

Avicennia germinans (L.) L.

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VERBENACEAE (VERBENA FAMILY)

Avicennia nitida Jacq.

Mangle de sal, mangle negro, mangle prieto, mangle puyequé, mangle salado
(Centro Agronómico Tropical de Investigación y Enseñanza 1984a, 1984b;
Markley and others 1992; Pennington and Sarukhan 1968)

This family has only one genus, *Avicennia*, which includes 11 species of trees and shrubs characteristic of mangrove forests. The genus is distributed in the wetlands of tropical and subtropical regions of Central and South America. It grows on both coasts, from Florida and the minor Antilles, through Mexico and Central America, to the coasts of Brazil and Peru, including the Galápagos Islands and other tropical and subtropical islands in America (Gentry 1993, Moldenke 1973). Species in the genus associate with *Rhizophora mangle* L., *Conocarpus erectus* L., and *Laguncularia racemosa* (L.) C.F. Gaertn. (Pennington and Sarukhan 1968, Salas 1993).

Avicennia germinans is an evergreen tree that averages 14 to 15 m in height; some trees may reach 20 m in height and 40 cm d.b.h. The trees are easy to distinguish because they have opposite decussate leaves growing on young, square, rising branches with leaf scars; they have ring-shaped joints or swollen nodes (Pennington and Sarukhan 1968) that are simple, grayish green, and opaque on the back side; the petioles form a hollow structure at the base, leaving a line similar to a stipule scar (Gentry 1993); and both surfaces of the leaves frequently show abundant salt crystals. The thick bark is gray, with a slightly salty taste (Salas 1993). The small crown is rounded (Pennington and Sarukhan 1968).

Avicennia germinans is a marine halophyte species (Bálsamo and Thomson 1995) and is physiologically adapted to grow in soils flooded with seawater. The trees can grow and develop in flooded soils with scarce dissolved gases because they have a great number of verticillate, erect pneumatophores. These spongy roots develop from the subterranean roots and push through the mud toward the surface. They absorb oxygen from the atmosphere, passing it on to the radicle system (Centro Agronómico Tropical de Investigación y Enseñanza 1984a, 1984b; McKee and others 1988). In the Caribbean

region, *A. germinans* typically is located inland, in mangrove swamp areas away from the coast; apparently the species can provide differing levels of oxygenation to the anaerobic substratum. McKee and others (1988) report low concentrations of sulphur in areas where the density of aerial roots is higher.

There are no known industrial uses for the wood of *A. germinans*, but where it grows it is used locally for poles in rural construction and for charcoal. The perfect, fragrant flowers remain open for several days and produce plenty of nectar, with which bees make excellent honey (Tomlinson 1980).

The tree flowers from May through July. The flowers are dense, gathered in terminal or lateral panicles; erect, in peduncles with four angles; zygomorphic, with a white corolla, yellow in color at the base; the five-lobed calyx contains three small bracts; white corolla, yellowish at the base. The fruits are two-valved flattened capsules, with a persistent calyx; they contain a big, ovoid, flattened seed, covered with silky yellowish hairs. The embryos of the seeds frequently germinate while the fruit is attached to the tree, causing its dehiscence (Pennington and Sarukhan 1968, Salas 1993). When the fruits fall, their walls open almost immediately, showing a plantule which consists of two folded cotyledons enclosing a thick radicle covered with dense radical hairs; its growth is fast and it adapts well to saline habitats (Tomlinson 1980). The production of plantules is high in September and October.

The fleshy green seed capsule germinates on the tree before falling and can survive floating in seawater for over 4 months, longer in fresh water. Seedlings tolerate some salinity but not more than that of seawater; they must be exposed at low tide for early development. Water temperatures over 40 °C are lethal to young seedlings. The seeds sprout and grow when placed on edge in moist, soft media. The tree sends up strong new sprouts from cut stumps. Both transplanted trees and

planted seedlings benefit from a high-nitrogen fertilizer and a mulch of seagrass. Under good growing conditions, young trees may add 60 cm in height per year (Nellis 1994).

ADDITIONAL INFORMATION

Unlike *Rhizophora*, *A. germinans* does not colonize open habitats above the high tide line. The species can grow in fresh water and does not require salt, but it tolerates high salt concentrations (Tomlinson 1980). The plantules tolerate salt con-

centrations equal to or lower than salt water, but not high salinity. The excess is exuded through microscopic glands in the leaves, giving them a salty taste. Generally, the morning exudate of salt dehydrates during the day, and salt crystals accumulate on the surface of the leaf. The concentration of salt during the rainy season can decrease to less than half that of salt water, while during the dry season it can increase to more than double that of salt water. The hypodermis may be where the salt is accumulated and stored. (Smith and others, cited by Bálamo and Thomson 1995).

