

# **Samanea Saman**

## **Monograph**



**Colegio Bolivar**

Agricultural Science

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# Introduction

*Samanea saman*, also known as rain tree or saman, is one of the most recognized and ecologically significant plants in tropical and subtropical landscapes, valued not only for its striking appearance but for its role in ecosystems and cultural significance. *Samanea saman* (Jacq.) Merr. belongs to Fabaceae. has a natural range from Central to South America but has been widely distributed across Asia, Africa, and the Pacific due to its adaptability, nitrogen-fixing capacity, and use in agroforestry systems. Its success as an evolutionary species is that it is tolerant to a range of conditions and can improve soil fertility, making it part of sustainable land management practices.

This monograph examines *Samanea saman* scientifically, beginning with its taxonomy classification and ecological distribution, proceeding to biological life cycle, reproductive tendencies, and environmental adaptations. Detailed chapters on propagation techniques, plantation technology, and applications in commerce demonstrate its utility as a timber crop, shade tree, ornamental tree, and even fodder crop. In addition, the rain tree's traditional, medicinal, and ecological uses underscore the importance of the species not just for ecosystems but also for human livelihood and culture. In this extensive research, *Samanea saman* presents itself as an exemplary convergence of botany, environmental care, and human innovation.

# 1.0 ECOLOGY

## 1.1: Affinity:

*Samanea saman* (Jacq Merr)., sometimes called rain tree or monkeypod tree, belongs to the family Fabaceae (legume family), subfamily Mimosoideae (iNaturalist, 2021) which consists of approximately 5,000 species worldwide, predominantly found in tropical and subtropical regions.

The Fabaceae are closely related to Caesalpiniaceae and Papilionaceae, other families of leguminous plants (HowStuffWorks). The only way for the members of the genus *Samanea*, *Samanea saman* is the most common and economically important species because it is used as an ornamental and shade tree. Similar species that exist within this genus include *Samanea tubulosa*, from various locations across South America, *Samanea inopinata*, native to Central America, and *Samanea guineensis*, which can be found in African regions.



**Figure 1:**

*Samanea Tubulosa* (iNaturalist 2019)



**Figure 2:**

*Samanea inopinata* (OECD 2018)



**Figure 3:**

***Samanea guineensis* (YVSREDDY 2012)**

## 1.2: Taxonomy:

Monkeypod trees (*Samanea saman*) belong to the Plantae kingdom, which includes all land plants including oaks, grasses and sunflowers (colombia.inaturalist.org). Eukaryotic multicellular autotrophic kingdom. Plantae. The "eukaryotic" means that their cells have a defined nucleus, and "autotrophic" refers to an organism that can photosynthesize—turning sunlight into energy. Kingdom Plantae members have cell walls made of cellulose that provide structural support to their multicellular forms. Characteristics of a large, exotic, and fast-growing tree in tropical environments are shown by *Samanea saman*.

### **Table 1:**

#### **Taxonomy of *Samanea Saman***

Kingdom	Plantae
Phylum	<i>Streptophyta</i>
Class	<i>Equisetopsida</i>
Subclass	<i>Magnoliidae</i>
Order	<i>Fabales</i>
Family	<i>Fabaceae</i>
Genus	<i>Samanea</i>
Species	<i>Samanea saman</i>

### 1.3: Fossil record:

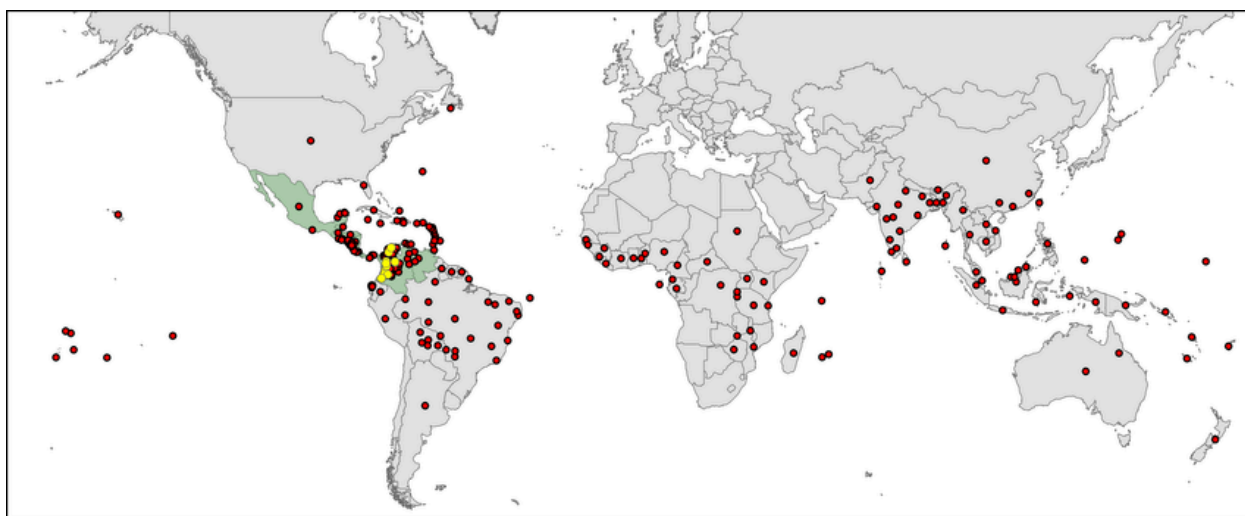
*Samanea saman* does not have as rich a fossil record as some other taxa, but its family (Fabaceae) does have an extensive evolutionary history. Fossil evidence shows that legumes first appeared during the Cretaceous period, more than 60 million years ago, emphasizing their ancient lineage. No known fossils of the *Samanea saman* exist, (although Miocene representatives have been found in the Mimosoideae subfamily and juvenile fossils found in the tropical areas where these trees grow today). They show that *Samanea saman* and its relatives were important components in remote past forest ecosystems.

## 1.4: Origin

Native to the tropical woodlands of Central and South America, the Monkeypod tree (*Samanea saman*) evolved naturally there for thousands of years. It is native to Mexico and northern South America and prefers warm, humid climates. While its precise origins are unknown, it has been appreciated for its environmental benefits, like providing shade, enriching the soil and bolstering biodiversity. When *Samanea saman* was first introduced to other tropical areas of the world (e.g. in Southeast Asia, the Pacific Islands, Africa) during the colonial era, it was also able to adapt to new environments. Today, the Monkeypod tree is cultivated worldwide in tropical and subtropical climates for its ornamental value and environmental benefits.

**Figure 4:**

**Global distribution of *Samanea Saman* (red dots). (ResearchGate, 2020)**



## 1.5: Environmental factors

### 1.5.1: Climate

Monkeypod tree (*Samanea saman*) thrives in a broad range of rainfall, from 640 to 3810 mm per annum (Tananeos, 2021). How fast its growth varies from very humid regions (with 1270mm or even more precipitation). But this accelerated development can become a bit too counterproductive, resulting in such a gigantic mass of weaved root carpet and a very coarse canopy that the tree suffers a compromise later down the road in the form of an unhealthy balance. Climate Ohia lehua trees have naturalized and spread on Hawaii in places with peak winter rainfall of 1140-2030 mm and temperatures between 10° and 30 °C.

### 1.5.2: Soils:

The Monkey Pod tree (*Samanea saman*) grows best when provided with deep alluvial soils that well-drain and are either neutral to slightly acidic. In Hawaii, much of the more adaptable climatic range for the Monkey Pod tree has been cleared for agriculture. Still, it has naturalized in Oxisols and Inceptisols on sites with gentle to steeper slopes. These trees are usually found on sites that are lower in elevation and that possess deeper, more humid soils than are found on nearby hills and ridges. However, the Monkeypod tree may be planted and grow well in a variety of soils and can tolerate periodic flooding if planted bare-root in Hawaii, albeit not in large scale. Severe drought stress following bare-root planting usually results in a high level of mortality. Nursery seedlings reach a size where they can be planted in around 4 months.

## 2.0 BIOLOGY

### 2.1 CHROMOSOME COMPLEMENT

*Samanea saman* is primarily diploid, with a chromosome number of  $2n = 2x = 28$ , meaning it has two complete sets of chromosomes, one from each parent (Sousa & Sinha, 2019). While diploidy is the common state, polyploidy has not been extensively reported in this species, unlike some other members of the Fabaceae family.

### 2.2 Life cycle and phenology

#### 2.2.1 Life cycle

##### 2.2.1.1 Seed germination

Germination in *Samanea saman* begins after the seed coat is softened, often requiring scarification to break dormancy. Natural scarification occurs through digestive tracts of animals or mechanical weathering (Tananeos.org, 2023). Once water is absorbed, the radicle emerges first, followed by the hypocotyl and shoot system (Singh & Lal, 2018).

##### 2.2.1.2 Juvenile/Vegetative Stage

The seedling develops a taproot system along with primary shoots bearing compound, bipinnate leaves. This juvenile phase lasts 3 to 5 years, during which the tree focuses on vegetative growth without flowering (Tananeos.org, 2023). Growth rate is influenced by soil fertility, moisture availability, and light conditions (Orwa, 2009).

##### 2.2.1.3 Flowering/Reproductive Stage

*Samanea saman* reaches reproductive maturity after 4 to 6 years. It produces pinkish, powder-puff-like inflorescences, primarily pollinated by bees and butterflies (Sousa & Sinha, 2019). The species exhibits asynchronous flowering, meaning individual trees may flower at different times depending on environmental conditions (Lobo, 2003).

**Figure 5:**

**A picture that shows *Samanea saman*'s flower** (Nutsiam, 2024).



#### **2.2.1.4 Fruit Development and Maturation**

Following successful pollination, the ovary develops into an oblong, indehiscent pod. Cell division occurs rapidly during the first few weeks, followed by cell expansion, driven by auxins and gibberellins (Pautasso, 2009). Pods mature within 4 to 6 months, turning dark brown with a sticky, sweet pulp inside (Pautasso, 2009).

#### **2.2.1.4.1 Sugar Accumulation and Maturation**

As the pods mature, carbohydrates accumulate, primarily as sucrose and fructose, which contribute to the sticky pulp's sweetness (Lobo, 2003). Warm temperatures enhance sugar synthesis and pod maturation (Sousa & Sinha, 2019).

#### **2.2.1.4.2 Ripening and Softening**

Ripening is facilitated by ethylene production, which softens the pod tissues and enhances aroma and color changes. Pectin degradation further facilitates softening (HowStuffWorks).

#### **2.2.1.5 Senescence and Death**

Productivity gradually declines after 40 to 60 years, though individual trees can live over a century under favorable conditions (Pautasso, 2009). Environmental stress, disease, and mechanical damage can hasten senescence.

### **2.2.2 Phenology**

#### **2.2.2.1 Evergreen to Semi-Deciduous Habit**

*Samanea saman* is semi-deciduous, shedding leaves briefly during dry seasons to conserve water. Leaf drop typically occurs in response to drought stress rather than temperature (Singh & Lal, 2018).

#### **2.2.2.2 Flowering and Fruiting**

Flowering occurs primarily during the late dry to early wet season, varying by region. In tropical areas like Brazil, flowering peaks between March and May, while fruiting extends into the rainy season (Singh & Lal, 2018).

## **2.2.3 Year-to-Year Variation in Flowering and Fruiting**

### **2.2.3.1 Temperature Fluctuations**

Temperature fluctuations impact flowering intensity. Unseasonal rains can trigger off-season flowering, while extreme heat can inhibit bud formation (Pautasso, 2009).

### **2.2.3.2 Tree Health**

Healthy trees with adequate water, nutrients, and pest control exhibit consistent flowering and fruiting. Stressors like nutrient deficiencies or pest infestations reduce reproductive output (HowStuffWorks).

## **2.2.4 Impact of Climate Change**

Climate change has altered *Samanea saman* phenology, with earlier flowering and fruiting observed in regions experiencing rising temperatures. Prolonged droughts also affect seed production and germination success (Pautasso, 2009). Conservation efforts now focus on identifying drought-resistant genotypes for future planting (Raven, 2020).

## **3.0 Propagation and Management**

### **3.1 Natural Regeneration**

*Samanea saman* exhibits moderate natural regeneration capacity under suitable conditions. Its seeds are primarily dispersed by animals, especially cattle and other livestock, which consume the pods and later deposit seeds in dung, promoting germination (Parrotta, 1990). However, the hard seed coat induces dormancy, and natural germination without scarification is often slow and irregular (Hossain, 2005).

### **3.2 Nursery Propagation**

#### **3.2.1 Propagation from seed**

##### **3.2.1.1 Pre-preparation and implications for germination**

*Samanea saman* seeds possess a hard, impermeable seed coat that enforces physical dormancy.

Pre-treatment is essential to enhance germination rates. Common methods include mechanical scarification or soaking seeds in hot water (80°C) for 10–15 minutes, allowing them to cool and then soaking for an additional 12–24 hours (Hossain, 2005). Acid scarification using concentrated sulfuric acid for 10–30 minutes is also effective but requires careful handling.

##### **3.2.1.2 Sowing and germination process**

After scarification, seeds are sown in well-drained nursery beds or polybags at a depth of about 1–2 cm. Optimal germination occurs at temperatures between 25–30°C with consistent moisture. Under these conditions, germination typically initiates within 7–21 days (Eartone, 2025).

### 3.2.1.3 Storage

*Samanea saman* seeds have relatively long viability if properly stored. When kept under dry conditions at 4–10°C, seeds can maintain high viability for over a year (Earthone, 2025). However, exposure to humidity and temperature fluctuations can significantly reduce seed longevity.

## 3.2.2 Vegetative propagation

### 3.2.2.1 Grafting

Vegetative propagation of *Samanea saman* is less common than seed propagation but can be employed to clone superior trees. Grafting techniques such as side veneer grafting (shown in figure 5) and cleft grafting (shown on figure 7) are utilized. Grafting is typically performed on young, actively growing rootstocks about 6–12 months old (PropMaster2K, 2024). Success rates improve when grafting is conducted during the active growing season, under high humidity conditions.

**Figure 6:**

**A picture that shows side veneer grafting (Bhandari, 2021)**

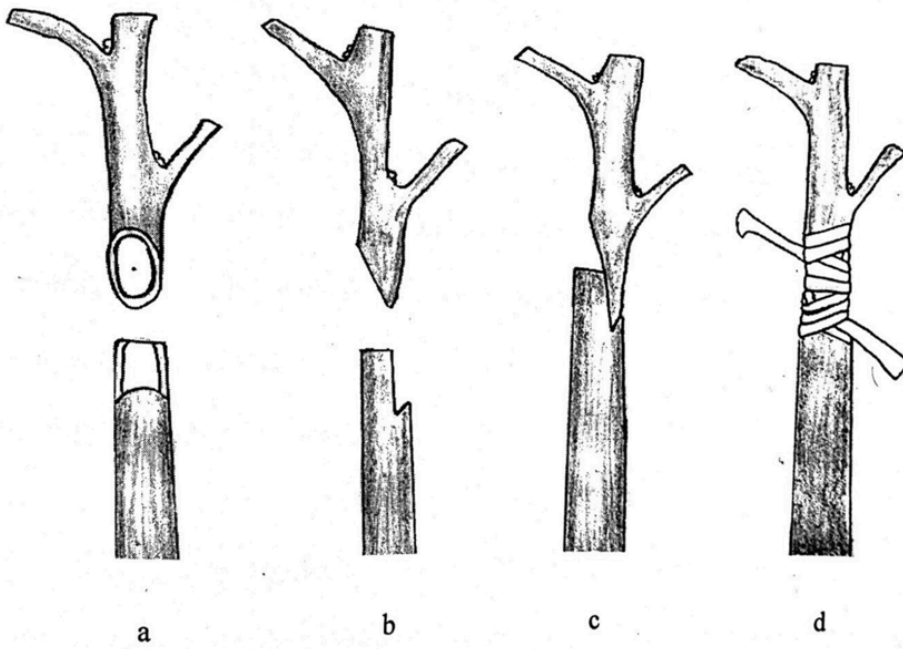
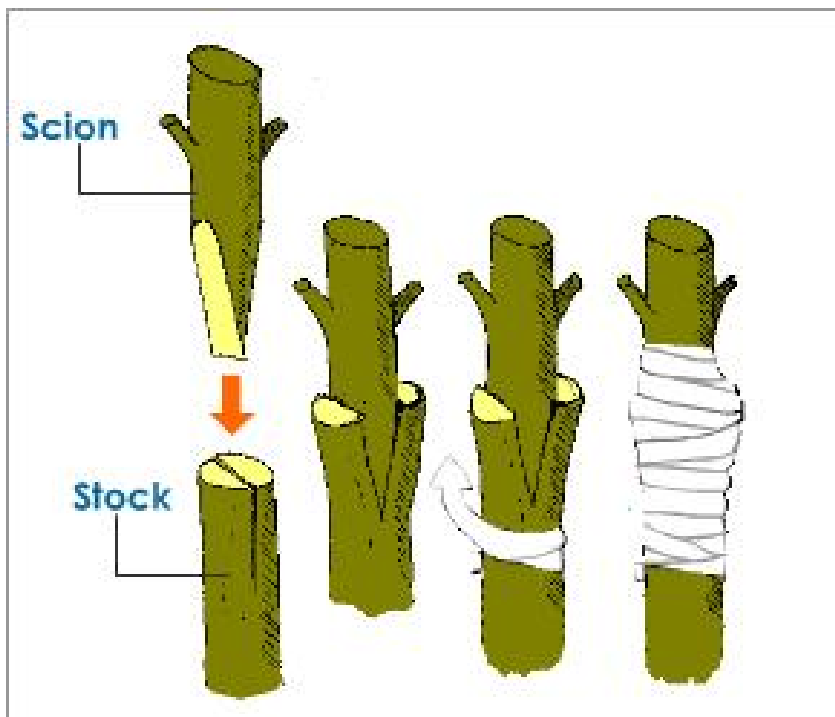


Figure 7:

A picture that shows cleft grafting (Heritage Fruit Tree, 2012).



### **3.3 Planting**

*Samanea saman* seedlings are ideally planted at the onset of the rainy season to ensure adequate soil moisture for establishment. The species thrives in a variety of soil types but prefers deep, well-drained loamy soils with a pH between 6.0 and 7.5 (Jacq. Merr, 2012). It grows best in full sun but is tolerant of partial shade. Spacing recommendations vary based on intended use: for shade or ornamental purposes, trees are spaced 8–12 meters apart, while for timber plantations, closer spacing of 4–6 meters may be applied.

### **3.4 Management**

#### **3.4.1 Tending**

During establishment, *Samanea saman* requires regular watering, particularly in dry periods, to promote root development. Mulching around the base of young trees helps retain soil moisture, suppresses weed growth, and moderates soil temperature. Regular weeding is necessary in the early stages. Formative pruning may be conducted to encourage a strong central leader and desirable canopy shape, especially when the tree is grown for shade or timber (Jacq. Merr, 2012).

#### **3.4.2 Fruiting**

During establishment, *Samanea saman* requires consistent watering, especially during dry spells, to support deep root development (Orwa, 2009). Applying organic mulch around the base of young trees conserves soil moisture, suppresses weed growth, and stabilizes soil temperatures. Early and regular weeding is critical to reduce competition for nutrients (Little & Wadsworth, 1964). As the tree matures, it

produces edible, sweet-flavored pods known as "*monkey pods*," which mature annually and are important for wildlife and livestock forage.

**Figure 8:**

A picture shows the "*monkey pod*" fruit from the *Samanea saman* (Juan J. Gonzalez, 2020)



### 3.4.3 Pest and Disease Control

No widespread or serious disease or pest problems are reported, although mealy bug attack is causing die-back in parts of Myanmar. However, some common pests of trees similar to *Samanea saman* include the seed borer (*Caryedon serratus*), leaf-eating caterpillars, and sap-sucking insects such as aphids and scales. Integrated pest management (IPM) approaches, including manual removal, the use of biological control agents like parasitoid wasps, and selective insecticide application, are recommended to reduce pest damage (Tropical Forages, 2020).

Major diseases affecting *Samanea saman* are root rot caused by *Phytophthora spp.* and fungal leaf spots, often linked to poor drainage or humid conditions. Management strategies include selecting well-drained sites, improving air circulation through pruning, and applying fungicides when necessary (CAB International, 2005).

## 4.0 Commercial Importance

### 4.1 Exporting and Importing of the product

*Samanea saman* is commercially valued for its durable hardwood, fodder, and shade applications. Its wood is moderately heavy, resistant to rot, and often exported for high-quality furniture, carving, and boatbuilding (PFAF, 2024). Although not traded at the scale of major timber species, regional trade, especially in Southeast Asia, the Pacific, Central America, and the Caribbean, is significant.

In addition to timber, the rain tree's pods — sweet and rich in protein — are harvested locally for animal feed. In some markets, rain tree seeds and pods are exported for use in agroforestry and reforestation projects (PFAF, 2024).

### 4.2 Importance in the economy

The rain tree plays an important role in local rural economies, particularly in tropical and subtropical regions. Its fast growth and valuable shade make it a preferred species for pasture improvement and urban greening projects, contributing to land management and livestock productivity (Parrotta, 1990). Rain tree wood products support small-scale industries, such as furniture making and handicrafts, providing income opportunities in rural areas (PFAF, 2024). Furthermore, its use in agroforestry systems, as a nitrogen-fixing species, improves soil fertility and crop yields, enhancing food security and sustainability for smallholder farmers (PFAF, 2024).

## **5.0 Commercial Production and Uses**

### **5.1 Food Uses**

#### **5.1.1 Fruit**

The seed pods of *Samanea saman*, commonly known as monkey pods or rain tree pods, contain a sweet, sticky pulp with a flavor reminiscent of licorice. This pulp is consumed raw in some regions and can be made into beverages similar to tamarind drinks. Additionally, the pods serve as nutritious fodder for livestock, offering a protein content of approximately 13–18% .

#### **5.1.2 Seeds**

While the seeds are not typically consumed due to their hardness and potential toxicity, they are utilized in traditional crafts. In Hawaii, for instance, cleaned seeds are fashioned into necklaces and other decorative items (PFAF, 2024).

#### **5.1.3 Nectar**

The flowers of *Samanea saman* produce abundant nectar, attracting bees and supporting honey production. Honey derived from rain tree nectar is valued locally for its distinct flavor and is sometimes sold in local markets (Tananeos, 2021)

### **5.2 Medical Uses**

#### **5.2.1 Nutrients**

### **5.2.1.1 Pod Pulp**

The sweet pulp is rich in carbohydrates and some minerals, making it a good energy source for livestock and occasionally for human consumption in rural communities (Ken Fern, 2025).

### **5.2.1.2 Flowers**

Rain tree flowers contain small amounts of bioactive compounds, and traditional medicine practices in parts of Central America and Asia have used flower infusions for treating colds and coughs (Ken Fern, 2025).

## **5.2.2 Diseases**

Various parts of the rain tree, particularly the bark and leaves, have been used traditionally to treat diarrhea, stomachache, and skin conditions. Bark decoctions have been cited for their anti-inflammatory and astringent properties (Allan & Ellen, 1981).

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