

# *Guajacum sanctum* L.

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## ZYGOPHYLLACEAE (CALTROP FAMILY)

*Guajacum sanctum* (orthographical variation, Missouri Botanical Garden 1999)

Bastard lignum-vitae, guayacán real, palo santo (Chudnoff 1984, Holdridge and Poveda 1975, Record and Hess 1949)

*Guajacum sanctum* ranges from southern Florida, eastern Mexico through the West Indies, along the west coast of Central America, to northern South America (Burger 1991, Chudnoff 1984, Holdridge and Poveda 1975, Jiménez 1993, Longwood 1962, Record and Hess 1949, Standley and Steyermark 1946). *Guajacum sanctum* is a heliophyte, generally a canopy species that grows well in open areas. In Costa Rica, the species grows in association with other tree species, among them: *Astronium graveolens* Jacq., *Tabebuia ochracea*, *Sideroxylon capiri* (Jiménez 1993). In Nicaragua it is associated with *Phyllostylon brasiliense* Capan. ex Benth. and Hook f., *Haematoxylum brasiletto* H. Karst., and *Caesalpinia coriaria* (Jacq.) Willd. in very hot, dry areas (Salas 1993).

*Guajacum sanctum* is a slow-growing, small to medium tree that reaches 4 to 25 m in height and up to 60 cm d.b.h. The crown is dense and round, sometimes with distally descendent branches. The external bark is grayish and rugose with longitudinal fissures, and it sometimes exfoliates in plates. The internal bark is light brown and slightly bitter (Holdridge and Poveda 1975, Jiménez 1993, Salas 1993). The leaves are opposite, paripinnate, 3 to 9 cm long with two to six pairs of leaflets; the petiole is 3 to 8 mm long, and the petiole and rachis are up to 5 cm long. The rachis is minutely puberulent or glabrescent and deeply sulcate above. The stipules are 2 to 4 mm long, triangular and acute, appressed, puberulent distally, thick, and persisting. Leaflets are opposite, elliptic, and narrowly oblong to oblong-ovate; the middle leaflets are the longest in each leaf and are bluntly obtuse or rounded to acute at the apex. Leaflets are broad, asymmetric, sessile or subsessile, and unequal on the thick petiolule; leaflets are entire, glabrous, 2 to 3.5 cm long, and 1 to 1.5 cm wide (Burger 1991, Holdridge and Poveda 1975, Jiménez 1993, Salas 1993).

The tree is largely confined to dry, exposed sites, where

it is often the predominant species and where the soil is very dry at least part of the year. It grows well in shallow soils, particularly in limestone areas, well-drained low areas, low foothills subject to hot dry winds, and rocky limestone regions (Longwood 1962). *Guajacum sanctum* grows at elevations of 10 to 200 m in Costa Rica and up to 700 m in Nicaragua. It is limited to lowland, deciduous, dry tropical forest formations with annual rainfall under 1500 mm and a range of temperatures of 28 to 35 °C.

The heartwood is a dark greenish brown to almost black and is readily distinguished from the narrow, pale yellow or cream-colored sapwood. The heartwood becomes even darker after exposure to air and light. The wood is very fine and uniform in texture with a heavily interlocked grain. It is oily due to a resin content (guaiac content) that constitutes about one-fourth of the dry weight. A slight scent is evident when the wood is warmed or rubbed. Color changes or a fine ripple marking from the interlocked irregular grain occasionally figures it (Longwood 1962).

The wood is extremely hard and heavy. The specific gravity (oven-dry weight/green volume) varies from 1.05 to 1.24. Oven-dry wood has a specific gravity of 1.2 to 1.36. The wood is difficult to dry, and considerable care is required to avoid shakes and end splits. The wood is very difficult to work with hand or machine tools, and a cutting angle of 15° or less is suggested in planing. The wood turns and shapes well and takes a high polish. Because of oily resins, it requires special surface treatments for satisfactory gluing. The heartwood is very resistant to attack by decay fungi, termites, and marine borers. The timber does not require preservation due to its high guaiac resin content and high wood density. The wood is used in bearings, bushing blocks, pulley sheaves, mallet heads, and turnery. Its most noted use is in bearings and bushing

blocks for propeller shafts of ships because of its self-lubrication and hardness (Chudnoff 1984, Herrera and Morales 1993, Longwood 1962, Record and Hess 1949). The tree is a source of resins, particularly from the wood and bark, which have guaiacic and benzoic acid. The resins obtained from wood, bark, leaves, and flowers are also used in some pharmaceutical preparations (Herrera and Morales 1993, Salas 1993). However, according to Decree 25700-MINAE, from the Ministry of the Environment of Costa Rica, logging *Guajacum sanctum* is forbidden (Ministerio del Ambiente y Energía 1997).

Flowering occurs during the dry season from February through May and a second flush occurs in November. The tree begins to flower after 6 to 8 years. The inflorescences are fascicles of four to eight flowers at distal nodes with peduncles sparsely and minutely puberulent. The flowers have five petals that are bright blue, broadly obovate, clawed at the base, 8 to 10 mm long, and 6 to 8 mm wide. A disc is usually present, often with extra or intrastaminal glands. The androecium has 10 free stamens, each 6 mm long; the outer stamens are opposite the sepals; anthers are bithecous and dehisce introrsely with longitudinal splits. The pistil is about 10 mm long and solitary, with four to five united carpels, a short stipe, and a slender style; the ovary is obovoid. Fruits have been observed in March, April, June, July, and October (Burger 1991, Holdridge and Poveda 1975, Jiménez 1993). The fruit is a two- to five-lobed or ridged obovoid capsule 14 to 16 mm long and 12 to 18 mm wide. The fruit is fleshy or moist at maturity but

dries to a yellowish and lustrous hard surface. The seeds are ellipsoid, about 1 mm long, and brown to black with a red aril (Burger 1991, Holdridge and Poveda 1975, Jiménez 1993, Salas 1993).

Fruits must be collected from the soil very early in the morning to avoid seed predation by rodents. The fruits are placed on the floor and dried for 7 days in the shade; later the fruit pericarp is removed with running water to extract the seeds. The seeds are then dried in the shade and stored in hermetic containers. Seeds average 20,000 per kg.

Fresh seeds have 40 to 60 percent germination in nurseries. Seeds can be stored for 1 month at 5 to 8 °C. They lose viability in less than 1 month if stored at ambient temperature and humidity. Seeds can be immersed in running water (at 20 °C) for 24 hours before sowing. Germination is epigeal, and the seedling is phanerocotylar. Germination begins 6 to 8 days after sowing and ends in 16 to 20 days.

Seeds are planted at a depth of 1 cm in germination boxes filled with sand; when they are 6 cm tall, they are transferred to nursery bags. Seedlings are ready for outplanting 1 year after sowing, when they reach 30 to 40 cm in height. Like *Guajacum officinale*, the primary problem at the nursery is leaf-eating insects: *Kricogonia castalia* (Fabr.), *Iridopsis* sp. and *Gnorimoschema* sp. (Timyam 1996). Regeneration is very good within the forest, with hundreds of seedlings and saplings; however, very few of them manage to survive to maturity (Jiménez 1993).

