Pouteria multiflora (A. DC.) Eyma — Jácana, Bully-tree

Sapotaceae — Sapodilla family

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Pouteria multiflora (A. DC.) Eyma, commonly known as jácana and bully-tree, as well as by several other local names, is a medium-sized to large evergreen tree with a spreading crown of large, elliptic leaves, and fissured, slightly rough, brown bark (fig. 1). Native to the Greater and Lesser Antilles, jácana is sometimes planted for its edible fruits. Its wood is used principally for construction, furniture, and posts.

HABITAT

Native Range

Jácana is native to Jamaica, Hispaniola, Puerto Rico, throughout the Lesser Antilles, and Trinidad and Tobago between latitudes 10° and 20° N. *(10)* (fig. 2). Jácana, like other large-seeded fruit species, was probably introduced to many of these islands by pre-Columbian native Americans. In Puerto Rico, it grows in advanced secondary moist and wet forests and on abandoned farmlands. In Port of Spain, Trinidad, it is cultivated in home gardens for its edible fruit *(14)*.

Climate

Jácana is mostly confined to moist and wet forests where the mean annual precipitation ranges from 1400 to 3000 mm. In upland habitats of its native range, rainfall is fairly evenly distributed throughout the year, whereas in lower montane and coastal areas, there may be a pronounced dry season lasting 2 to 4 months. Mean monthly temperatures vary from 22 °C in January to 27 °C in July in the Greater and Lesser Antilles. Frosts do not occur within the native range of jácana.

Soils and Topography

Jácana most commonly grows on soils derived from limestone and igneous rocks. On sites where it occurs, the most common soil texture is clay, although other textures, including sandy loams, also provide good habitat. Soil pH ranges from 4.5 to 7.0. In Puerto Rico, the species grows on moist coastal and lower montane sites up to a 770-m elevation *(10, 13)*. Jácana growth does not appear to be greatly affected by slope position. In 6- to 8-year-old plantations established in the Toro Negro Forest in Puerto Rico, average annual stem-diameter increments were nearly identical for trees in slope, ridge, and valley positions; height growth was slightly greater for trees found in valleys than on slopes or ridges *(12)*. In Jamaica, jácana occurs naturally in woodlands on limestone-derived soils *(1)*. In Dominica, jácana grows on montane slopes at elevations of between 280 and 430 m *(3)*. In Martinique and Guadeloupe, it is found at 300- to 700-m elevations *(7)*.

Figure 1. — *Jácana* (Pouteria multiflora) *growing in the Luquillo Experimental Forest, Puerto Rico.*

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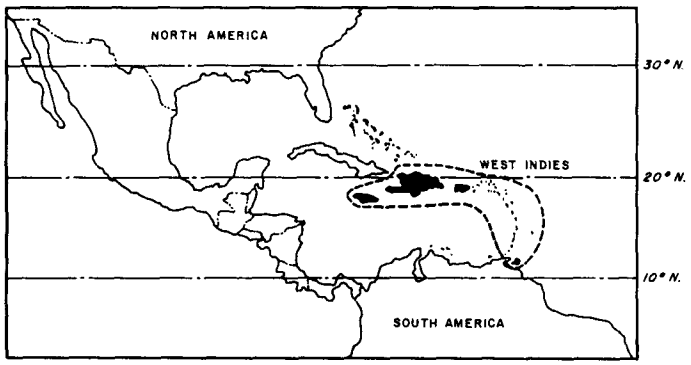

Figure 2. — *Shaded area represents native range of jácana* (Pouteria multiflora).

Jácana growth was poor in Puerto Rican plantations established during the 1930's on serpentine soils and on eroded, rocky, drought-prone acidic clays. On degraded sites, trees tend to be stunted and chlorotic *(12)*[1].

Associated Forest Cover

In Puerto Rico, jácana is found in mature moist and wet secondary forests and abandoned farm sites. In old (50 to 55 years) plantation stands in the Luquillo Experimental Forest, jácana grows in association with *Casearia* spp., *Cordia sulcata* DC., *Didymopanax morototoni* (Aubl.) Decne. & Planch., *Guarea guidonia* (L.) Sleumer, *Inga fagifolia* (L.) Willd., *Petitia domingensis* Jacq., *Prestoea montana* (R. Grah.) Nichols., *Swietenia macrophylla* King, *Syzygium jambos* (L.) Alst., and *Tabebuia heterophylla* (DC.) Britton (authors, personal observation).

Jácana occurs at low-population densities, usually in a suppressed position, in lower montane rain forests dominated by *Dacryodes excelsa* Vahl and *Sloanea* spp. in St. Kitts, St. Vincent, Dominica, and Grenada *(3)*.

In Trinidad, jácana is rare and limited to the northern montane forests, where it occurs as a subdominant or understory species *(14)*.

LIFE HISTORY

Reproduction and Early Growth

Flowering and Fruiting.—Jácana begins to flower when trees have well-developed crowns, which is usually between 20 and 30 years. Flowering phenology varies considerably within the species' native range and is probably influenced by rainfall seasonality. In Puerto Rico, flowering occurs throughout the year, although individual trees flower only seasonally. In Guadeloupe and Martinique, flowering occurs between October and January and again between June and July *(7)*.

The flowers are borne in small clusters on minutely hairy green stalks about 1 cm long. Individual flowers consist of four broad, rounded, green sepals approximately 6 mm long; a six-lobed tubular corolla 10 mm long and 6 mm broad, white to pink in color; six stamens and six stamenodes; and a pistil with a brown, hairy four- or five-celled ovary and stout style 6 mm long *(10)*. Insects appear to be the primary pollinating agents.

Jácana fruits are orange-yellow, smooth, ovoid berries up to 5 cm long and 3 cm wide with an edible yellow or orange pulp and a hard, brown, ovoid seed approximately 2.2 to 6.4 cm long and 1.3 cm wide (fig. 3) *(10, 14)*. Although the fruits typically contain a single seed, multiple-seeded fruits are common in Puerto Rico.[1] The average fresh weight for a sample of 416 fruits from Puerto Rico was 68 g.[1] The fruits mature throughout the year in Puerto Rico *(10)*, while in drier locales in the West Indies, such as Trinidad, the fruits ripen in February during the early part of the dry season *(14)*.

Seed Production and Dissemination.—Jácana seed weights are highly variable and appear to be inversely related to the number of seeds per fruit. A sample of fresh seeds from fruits containing an average of 2.0 seeds each had an average weight of 12.0 g,[1] whereas a sample of 69

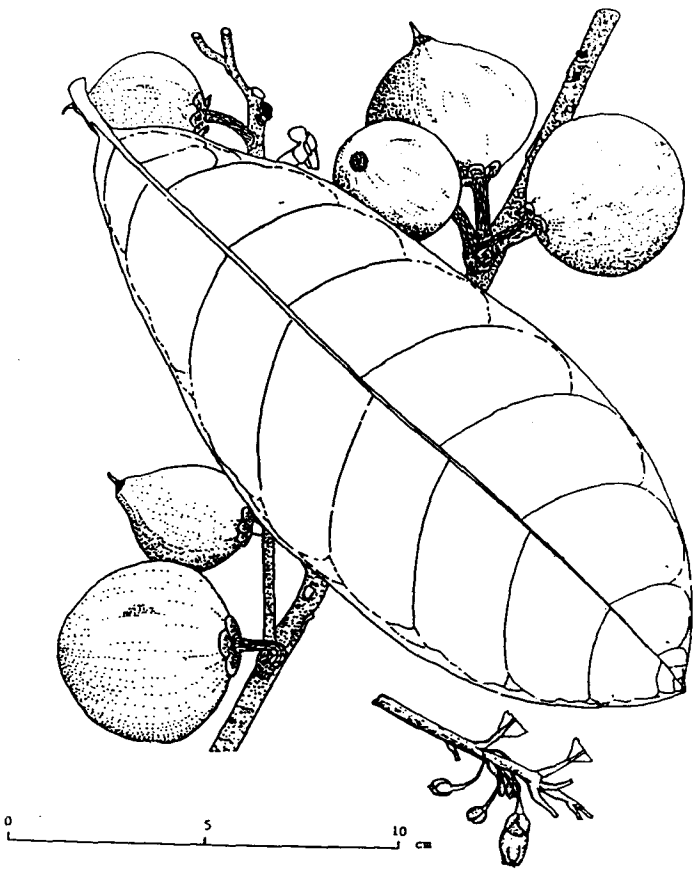

Figure 3. — *Foliage and fruit of jácana* (Pouteria multiflora) (10).

[1]U.S. Department of Agriculture, Forest Service, International Institute of Tropical Forestry. [n.d.]. Unpublished field data on *Pouteria multiflora* (A. DC.) Eyma. On file with: International Institute of Tropical Forestry, U.S. Department of Agriculture, Forest Service, Río Piedras, PR 00928-2500.

seeds from predominantly single-seeded fruits had an average weight of 23.2 g (authors, personal observation). Therefore, depending on seed source, there may be between 40 and 85 seeds per kilogram. A large tree may produce 200 to 300 fruits each year. The seeds are recalcitrant; i.e., they cannot withstand drying. Although seeds are dispersed limited distances by gravity, the primary carriers for long-distance transport of seeds are humans and, to a lesser extent, frugiverous birds, bats, and, possibly, rats and cattle.

Seedling Development.—Germination in jácana is hypogeal and occurs between 3 and 10 weeks after sowing. Germination percentages are usually high for fresh seeds, ranging from 50 to 100 percent[1] (authors, personal observation). Jácana seeds lose their viability very quickly in storage at room temperature, generally within 1 month after collection.[1] The production of multiple leaders is common in jácana and was noted in nursery tests in Puerto Rico in approximately 20 percent of seedlings soon after germination (authors, personal observation).

In nursery tests conducted in Puerto Rico in the 1940's, germination percentages did not differ between seeds sown under full sunlight and under shade. Seedling-height growth was slightly better under shade than in full sun, although seedings grown in full sun were more woody and had better diameter growth. Average seedling heights for the shade-grown seedlings were 18.2, 19.6, 33.1, and 51.0 cm at 1, 2, 4, and 6 months, respectively, after sowing. The corresponding heights for unshaded seedlings were 14.8, 15.9, 22.2, and 39.4 cm.[1] In recent nursery tests under shaded conditions, mean seedling heights of 28.5 ± 2.6 (SE) cm and 41.2 ± 5.8 (SE) cm were recorded at 9 and 15 weeks after sowing in a commercial potting mix (authors, personal observation). Seedlings reach plantable size, which is 40 cm in height, approximately 5 months after sowing.

Plantations can be established using potted seedlings or by direct seeding. Both techniques have been used successfully in the national and state forests of Puerto Rico *(15, 16, 17)*. Between 1 and 3 years after planting at numerous sites, mean survival percentages and average seedling heights were not significantly different in plantations established by the two methods. Seedling survival and seedling height averaged 60 percent and 28 cm 1 year after planting, and 56 percent and 35 cm 3 years after planting. Good survival has been reported in plantation trials established using transplanted seedings (wildings) on favorable sites *(12)*.

The natural regeneration of jácana is abundant beneath parent trees in Puerto Rico, although only rare individuals survive long enough to grow beyond the sapling stage.

Vegetative Reproduction.—While jácana coppices well after cutting, it is difficult to propagate vegetatively. Stem cuttings that were approximately 40 cm long from 1-m tall seedlings collected in the field (forest understory) were tested for their rooting capacity in nursery tests at the International Institute of Tropical Forestry. This experiment included cuttings with and without leaves, half of which were treated with a rooting powder containing Indole-3-butyric acid (IBA) and 1-Naphthaleneacetamide (NAA). A group of 25 cuttings comprised each of the 4 treatments. The cuttings were set at a 45° angle in shaded nursery beds for a period of 8 months. Although one-third of the cuttings in all treatments were alive at the end of the experimental period, the only cuttings that rooted were those without leaves that had been treated with the rooting powder. With this treatment, 20 percent of the cuttings rooted. The use of misting and bed-heating equipment would probably improve success.

Sapling and Pole State to Maturity

Growth and Yield.—Mature trees usually attain heights of between 12 and 28 m with diameters at breast height (d.b.h.'s) of 60 to 90 cm *(19)*. The largest jácana measured in Puerto Rico was 25.8 m tall with a d.b.h. of 1.4 m.[2]

On favorable sites, 5-year-old trees attain heights of 3 to 6 m and d.b.h.'s of 2.5 to 5.0 cm *(12)*. In Puerto Rico, better growth was reported in the Luquillo Mountains than in the Cordillera Central (Toro Negro). In the latter forest, the average annual diameter and height increments in 6- to 8-year-old plantation stands were 0.45 cm and 0.27 m, respectively *(12)*. In two 50- to 55-year-old plantation stands surveyed in the Luquillo Experimental Forest, mean d.b.h.'s and heights were 29 ± 3 and 18 ± 3 cm and 12 ± 1 and 11 ± 1 m, respectively. The mean d.b.h. and height in a 43-year-old plantation stand established on a degraded site in St. Just were 16 ± 1 cm and 12 ± 1 m (authors, personal observation). Thus, for these older plantations, the mean annual d.b.h. and height increments ranged from 0.34 to 0.55 cm and 0.21 to 0.28 m, respectively.

Jácana was the 47th most important tree (in terms of total basal area of 173 species sampled) in an inventory of Puerto Rican secondary forests taken in 1980 *(4)*. Approximately 8,200 m^2 of basal area, or 0.52 percent of the total, was estimated for jácana in these secondary forests, most of it in the intermediate (20 to 40 cm) diameter classes. In St. Vincent, jácana was the 17th most important tree (of 39 species recorded) in a survey of young secondary forests taken in 1984. Jácana comprised 2.1 percent of the total basal area; 93 percent of the trees measured were saplings with d.b.h.'s of between 2.5 and 12.5 cm *(5)*.

In two 10-m radius plots located in 50- to 55-year-old plantations in the Luquillo Experimental Forest, jácana had a total basal area of 15.5 and 21.1 m^2 per hectare, or 38.5 and 34.3 percent of the total stand basal area (authors, personal observation).

Rooting Habit.—Seedlings produce strong taproots with numerous laterals. Older trees are both deeply and extensively rooted. Large laterals often protrude above the soil surface on clayey sites. A small buttress is evident on older trees.

Reaction to Competition.—Jácana is shade tolerant. Seedlings can survive 10 to 20 years in the understory. If a small opening or thin spot in the canopy develops, the stronger seedlings will grow into saplings and small trees. If the forest canopy then remains thin or a gap develops, they proceed to intermediate or codominant crown positions

[2]Francis, John K.; Alemañy, Salvador; Parrotta, John A. 1992. The champion trees of Puerto Rico. Unpublished manuscript. On file with: Institute of Tropical Forestry, U.S. Department of Agriculture, Forest Service, Río Piedras, PR 00928-2500. 13 p.

where they can produce seed and reproduce. Growth is probably not fast enough for jácana seedlings to occupy large canopy gaps before faster growing, shade-intolerant species dominate such sites.

Rapid and vigorous early growth has been observed in plantations established under shaded conditions as in the understory of secondary forest stands *(12)*. Excellent growth and tree form have been reported for trees in 6-year-old plantations established under shelterwood in Puerto Rico *(13)*. Plants established by direct seeding and nursery-grown seedlings both withstand weed competition fairly well *(12)*. Young, open-grown trees tend to develop open crowns and are susceptible to windthrow *(12)*.

Damaging Agents.—In Puerto Rico, damage by the termite *Nasutitermes costalis* (Holmgren) and herbivory by the orthopteran *Diapherodes* sp. (Phasmatidae) have been reported *(18)*. The species is otherwise unusually free from insect damage and diseases *(12)*.

Large trees are moderately susceptible to limb breakage and trunk snap in hurricane-force winds but are very resistant to windthrow. Trees with snapped trunks and broken tops quickly recover (authors, personal observation).

A survey of timber in Puerto Rican secondary forests found 77 percent of jácana in sawtimber sizes had some degree of damage or degrade. Form was the largest source of degrade; heart rot appeared in very few (2.5 percent of the volume) of the stems *(2)*.

SPECIAL USES

The light reddish-brown heartwood of jácana is not easily distinguished from the light-brown sapwood. It has a uniformly fine texture, straight grain, and medium to low luster. It is very hard, firm, strong, and very heavy. The density of green, air-dried (15 percent moisture content), and ovendried woods are 1.19, 0.95, and 0.78 g/cm^3, respectively *(11;* authors, personal observation). Jácana wood dries slowly with considerable degrade in Puerto Rico and requires about 7 months to air-season to 17-percent moisture content. Shrinkage during drying to 15 percent moisture content is 3.6 percent radial and 5.4 percent tangential *(11)*. The wood is fairly difficult to work due to its high density, hardness, and silica content, and although it bores very well, it splits rather easily with screws or nails *(11)*. Shaping, turning, mortising, and sanding properties are good *(10)*. Jácana is susceptible to attack by the West Indian drywood termite, *Cryptotermes brevis* (Walker) *(21)*. The wood is currently used in the Caribbean for heavy construction, house frames, bridgework, posts, and other uses requiring a hard, strong wood. It is suitable for furniture, agricultural implements, heavy flooring, and boatbuilding *(11)*, and is commonly used for fuel *(6)*.

The edible fruits are creamy to pasty in texture with a mild, pleasant flavor. They are widely eaten but not exploited commercially except in Trinidad, where they are sold in markets *(14)*.

GENETICS

The genus *Pouteria* is comprised of approximately 325 species of tropical trees and shrubs, of which about 200 are native to the neotropics *(20)*. Botanical synonyms of *P. multiflora* include *Lucuma multiflora* A. DC., *Vitellaria multiflora* (A. DC.) Radlk., *Radlkoferella multiflora* (A. DC.) Pierre *(20)*, *R. guadelupensis* Pierre *(7, 8)*, *L. dussiana* Pierre, *L. martinicensis* Pierre, *P. dussiana* (Pierre) Stehlé, and *P. martinicensis* (Pierre) Stehlé *(8)*.

Three other *Pouteria* species occur in Puerto Rico *(9)*. These include *P. dictyoneura* (Griseb.) Radlk. ssp. *fuertesii* (Urban) Cronq., which is uncommon in the limestone hill forests; *P. hotteana* (Urban & Ekman) Baehni, which is uncommon on the southern slopes of western mountains at lower and middle elevations; and *P. sapota* (Jacq.) H.E. Moore & Stearn, rarely planted at lower elevations for its fruit and shade, but not naturalized. *Pouteria dictyoneura* and *P. hotteana* are also native to Hispaniola and Cuba, whereas *P. sapota* is native elsewhere in the West Indies and from Mexico to northern South America.

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