Tabebuia Rosea (Bertol.) Bertero ex A.DC.

Monograph

Agriculture

2024-2025

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Introduction

Kingdom: Plantae

Taxonomic Rank: Species

Common names: pink poui, pink trumpet tree, guayacán rosado,

Scientific name: Tabubeia rosea

Tabebuia rosea is the scientific name for the Pink Trumpet Tree or better known in Colombia as Guayacán rosado. This tree is native to Central and South America and is widely cultivated in tropical and subtropical regions. Recognized as an ornamental species it has been spread to non-native regions such as India, Malaysia and the Philippines, as well as its frequent use in cities throughout its native range in the Americas. It thrives in warm climates and well-drained soils, making it suitable for a wide variety of environments. *T.rosea* is valued for its pink to pale purple flowers that bloom several times throughout the year. The tree is also used as timber and for traditional medicinal purposes.

In this monograph chapter one will discuss the ecology of *T.rosea*; Affinities, Fossil Record, Origin and distribution, and *T.rosea* as a vegetation component

Chapter two will focus on biology of the plant including
Seed conservation, chromosome complement, life cycle and phenology, floristic elements,and reproductive biology
Chapter three will discuss propagation and management of *T.rosea* including the following: In vitro propagation, natural regeneration, vegetative propagation, planting, management and pest and disease control.

Chapter four focuses on the Uses of *T. rosea* as its market is not developed. Ornamental use, wooden, and medicinal use.

1 Ecology

1.1Affinities

Tabebuia Rosea is part of the kingdom Plantae and has been recognized as a species, *Tabebuia Rosea (Bertol),* since being published in 1845; most commonly known as Guayacán Rosado, Máculis, pink trumpet tree or Pink poui,(*Tabebuia Rosea (Bertol.) Bertero Ex A.DC.*, n.d.) *T.rosea* is a part of the Subkingdom Viridiplantae, which are green plants that produce chlorophylls a and b and store their products in double membrane chloroplasts as photoautotrophic organisms(O'Neill et al., 2022).

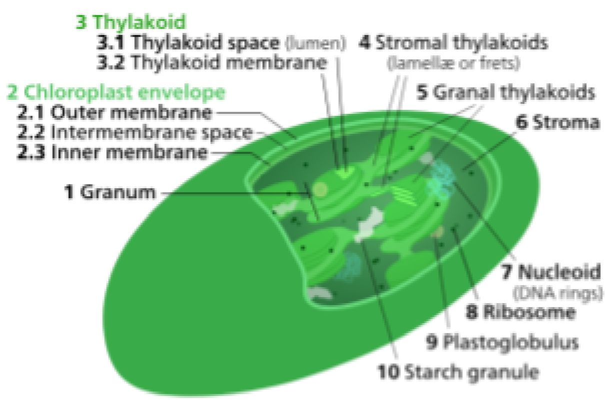


Figure 1: Chloroplast structure (*Mitochondria and Chloroplasts (Article) | Khan Academy*, n.d.)

Viridiplantae convert carbon dioxide to carbohydrates, which allows for this subkingdom to use these and develop in diverse structures. Viridiplantae divide in two, Chlorophyta and Streptophyta; *T.rosea* is part of the infrakingdom Streptophyta, which comprises land plants and charophytes (algae) (O'Neill et al., 2022). Embryophyta or embryophytes refers to the development of an embryo in the seed, in addition Embryophyta "share a a pluricellular sporophyte", male and female gamete producing organs (Broutin & Encyclopedia of Life Support Systems (EOLSS), n.d.). It has also been placed in the clade Angiospermae, part of the flowering plants. Within the Embryophyta, *Tabubeia rosea* belongs to the Tracheophyta, vascular plants, 'tracheid plants' are plants with a vascular system, these show bands in the form of spirals, providing additional structural support aside from their main purpose which is the transportation of water and nutrients (The Editors of Encyclopaedia Britannica, 2024). The plant's vascular system is conformed by xylem, water transporting tissue, and phloem, conduction of food (glucose) (The Editors of Encyclopaedia Britannica, 2024). Spermatophyta refers to plants producing seed, using them to reproduce. *Tabubeia rosea's* class is Magnoliopsida, within the vascular plants those that produce flowers and are termed angiosperms, within these it is a dicotyledon, these are plants with two cotyledons in the embryo seed. Belonging to the superorder Asteranae means that it produces compositie flowers made up of florets (small flowers in themselves that makeup the larger appearance of the flower). It is a members of the order Lamiales which generally have zygomorphic flowers (symmetrical flowers) along with other specific characteristics such as their perianth(outermost non-reproductive group of modified leaves of a flower), leaves, storage of carbohydrates, androecium, amongst others (*Menta, Acantos, Verbenas Y Afines (Orden Lamiales)*, n.d.) (UNNE). Within this order it belongs to the family Bignoniaceae, characterized by their composite and opposite placed leaves. The scaly buds, ending in pseudostipules, are often conspicuous, the flowers of this family are often distributed by pollinators, but can also be distributed in a lesser measure through mammals or water (UNAL). The Genus *Tabebuia* consists of plants with flowers that are larger than 2 cm long, tubular-campanulate to tubular-infundibuliform and glabrous anthers. The species, *Tabubeia Rosea,* is defined by 8' leaflets acuminate or abruptly acute; leaves uniformly 5-foliolate; inflorescence usually with many flowers (UNAL).

Table 1
Taxonomic hierarchy of *Tabebuia rosea*

Taxonomic Rank	Name
Kingdom	Plantae
Subkingdom	Virdiplantae
Infrakingdom	Streptophyta
Superdivision	Embryophyta
Division	Tracheophyta
Subdivision	Spermatophytina
Class	Magnoliopsida
Superorder	Asteranae
Order	Lamiales
Family	Bignoniaceae
Genus	Tabebuia
Species	Tabebuia Rosea

Table 1: Taxonomic Hierarchy of Tabebuia Rosea

1.2 Fossil Record

The first fossil record of Bignoniaceae related to the Tabebuia alliance dates to the Late Pleistocene epoch (126,000 to 11,700 years ago) with a fossilized wood found in the Arroyo Feliciano Formation In Entre Ríos Argentina (Moya et al, 2015) . The origin of this fossil is from a fluvial unit formation in the Gualeguay Basin (surface water converging) Which has been significantly important for paleo-flora permineralized fossil formation due to its sediment characteristics. The soil is characterized by fine lamination and layering; cracks in the soil are lined by manganese oxides. The upper section contains calcium carbonate segregated in concretions. It is an alluvial plain in a humid environment, the calcium carbonate indicates a semi arid section previous to this (Zucol et al., 2016).

Figure 2: Gualeguay Basin Hydrographic Network, Entre Rios, Argentina (Bianchi, 2012)

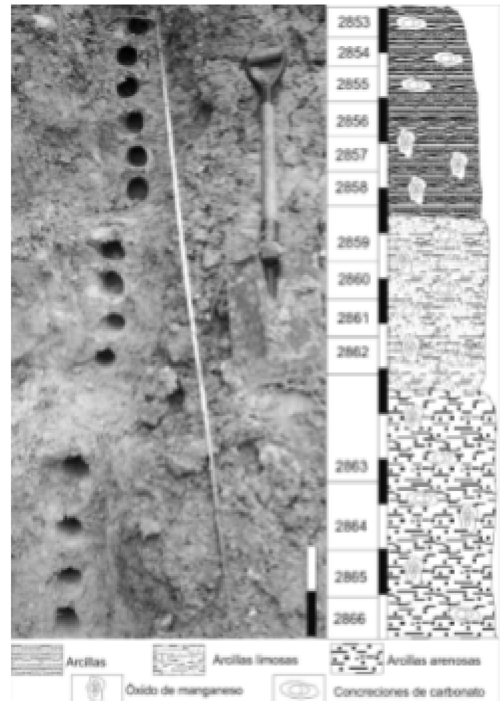


Figure 3: Soil composition in Gualeguay basin (Bianchi, 2012)

The first fossil record of Bignoniaceae related to the Tabebuia Genus being found in Argentina strongly supports the origin of Tabebuia being South America, and its endemic nature to the Americas.
The features in the fossilized wood found in Entre Rios that could be closely related to the Genus tabebuia are:

Growth rings indistinct; diffuse-porous wood; vessels predominantly solitary, occasionally radial (two to four cells) and tangential multiples (two to seven cells) and in clusters; simple perforation plates; alternate, bordered and non-vestured intervessel pits; axial parenchyma apotracheal diffuse and paratracheal, vasicentric complete and incomplete, lozenge aliform and confluent; strands of two to four cells; homocellular rays; mainly uniseriate and some biseriate rays; fibers septate and nonseptate; prismatic crystals in chambered axial parenchyma cells; and partially and irregularly storied structure in vessels, rays and/or parenchyma (Moya & Brea, 2018)

1.3 Origin

The native range of *T.rosea* is central to the upper part of south america, in the following countries: Belize, Colombia, Costa Rica, El Salvador, Guadeloupe, Honduras, Mexico, Nicaragua, Panama, Venezuela (*World Agroforestry Centre | Agroforestree Database 4.0*, n.d.) This plant comes from Bignoniaceae, and within these the Neotropical Plants (Species that evolved and grow exclusively in the tropic), the genus tabebuia, and within it a group of plants called the Tabebuia Alliance, a group of çlosely related plants that are believed to have a common ancestor, some genera have surged in parallel such as Handroanthus and Roseodendron because of the tabebuia alliance being paraphyletic. Phylogenetic analysis reveals that the Tabebuia Clade is strongly related, formed by Ekmanianthe, Spirotecoma, Crescentia, and Parmentiera (Vieira et al., 2022)

1.4 Present distribution

T.rosea is found primarily in Central and upper South America, from mexico to north of Equator, Currently *T.rosea* natively grows in: Belize, Colombia, Costa Rica, Ecuador, El Salvador, French Guiana, Guatemala, Guyana, Honduras, Mexico Central, Mexico Gulf, Mexico Northeast, Mexico Northwest, Mexico Southeast, Mexico Southwest, Nicaragua, Panamá, Venezuela, and has been introduced as an exotic species to the Brazil Southeast, Brazil West-Central, Cayman Is., Cuba, Dominican Republic, Gambia, Jamaica, Leeward Is., Puerto Rico, Trinidad and Tobago, Venezuelan Antilles, Windward Is, Ghana, Sri Lanka, and Uganda (*Tabebuia Rosea (Bertol.) DC. | Plants of the World Online | Kew Science*, n.d.), (*World Agroforestry Centre | Agroforestree Database 4.0*, n.d.)

Figure 4: Present Distribution of Tabebuia Rosea of 6,961 georeferenced records (GBIF, 2024)

1.5 Environmental factors in distribution:

1.5.1 Ecoregion, Elevation and Climate

Ecoregions *T.rosea* can be found in:

- Temperate humid and sub-humid
- Tropical Humid and sub-humid

T.rosea is usually found in multispecific forests, where a multitude of species grow. *T.rosea* grows in tropical climates, from sea level up to 1200m, and having an ideal temperature of growth between 25°C and 32°C the types of forest where it grows are the following (Gobierno de México, nd):

- Oak forests, plant community dominated by different types of oaks (*T.rosea* is a type of Oak) these mainly in the Andean region of south america (*Oak Tree Forests | Biodiversity 2016*, n.d.).
- Gallery forests, formed along the caudal of a water source. These forests occur in regions that otherwise do not count with lush forest elsewhere (Chepkemoi, 2017).

- Mesophilic mountain forest, usually with high humidity, tropical and subtropical characterized by a high mist concentration, mainly in places with high elevation points (Santillán-Fernández et al., 2020)
- Tropical deciduous and subdecidous forest, occur in regions with heavy rainfall followed by a marked dry season. These forests are dense and lush during the rainfall season and almost all leaves fall during the dry season (deciduous trees shed once a year). They generally occur under 10- 20N and 10- 20S latitude, especially abundant in mexico and bolivia (Moran, 2022)
- Evergreen tropical forest, also called a rainforest, around rainfall of 1500mm per year , relative humidity high, around 20 to 30C, locate in the tropic, Plants that maintain their green leaves and functional for more than one season (Adams et al., 2019)
- Savannah type grassland, Scattered trees, rainfall that graduate decreases in previously evergreen tropical forest (Smith, 2024).

1.5.3 Water

The mean annual rainfall *T.rosea* should receive is 1200-2500mm, and average water content in fresh seeds is 12 to 13 percent. However it can sustain annual rainfall up to 3000mm (*World Agroforestry Centre | Agroforestree Database 4.0*, n.d.)
Water uptake is primarily from deeper soil layers due to the extensive root system *T.rosea* possesses, however seasonal shifts deeply affect its water intake. *T. rosea* (in a monoculture) utilizes around 11% to 24% from the top 30 cm during the dry season, meanwhile during the wet season *T. rosea* acquires 41% to 49% from the top 30 cm, the rest of the water is obtained below this measure (Schwendenmann et.al, 2015)

T. rosea has both lateral roots and deeply penetrating taproots as observed during root excavations at Sardinilla (Jefferson Hall, 2010), which enables *T. rosea* to extract water from deeper soil layers. (L. Schwendenmann, Et.al 2015)
Access to deeper water is also linked to leaf phenology, *T. rosea* has a high production and sustain of transpiring leaves over the course of the dry season compared to other plants that lack its characteristic roots.

1.5.4 Geology and soils

T.rosea grows best in deep, fertile, moist, well drained soils in full sun. (Farji-Brener, 2001; Orwa et al., 2009; Missouri Botanical Garden, 2015). It prefers sandy soil, yet will also tolerate clay loams and poor soils (Orwa et al., 2009; PROTA, 2016).

T.Rosea can grow in soils that have periodic floods, or in humid soils with slow and regular drainage (Gómez, Toro & Piedrahita, 2013). According to Ospina et al. (2008), *T.Rosea* does not grow well in soils with low moisture retention, or in those with a marked water deficit or on slopes greater than 60%.

T.rosea can adapt to a great variability of soils with alkali, neutral, or acidic pH´s, however it will prefer soils that have between 5,5 and 6,5 in the pH scale.

Additionally it has been reported that in a region in Urabá T. rosea has had a good development in soils with a high alkali saturation between 37 and 68% and with a deficit in phosphorus (CONIF, 1996)

1.5.5 Light

It is recommended that *T.rosea* has an ample source of sunlight for its growth (preferably in full sunlight), however, its germination capacity in the dark is decreased but it still counts with a value of about 70% through the first year, highlighting its adaptability. (Basto & Ramírez 2014).

1.6 *Tabebuia rosea* as a Vegetation Component

1.6.1 Associated species

Flora species related to *T.rosea* are of tropical and subtropical climates. While some of them are more usual in the wild, *T. rosea* is also paired with other ornamental plants.

Smilax spp: A genus of woody perennial vines or shrubs (approx. 200-300 sp) yellowish to green flowers that give a small black berry (fruit)(The Editors of Encyclopaedia Britannica, 1999). The canopy structure of *T.rosea* allows for Smilax (plants) to grow with less exposure to sunlight and reduce water loss, while also giving a place to climb (Comita et al., 2007).

Hura crepitans: A large tropical tree (30-40 m), belonging to the family Euphorbiaceae, grows in tropical regions. Has sharp conical spines. It is toxic and its fruit explodes ejecting seeds. (*Hura Crepitans L. GBIF*, n.d.) Found in the wild, *T. Rosea* creates a beneficial microclimate during dry seasons for *Hura crepitans*, their nutrient cycling is similarly complementary, *T.rosea* peaks in the late dry season while *H. crepitans* peak during the early dry season . However it competes for resources with *T.rosea*, at the same time *T.rosea* attracts pollinators while Hura Crepitans attracts fauna that search for refuge. Also used for ornamental purposes (Scherer‐Lorenzen, et.al 2007).

Lysiloma spp: A genus of flowering plants in the Fabaceae family, native to tropical and subtropical regions. Usually trees or large shrubs with bi pinnately compound, its fruit is an elongated legume pod.They have the same type of environment (tropic and subtropic) however they

Handroanthus chrysanthus: Species of the Bignoniaceae family, medium size deciduous tree, palmately compound leaves, flowers are bright yellow in trumpet shapes, fruit is in an elongated capsule, seeds are winged. (*Handroanthus Chrysanthus (Jacq.) S.O.Grose*, GBIF, n.d.) (*Lysiloma Benth. | Plants of the World Online | Kew Science*, n.d.) Both Handroanthus Chrysanthus and *T.rosea* have specific bacterial communities in their rhizosphere, endosphere, and phyllosphere that are beneficial to maintaining forest cover. This complex interaction (Becerra-Lucio, et al 2021).

Other plants associated with *T. Rosea*´s area of growth (tropic and subtropic) and ornamental purposes (Gobierno de México)

Acacia spp. Genus of about 160 sp of trees and shrubs belonging to the Fabaceae family. Native to tropical and subtropical regions. Its flowers are often in cylindrical clusters, its fruits are legumes (The Editors of Encyclopaedia Britannica, 2024).

Bursera spp. Genus of deciduous trees and shrubs, usually aromatic with compound leaves. Flowers are often small and can vary in color (red, green, white or yellow), the fruit contains one seed. (*Copales Y Cuajiotes (Género Bursera)*, I Naturalist n.d.)

Cedrela spp. Genus of perennial or deciduous trees belonging to the Meliaceae family. Medium to large size, from 10 to 40 m, its leaves are pinnately compound and its flowers are arranged in panicles (green or white), they are monoecious, usually aromatic. (*Cedros (Género Cedrela)*, INaturalist, n.d.)

Pithecellobium spp: Genus part of the Fabaceae family, medium to large hermaphrodite shrubs or trees. Fruit comes in a coiled-shaped legume pod. Ornamental use. (*Guamúchil, Coralillos Y Parientes (Género Pithecellobium)*, INaturalist, n.d.)

Pinus spp. Genus belonging to the Pinaceae family, coniferous large trees. Its leaves are small and needle-like organized in fascicles. Pines produce male cones which produce pollen and female cones that are more woody and contain seeds. (*Pinos, Ocotes Y Piñones (Género Pinus) INaturalist*, n.d.)

Liquidambar spp: Genus that belongs to the Altingiaceae, comprised of medium to large deciduous trees. Leaves are palmately lobed (5-7 lobes) and are vibrant colors (red, orange, yellow, purple), fruit presents in a spiky capsule. Usually aromatic (*Liquidámbar (Liquidambar Styraciflua)*, INaturalist, n.d.)

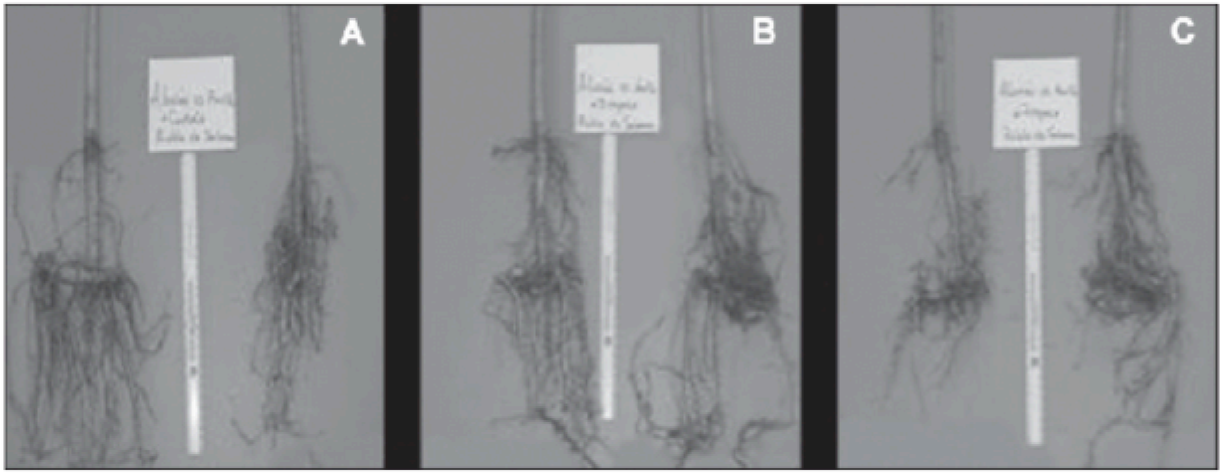
Terminalia spp: Genus that belongs to the family Combretaceae, of deciduous and evergreen, trees and shrubs, leaves are alternate or sub-oposite, flowers are in spikes or rameces. (*Mirobálanos O Almendros Tropicales (Género Terminalia) I*Naturalist, n.d.)

Bunchosia spp: Genus from the family Malpighiaceae, evergreen small shrubs and trees (2-10 m), opposite, elliptical leaves, flowers are yellow, arranged in racemes or panicles, fruits are ovoid red to yellow drupes, edible and ornamental. (*Bunchosia Argentea (Jacq.) DC.*,GBIF n.d.)

Cassia Fistula: Species of the Fabaceae family,
Ornamental, native to India, introduced to the Americas. Pinnately compound leaves Its flowers are yellow and grow in long racemes. (*Caña Fístula (Cassia Fistula) INaturalist* , n.d.).
Other plants from the genus Tabebuia may also be found near T. Rosea.

1.6.2 Interactions

1.6.2.1 Root system



Root system of pink trumpet [Tabebuia rosea (Bertol.)] harvested six months after planting on three treatments in both soils. The root systems located at left side, represent the trees planted on sandy clay loam, and the root systems located at right side, represent clay soil: (a) control, (b) three layers (D b ≈ 1.15 g/cm 3), and (c) seven layers (D b = 1.4 g/cm 3).

Figure 5: Soil compaction effects on the establishment of tropical tree species -(Scientific Figure on ResearchGate)

While resisting multiple types of soil, it shouldn't be too compacted in order for the roots to grow optimally.

In agroforestry systems, the root system of *T.rosea* reproduces most effectively below 100 cm (*Padovan et al,2015)* . Its root architecture is characterized by long root internodes and a high proportion of biomass allocated into the taproot; this is a strategy for deeper soil stability and long-term resource acquisition. (Coll et al. 2008)

1.6.2.2 pests and diseases

Pests

Nematodes

Nematodes or roundworms consume seedlings and seeds of *T.rosea. T.rosea* is particularly susceptible to nematodes like Meloidogyne incognita, which cause yellowing and drying of the seedlings and the reduction of the root system causing losses in the developmental quality of vegetal material. Dihydro Methyl 7-benzofuran methylcarbamate, at a dose of 3 g per fifteen-month-old seedling, is employed to control this pest (CONIF, 1996).

Beetles and Weevils

Additionally, the seeds can be affected by beetles (*Bruchidae sp*.) and weevils (*Amblycerus sp.*) (Gómez, Toro & Piedrahita, 2013; Trujillo, 2013). These do not represent a danger for T. rosea, however their permanence in the nursery stage delays development. It can be controlled with a contact insecticide with low toxicity, such as: emulsifying paraffin oil or phosphorothioic acid - diazinon; Larvae can be collected manually. Adults could be evaluated and controlled using light traps. Some biological controllers have been found, including *Apanteles sp*., which in some laboratory tests has controlled up to 5% of the larvae.

Leaf Borers and Leaf Gluers

Leaf borers (*Walterianella sp.* and *Omophoita sp.*) (Coleoptera: *Chrysomelidae*). And Leaf gluer. (*Eulepte gastralis (Guenée)) (Lepidoptera – Crambidae)* have also been found in *T.rosea.* Trichogramma pretiosum, which synchronized with the oviposition peaks show a good control of this insect.

E. gastralis

Applications of *Bacillus thuringiensis* can be of great help in regulating *E. gastralis* populations. The galleries are kept clean because the larvae accumulate their excrement and feeding residues at the entrance of the same, which facilitates the location of the larvae in the field and their possible control. A solution containing Bacillus thuringiensis, Beauveria bassiana or a (selective) insecticide can be placed in these holes using a syringe.

Species of the hymenoptera order

Anagrus sp. and Gonateocerus sp. species of the Hymenoptera order have been identified as egg parasitoids, as well as controllers of nymphs of the Dryinidae family and predators of adults of the Reduviidae family. As a control, it is advisable to maintain the plantation with shrubby and low-growing species that have a distracting effect. When populations are high, the application of systemic insecticides is necessary. According to Gómez, Toro & Piedrahita (2013), the presence of fungi in the seed produces colour changes, going from pink to dark brown when it has deteriorated. dark when they have already deteriorated; those that attack with greater incidence are *Fusarium sp.; Cladosporium sp.; Nigrospara sp. and Curvularia sp.; and Ascochyta sp. and Phomosis sp.* are reported in lesser proportion.

Rhizoctonia sp and Phoma sp.

In germination periods, "damping off" is reported, caused by Rhizoctonia sp and Phoma sp., whose control is achieved by reducing irrigation, using substrates with a loamy texture, disinfecting the substrate before sowing and applying fungicides to the seeds CONIF (1996a).

Oak rust

Oak rust (Prospodium sp.), has been reported on the Atlantic coast, in nine-year-old oak plantations; the leaves have irregular light green spots, which later revert to prominent black necrotic spots; later, a total drying of the leaf occurs (Trujillo, 2013).

Diseases

Root-knot nematodes

The *Meloidogyne incognita* complex and *M. javanica*. The main difficulty for control lies in identifying the symptoms and signs in the roots and in the soil. Crop rotation is not very effective in the case of Meloidogyne, since its species are polyphagous, while in fallow areas the nematode can die from starvation and heat. Some works have reported a controlling action of organic amendments on nematodes, and the nematicidal potential of some extracts of plants such as marigold, garlic, onion, rue and neem.

Solarization is also effective for nematode control, by harnessing solar energy to increase soil temperature, which has previously been covered with a plastic sheet, until reaching lethal temperatures for many soil pathogens. Once nematodes have established themselves in the roots of guaiacwood seedlings, it is difficult to control them. Applying nematicides directly to the soil has very little effect because the nematodes are encysted in the root nodules of the seedlings and will not be affected by the nematicide. The same effect would be achieved with the use of antagonistic fungi such as Paecilomyces lilacinus, which could reduce the action of the nematodes, but without a very noticeable effect. In this sense, the early inoculation of beneficial organisms, such as arbuscular mycorrhizae, has significantly stimulated the growth of purple flower plants, through the improvement of their nutrition, compensating for the damage caused by the nematodes M. incognita and M. javanica, due to the tolerance acquired by the plants, generated by the symbiotic association.

Stem disease in T.rosea germinators

Fungal contamination is more common in seed lots that are not clean and poor quality seeds produce weak seedlings that are particularly susceptible to the pathogenic fungus. For germinators, it is necessary to use washed river sand as a sowing substrate and build germinators raised from the ground, to avoid contact of the seed and seedlings with the soil and/or organic waste that may contain the fungus (Gaitán, 2003). If plastic containers are used for germination, they must be cleaned for reuse, in order to prevent the fungal inoculum from passing from one crop to the next. A high pH, both in the substrate and in the irrigation water, can favor the disease.

Rust

In the field, the damage is not considered serious, except when it affects sprouts from stumps that will be used for rooting cuttings. The affected material in the nursery must be rejected for planting in the field. When the disease occurs in nurseries or in the sprouting of stumps, alternate spraying with fungicides based on triadimenol and mancozeb should be carried out. As in seedlings older than six months, after removing affected leaves.

2. Biology

2.1 Seed conservation:

Tabebuia Rosea has an orthodox seed which means that for it to be conserved it requires 10% of humidity or less and in low temperatures. The optimal conservation is at 9.8% humidity and -1°C, which according to the Czabator index shows a better germination percentage, and additionally stored in polyethylene. Conserved at room temperature, its seeds are of low longevity and viability. (Piedrahita E. 1987)

2.2 Chromosome Complement

T.Rosea, like most species in the *Tabebuia* alliance have karyotypes (complete set of chromosomes) with a pair of chromosomes with large CMA+/DAPI- telomeric bands, which means that at the regions at the end of the chromosomes (telomeres) the region is rich in guanine and cytosine but have a low content of adenine and thymine (Cordeiro et al., 2019).

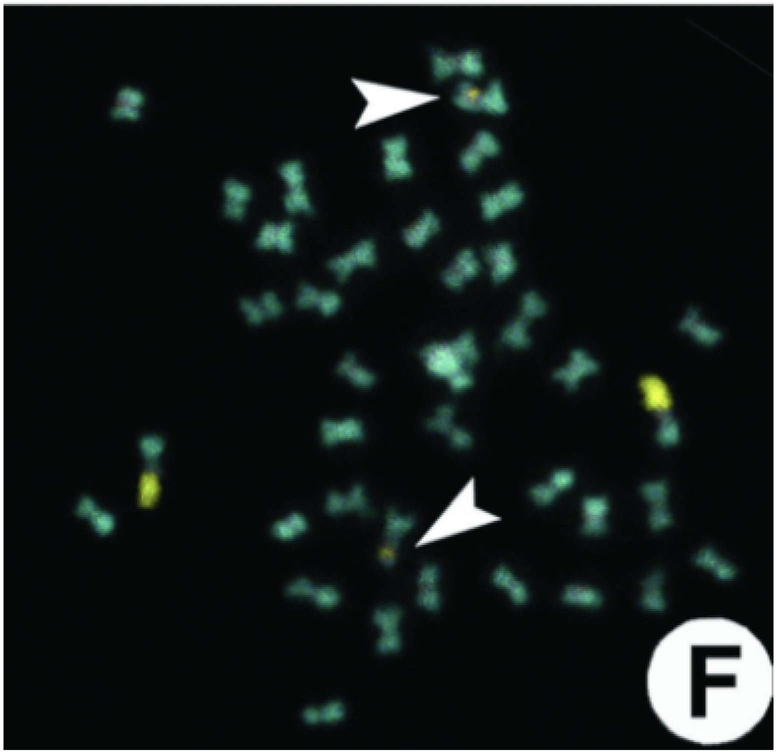


Figure 6: Chromosomes of T.rosea (Cordeiro et al., 2019)

T.Rosea has a diploid genome 2n=20 (Soontornchainaksang & Chaiyasut 1996). n=20 has been historically considered the haploid base number for the *Tabebuia* alliance (Cordeiro et al., 2019)

2.3 Life Cycle and Phenology

Life Cycle

See figure 7 for reference in this section.

The most vegetative growth (c) of *T.rosea* was observed to be correlated with the highest temperatures and precipitation in Costa Rica, however extreme peaks in precipitation are also counterproductive (Gómez, & Fournier, 1996.) Fournier indicates that sprouting in *T.rosea* begins first at lower altitude sites since there is an acceleration of metabolism at higher temperatures (lower altitude). Thus, it can be concluded that vegetative growth in *T. rosea* is restricted by drought.

The fall of leaves of *T.rosea* aligns with the dry season, in Costa Rica, from February to May. Defoliation (d) is a way to minimize transpiration area during drought when hydric levels are critical: there is a negative correlation between defoliation, and precipitation and floor humidity (Gómez, & Fournier, 1996.)

Flowering (b) periods are highly correlated with temperature oscillation between high and medium temperatures. There is a negative correlation between flowering and precipitation. Intense floration occurs after the tree is completely devoid of foliage (a), and provided with ample sunlight. Fructification occurs shortly after floration and follows the same patterns; it can start to occur after 3 years from seed (Gómez, & Fournier, 1996.)

Figure 7 : Life cycle of Tabebuia Rosea, a:Leafless T.rosea, b:flowering, c:vegetative growth, d:defoliation (Pineda-Herrera et.al, 2016)

Phenology

T. rosea has commonly been described as a deciduous and synchronical plan, however in Urrego and Del Valle´s study the T. rosea population studied presented sprouting and leave fall that weren't stationary and relatively asynchronous with a strict pattern. Phenophase presented from 36 to 50% increase in phenophase (life cycle starting events) with high sunlight and low to medium precipitation. Looks like these species lose their deciduousness when they grow in seasonal climates, high atmospheric humidity and specific soil characteristics(Urrego, & Del Valle, 2001.)

2.4.3 Floristic elements

Flowers can be lilac or pink composed of 5 petals each, they are hermaphrodite. Corolla is 5-8 cm long, 4-5 cm wide in average, bell- or funnel-shaped tubular.Flowers in terminal subumbelliform panicles. Pedicel is up to 2 cm long. Calyx is 1-2 cm long, bilabiate and glabrous (*Tabebuia Rosea (Bertol.) DC. | Colombian Plants Made Accessible*, n.d.) (*Tabebuia Rosea (Pink Poui) | CABI Compendium*, n.d.)

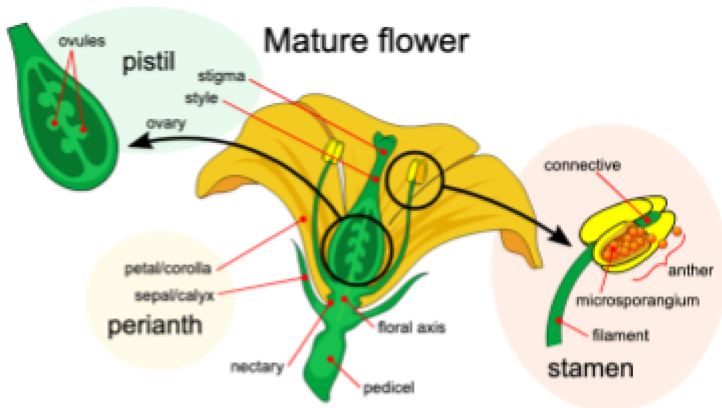


Figure 8: General Flower Morphology Graph

Figure 9: Details of inflorescence
(Granja, Barros, 2001)

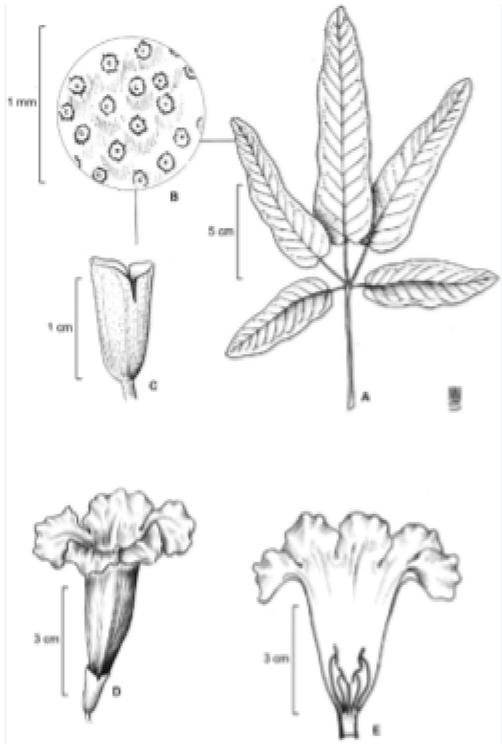


Figure 10: leaf and flower measurements of Tabebuia (Granja, Barros, 2001)

The fruit that emerges is a cylindrical linear capsule, 22-38 cm long, narrow at each end with a rough surface, dehiscent, light green when young and dark green when mature. One fruit contains 240-300 winged seeds. (*Tabebuia Rosea (Pink Poui) | CABI Compendium*, n.d.)

T. rosea requires a distinct dry period in order to flower. Flowering occurs in February-March in Costa Rica, or February-April in Ecuador, and in some regions occurs twice a year and up to four. The leaves are shed just before flowering, resulting in a colorful floral display. The flowers are pollinated by bees, and once the tree is 4 years old fruiting begins. Three months after flowering the fruit matures, at the onset of the wet season. (*Tabebuia Rosea (Pink Poui) | CABI Compendium*, n.d.)

2.4 Reproductive Biology

T.rosea is propagated by seeds (wind dispersed), cuttings, or air layers. Seeds are reported to grow within 3 months (World Agroforestry Center, 2016). Specimens are self incompatible, meaning it doesn't produce fruits when self pollinated (Bawa, 1974).

3 Propagation and Management

3.1 In vitro Propagation

A study was aimed at multiplying and maintaining in vitro plants from seedlings from five *Tabebuia Rosea* and one *Cordia alliodora*. Apical leaf buds were excised from mother plants (MP) and cultured *in vitro* until 1480 plants had been produced from the two species. Monitoring was made evaluating each plant's behaviour during the *in vitro* culture process by calculating the rates of multiplication (RM) and loss (RL).Results of the study reported rapid germination, between 9 and 15 days after the seed was planted. Well developed leaf blades and stem straightness. 300 were selected as MP of tabebuia rosea, these were maintained as explant specimens for 10 months for micropropagation. In *in vitro* multiplication, per MP approximately 5 plants were obtained for the duration of 10 months. The loss in the T.rosea species is minimal, rooting proceeds as normal, plants inferior to 1 cm were lost which was equivalent to 1% of loss in the process of introducing it to a new environment. Invitro propagation might mitigate the effects pests and diseases have over the performance of the propagation of the plants. (Schuler et al., 2005)

3.2 Natural regeneration

A total of 680 *T.rosea* trees were studied at the later stage and showed that within regeneration of the area 20% showed a much higher diameter growth than the general population. This was also due to the region of Uraba in Colombia where the study was conducted in which temperatures are between 26 and 28 C and an average rainfall of 2,500mm. (Schuler et al. UNAL, 2005)
Propagation is done through seeds, these need to be sundried. If untreated the seed remains viable for 12-14 days. They may be stored up to 2 years. Seed behavior is orthodox and the percentage of germination varies from 75 to almost 100 percent. Seeds do not require special treatment. Germination occurs either in shade or direct sunlight, provided humidity is kept stable. Germination is epigeal and seedlings are phanerocotylar. Seed imbibition lasts 24 hours; root emergence occurs 3 to 4 days after sowing. Seeds can be sown under partial shade in beds or plastic bags filled with humid sand or a mixture of soil and sand. Seedling development is fast

and the small seedlings can be transplanted to plastic bags 8 days after sprouting. Outplanting can be done when seedlings are 3 to 5 months old (Flores et al., n.d.)

Figure 11 :Seeds of T.rosea (GreenParadiseLive, n.d.)

Figure 12: Measurement of T.rosea seeds (Coleshill & Gomez)

Environmental conditions discussed in the ecology chapter should be met in order to achieve best results.

3.3 Vegetative propagation

3.3.1 Air layering

To employ this technique, soil mounds are built up around the shoots emerging from coppiced stumps and then the rooted shoots are severed from the stump and planted. This method will result in cloning the parent plant.(Leakey, 2017)

Air layering is usually used in mature branches within the tree crown, usually a long way from the ground. In some cases, a ring of bark is removed to promote the accumulation of photosynthates. Then the exposed cambium is typically treated with an auxin rooting powder to promote rooting. It is then wrapped in black polythene enclosing damp compost, peat, or other rooting medium and left for some weeks or months to form roots. This treated part of the branch should be close to the main stem. Once rooted the branch is severely pruned and detached from the tree. (Leakey, 2017)

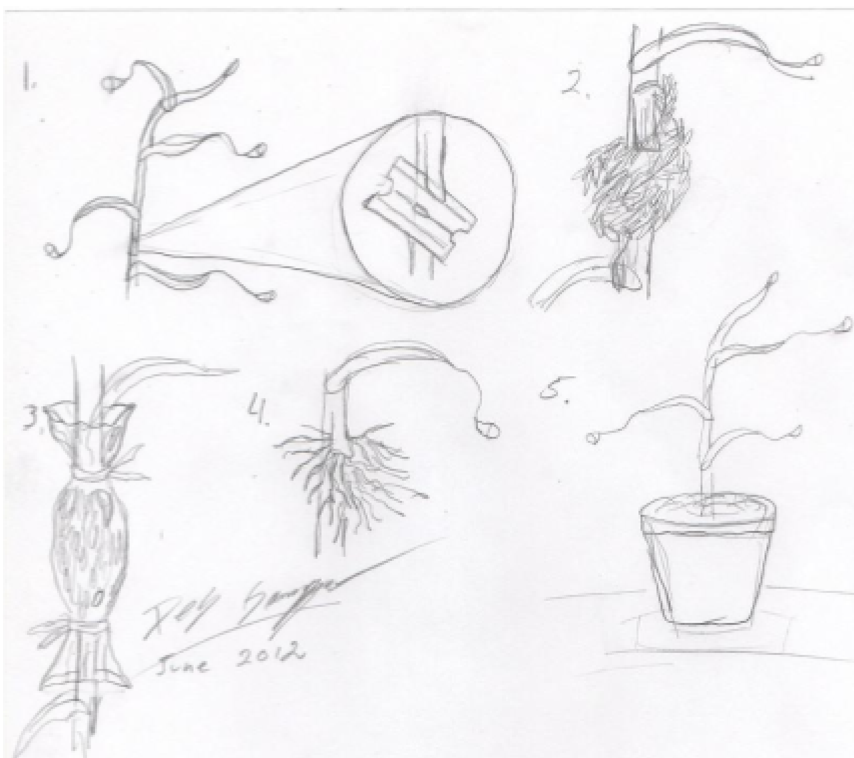


Figure 13: graphic instructions on air layering (Terraforums, 2012)

Figure 14: Air layering (iStock 2021)

3.3.2 Cuttings

Cuttings involve rooting a severed part of the parent plant. To ensure this method takes, the medium (or soil in which the plant is gonna be planted in) must be of good quality. The medium should be porous for root aeration and drainage, and oxygenation, it must also be capable of water and nutrient retention. To form a new root system, the medium must have a ready moisture supply at the cut surface. Most commercially prepared mixes are termed artificial (contain no natural soil) but they tend to meet these requirements. Usually the mix is composed of sphagnum peat moss and vermiculite, both of which are generally free of diseases, weed seeds, and insects (sterile). Cuttings are susceptible to fungi and bacteria and thus why it's important to meet these conditions. The media should be low on fertilizer, or use slow release fertilizers as too much will damage or inhibit new roots.A mix of 50% peat moss and 50% perlite favors good aeration. An equal mix of peat moss, vermiculite, and perlite is also good and favors moisture retention.
Cut at least one node from distance from the main stem. (Virginia state univeristity et al., 2019)

Figure 13: Healthy vs necrosis in tabebuia rosea flooded roots (Oliveira et. al)

3.4 Planting

Tabebuia trees should be planted in a sunny and well drained area, if the place has stations usually early spring is recommended for the tree. Due to their size, they should be planted with 5-10 meters of distance from each other, this spacing can also depend on the type of usage the tree is intended for. Planting from seeds, these should be collected from a dried pod and kept moist before planting. (EarthOne, 2025)

The seeds germinate within 2-3 weeks without any treatment. However, to improve and homogenize germination it is recommended to steep the seed in pure water for 12 hours (CONIF, 1996). Using a light substratum that can be disinfected to control nematodes can encourage successful germination and good root development. Shade is also recommended during germination. Seedlings reach a size suitable for planting out after 1-3 months. Once planted out it is necessary to eliminate weeds, and clear the area 2 or 3 times in the first year.

3.5 Management

3.5.1 Tending

T.rosea is considered a low maintenance tree, pruning is necessary to maintain the desired shape of the tree and for health reasons. Pruning should be done during the dormant season of the plant (non flowering) removing dead or diseased branches. (EarthOne, 2025)

3.5.3 Pest and disease control

See section pest and disease control for further information about the species affecting the plant, here control will be discussed:

3.5.3.1 Pests

Nematodes:
Most reliable control is preventive because of the size of nematodes, sanitation can also be used. Reducing existing infestation can be done through soil solarization, however this method only reduces nematodes primarily in the top of the soil (aprox. 30cm, which reduces their effectiveness in the frame of a year. This method is useful for helping young plants establish a new floor. During the cooler times of the season nematodes are less active. Irrigation and soil amendment should make the plant more resistant to nematodes.

Leafminers (hymenoptera and borers):
In order to control leafminers monitoring the plantation is crucial to identify infestation in the first stages. Pesticides can be used 2-3 times throughout the season to eliminate these insects, however other organical solutions include the usage of sticky traps which trap adult specimens before they lay eggs that can damage foliage, if eggs are spotted these should be removed physically as soon as possible.
Plant trap crops are used to attract leafminers such as Chenopodium album and Abutilon theophrasti, leafminers prefer these species over most, directing them away from the crop desired to be protected. *Dilgyphus isaea* can be introduced to the environment as it is a species of wasp

that parasites leafminer larvae, killing them before they can mature. Best results are achieved when releases of *D. isaea* are made early in the season before leafminer populations reach maturity or have grown into large numbers. *Organic Control of Leafminers | Beneficials & Insecticides*. (n.d.).

3.5.3.2 Diseases

Stem disease and root rot: Usually hard to control once symptoms are observed, continue watering and apply a recommended fungicide, allowing the soil to dry completely after next irrigation. Other options are adding beneficial fungi like Coniothyrium minitans and sterilizing tools in order to prevent spreading. (Texas Plant Disease Handbook, nd.)

4. Uses

Uses

Ornamental

Borchert & Tomlinson (1984) describe in their paper the complex structure of *Tabebuia rosea* consisting of three distinct geometric patterns in its crown.

> "Sympodial branching begins with the arrest of the terminal bud of the trunk and symmetric outgrowth of a pair of subtending lateral buds. During an intermediate phase, branching becomes asymmetric at about Order 5. At each sympodial bifurcation there is differentiation between vigorous, relatively straight main branches (leaders) and less vigorous laterals forming regular pseudomonopodial branch complexes, which collectively constitute the cup‑shaped crown. Finally, dormant lateral buds in the lowest bifurcation of the trunk are released and reiterate the original crown form. Ultimately an erect, apparently monopodial tree is formed by a set of superimposed cup‑shaped crowns"

In which mainly its vertical growth and monopodial structure aid it to remain growing vertically instead of spreading excessively at low heights minimizing interference with dense urban areas. Also the structure of the crown allows for balanced shadow and sunlight that will allow other plants to grow near it.

*T. Rosea'*s visual appeal has been of great importance and the main reason the tree is cultivated. Its strikingly beautiful pink flowers that unlike other species can bloom multiple times a year. This tree is also valued for the possibility of creating bonsais.

Agroforestry

A study in Nicaragua found that *T.rosea* used as shade for coffee plantation in non-optimal conditions aids the production of nutrients and the overall soil health. Compared to other species *T.rosea* aids the efficient use of resources through root zone reparation (process of rehabilitating the zone in which the roots of a plant absorb water, air and nutrients, through restoration) particularly in relation to Tapeltate (type of soil in the andean region). The region where roots prefer to grow create a stratification system where coffee roots grow on the upper 0-80 cm and *T.rosea* below 100 cm, facilitating functional complementarity, less competition of resources in the same area thus making them more effective (*Padovan et al,2015).*

Wood

T.rosea wood is occasionally used in carpentry. Its characteristics are: a dry scentless wood, freshly cut it is light brown with pink undertones, the heartwood is deep brown. Its fibre is slightly crossed in straight lines. Its main attractiveness is its feathery veiny texture on the tangential faces defined by overlapping arches. (*Holystone Group*, *Tabebuia Rosea – Roble* – n.d.)

Figure 14: Sample wood pattern of T.rosea (Holystone group)

Medicinal

Research has explored the possibility of using *T.rosea* seed extract in green synthesis of silver nanoparticles (AgNPs), AgNPs synthesized this way exhibited antibacterial, antioxidant and cytotoxic properties. These showed potential in nanomedicine with laboratory results against bacterial strains and human fibroblast cells. (Muruganandham et al., 2023)

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