

Cultivating Agarwood (*Aquilaria malaccensis*): From Seedlings to Harvested Tree



Introduction to *Aquilaria malaccensis*

Aquilaria malaccensis is one of the primary and most valued tree species used for the production of **agarwood** (also known as aloeswood, gaharu, or oud). Native to the rainforests of Southeast Asia and parts of South Asia, this large evergreen tree is globally renowned for the dark, fragrant resin it produces in response to fungal infection or physical injury.

Because wild populations have been heavily overharvested, *A. malaccensis* is listed under **CITES Appendix II**, making sustainable plantation cultivation vital for both conservation and economic viability.

Chapter 1: Botany and Ecological Requirements

Understanding the natural habitat of *Aquilaria malaccensis* ensures high survival rates and optimal growth in a plantation setting.

- **Tree Profile:**
 - Can grow up to **15 to 25 meters** in height with a trunk diameter of up to **80 centimeters**.
 - Smooth, grayish-white bark with white-colored wood beneath.
 - Alternate, simple leaves with a glossy, leathery texture.
- **Climate Requirements:**

- **Temperature:** Thrives in tropical climates with average temperatures between **22°C and 32°C**.
- **Rainfall:** Requires high annual rainfall, ideally between **2,000 mm and 3,500 mm**, well-distributed throughout the year.
- **Altitude:** Best suited for lowlands to mid-elevations, typically ranging from **sea level up to 750 meters** above sea level.
- **Soil Preferences:**
 - Prefers deep, fertile, well-draining loamy or sandy-clay soils.
 - Tolerates slightly acidic to neutral soils (pH **4.5 to 6.5**). Waterlogged soils must be avoided as they cause root rot.

Chapter 2: Nursery Management and Seedling Production

Starting from quality seeds is the foundation of a healthy, resilient plantation.

1. Seed Procurement and Viability

- **High Perishability:** *Aquilaria* seeds lose their viability very quickly—often within **7 to 14 days** of shedding from the capsule. They cannot be stored dried for long periods.
- **Selection:** Collect fresh, brown, fully mature seeds directly from healthy, mature mother trees.

2. Germination Process

- **Sowing Medium:** Use a mixture of **1 part forest topsoil, 1 part river sand, and 1 part well-decomposed compost** (or coconut coir) to ensure good aeration.
- **Technique:** Sow seeds flat at a depth of roughly **1 centimeter**. Keep the seedbed shaded and consistently moist using a fine mist sprayer.
- **Timeline:** Germination typically occurs within **7 to 15 days**.

3. Transpotting and Hardening Off

- Once seedlings develop **2 to 3 true leaves**, carefully transplant them into polybags (approx. 4x6 inches or larger) filled with rich potting soil.
- **Shade Management:** Keep seedlings under **50% to 70% shade netting** for the first 3 to 4 months.
- **Hardening Phase:** Gradually reduce shading over the last 2 months before outplanting to expose the saplings to direct sunlight and toughen their stems. Seedlings are ready for the field when they reach **30 to 45 cm** in height (usually around 6 to 9 months old).

Chapter 3: Plantation Establishment and Land Preparation

Proper layout and spacing maximize land efficiency and light capture.

- **Land Clearing:** Clear weeds and debris manually or lightly. Avoid heavy machinery that strips topsoil or compacts the ground.
- **Planting Layout and Spacing:**
 - Recommended spacing: **3m × 3m** or **3m × 4m**, which accommodates roughly **800 to 1,100 trees per hectare**.
 - Closer spacing can encourage competition for light, leading to taller, straighter trunks with fewer low branches.
- **Hole Digging:** Dig planting pits measuring **40 cm × 40 cm × 40 cm** at least two weeks before planting. Mix the excavated topsoil with organic compost and a small amount of rock phosphate.
- **Outplanting:** Plant at the **onset of the rainy season** to allow natural irrigation for root establishment. Gently remove the polybag, place the sapling straight, backfill, and firm the soil around the base. Create a slight basin around each sapling to retain rainwater.

Chapter 4: Maintenance, Care, and Growth Management

Routine care during the early years ensures rapid, healthy vegetative growth.

- **Weeding:** Regularly weed a **1-meter radius** around each sapling for the first 2 to 3 years to prevent nutrient and water competition.
- **Fertilization:**
 - Apply balanced organic compost or NPK fertilizer (e.g., 15-15-15) every 6 months during the first two years.
 - Transition to higher potassium and phosphorus formulations as the trees mature to strengthen wood structure.
- **Pruning:**
 - Prune lower branches during the dry season once the tree reaches **3 to 4 meters** in height.
 - Keeping the lower trunk clear of branches up to 2 meters promotes a clean, straight trunk, which improves overall timber value.
- **Pest and Disease Management:**
 - Monitor for leaf-eating caterpillars, stem borers, and fungal root rots (such as *Phytophthora*).
 - Maintain proper drainage and spacing to minimize humidity-driven fungal outbreaks.

Chapter 5: Resin Induction (Inoculation)

Natural resin formation occurs rarely and unpredictably in the wild (usually due to lightning strikes, insect attacks, or natural fungal infection). Modern commercial plantations rely on **artificial inoculation** once trees reach maturity.

Timing for Inoculation

- **Age:** Trees are typically ready for inoculation when they reach **6 to 10 years of age** or when the trunk diameter (DBH) measures at least **12 to 15 cm**.

Common Induction Methods

1. **Chemical/Biological Inoculation (Most Common):**
 - Specialized chemical solutions or fungal inoculants (such as specific strains of *Fusarium* or *Aspergillus*) are injected into holes drilled into the trunk.
2. **Physical Injury Methods:**
 - Methods include nailing, chopping, or drilling holes strategically into the trunk to simulate natural damage, prompting the tree to secrete protective resin into the surrounding tissue.

Chapter 6: Harvesting and Processing

The culmination of the cultivation cycle requires patience and precision.

- **Harvesting Timeline:**
 - Allow **1 to 3 years post-inoculation** for the resin to thoroughly permeate the heartwood. Harvesting too early yields low-grade resin; waiting too long can cause the core wood to degrade excessively.
- **Felling and Processing:**
 - Trees are carefully felled, and the resin-infused dark heartwood is meticulously separated from the white, uninfected sapwood.
- **Grading and Products:**
 - Wood is graded based on resin density, weight (sinking vs. floating grades), and aroma profile.
 - Processed materials are utilized to produce **agarwood chips, incense, essential oils (oud oil) via hydro- or steam-distillation, and carved artifacts**.