this method, more than one scion is inserted into the stock to encourage a bushy type of growth.
- **Whip Grafting**: Here, the stock (1.2–2.5 cm thick) is cut at an oblique angle, 3.5–5 cm in length. A scion of the same thickness is given a matching cut and fitted precisely to the stock. The joint is secured with fibre ties and coated with grafting wax.



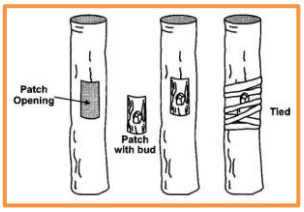


- **Wedge Grafting**: This technique is mainly employed to rejuvenate old plants. The stock is pruned at a convenient height, and a V-shaped notch is made on the cut surface. The basal end of the scion is trimmed to fit the notch, after which it is inserted and sealed with grafting wax.

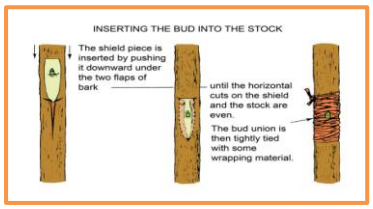
Bud Grafting

Bud grafting is practiced when scion material is scarce, as it requires only a single bud along with a small piece of bark, excluding wood, for grafting onto the stock. This method reduces the chances of transmitting diseases since only a minimal portion of the scion is used. However, the major drawback is that plants established by this technique take a longer time to attain full growth.

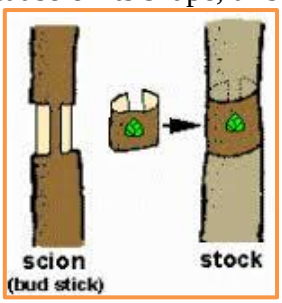
For mulberry, three main types of bud grafting are commonly employed:



- **Patch Budding**: A section of bark containing a bud is removed from the stock, and a scion bud of similar size is fitted into the space. The union is secured with fibre ties and covered with grafting wax.



- **T-Budding (Shield Budding)**: A T-shaped incision is made on the stock at the nodal region. The scion bud is inserted beneath the bark flaps, then bandaged and sealed. Because of its shape, this technique is also called shield budding.



- **Flute Budding**: A ring of bark measuring 2.5–3.5 cm in length is removed completely around the stock. A scion bud with a matching strip of bark is placed in this region and fastened securely.

3. Layering

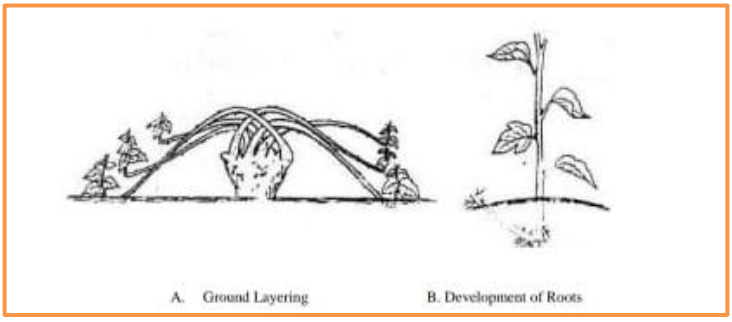
Layering is a propagation method in which roots are induced on a stem while it is still attached to the parent plant. Once the roots are established, the stem is detached and grown independently as a new plant. The rooted stem obtained through this process is called a **layering**. Root initiation during layering is encouraged by treatments that block the downward movement of assimilates from the leaves. As a result, carbohydrates, auxins, and other growth regulators accumulate at the treated site, promoting callus formation and subsequent rooting. The main advantage of layering is its simplicity and reliability — the developing roots are not exposed to drying, as sometimes occurs with cuttings or grafts. It is therefore considered a safer method of vegetative propagation. However, its limitations include higher labour costs, longer time requirements, and its unsuitability for large-scale

multiplication. Moreover, mulberry varieties with poor rooting ability cannot be propagated successfully by this technique. Layering is often employed to produce larger plants quickly or to replace gaps in the field where cuttings have failed to establish.

Several forms of layering are practiced:

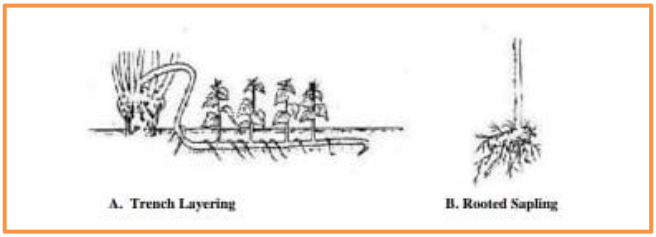
1. Simple Layering

In this method, a lower branch of a bush mulberry is partially girdled by removing 2.5–3 cm of bark from its middle portion. The branch is bent down so that the treated section is buried in soil, while the tip remains exposed. Roots develop in the covered portion, after which the branch is cut from the mother plant to grow independently.



2. Trench Layering

Widely adopted in Japan, this method involves bending a branch horizontally and covering a long section of its middle with soil mixed with manure. Shoots arise from the exposed buds, while roots form beneath the soil. In this way, multiple new plants can be obtained from a single branch.



3. Air Layering

Also known as **gooting**, this method is commonly used for erect branches. A circular ring of bark (1–2 cm wide) is removed from the middle of a shoot. The exposed region is packed with peat moss or well-decomposed manure, often mixed with a rooting hormone, and wrapped securely with polythene. The medium is kept moist by sprinkling water. Roots generally appear within 1–2 months, after which the branch is cut from the parent and transplanted to develop into a new plant.

Conclusion

Efficient propagation of mulberry is the cornerstone of sustainable sericulture, as it ensures a steady supply of nutritious leaves for silkworm rearing. While seedling propagation is mainly confined to breeding and research due to its variability, vegetative methods such as cutting, grafting, and layering remain the preferred choice for commercial cultivation. These techniques not only guarantee genetic uniformity and faster establishment but also enable the large-scale multiplication of superior varieties suited to specific agro-climatic conditions. Among them, cuttings are the most widely adopted due to their simplicity and cost-effectiveness, while grafting and layering serve as reliable alternatives for varieties with poor rooting ability. By selecting the right method based on local needs, farmers can maintain vigorous plantations, enhance productivity, and ultimately strengthen the sericulture industry.

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