

Samanea saman (Jacq.) Merr.

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FABACEAE (BEAN FAMILY)

Acacia propinqua A. Rich. (Histoire Physique, Politique et Naturelle de l'Île de Cuba, Botanique.-Plantes Vasculaires 1: 466; 1845); *Albizia saman* (Jacq.) F. Muell. (Selected Plants, ed. 2: 12; 1876; annot. as *Albizzia*); *Calliandra saman* (Jacq.) Griseb. (Flora of the British West Indian Islands 225; 1860); *Enterolobium saman* (Jacq.) Prain ex King (Journal of the Asiatic Society of Bengal, Part 2, Natural History 66: 252; 1897); *Fueilléa saman* (Jacq.) Kuntze (Revisio Generum Plantarum 1: 189; 1891); *Inga cinerea* Humb. & Bonpl. ex Willd. (Species Plantarum, editio quarta 4[2]: 1024; 1806); *Inga salutaris* Kunth (Nova Genera et Species Plantarum 6: 304; 1823); *Inga saman* (Jacq.) Willd. (Species Plantarum, editio quarta 4[2]: 1024; 1806); *Mimosa saman* Jacq. (Fragmenta Botanica 15, t.9; 1800); *Pithecellobium saman* (Jacq.) Benth. (London Journal of Botany 3: 216; 1844); *Zygia saman* (Jacq.) Lyons (Plant Names, Scientific and Popular [ed. 2]: 503; 1907)

Algarrobo, algarrobo del país, almacigo blanco, árbol de lluvia (arbre a pluie), bordao de velho, carabali, carito, carreto, carreto real, cenícero, cenísero, cenísero claro, cenísero oscuro, cenízaro, compano, cow tamarind, daugení, dormilón, French tamarind, genízaro, gipio, gouannegoul, guango, huacamayo-chico, lara, monkey pod, rain-tree, regenboom (Dutch), saaman, sama, samán, samán blanco, samán negro, samana, tabaca, tabaca de monte, urero, urero macho, urero negro, zorra (National Academy of Sciences 1979, Record and Hess 1949)

Samanea saman is a widely cultivated tree, indigenous to the dry American tropics, which extend from Mexico, through Central America, down to Venezuela and Colombia in South America (Allen and Allen 1981, Woodson and Schery 1950). Its widespread distribution could be the result of seed dispersal by cattle, horses, and man (Janzen and Martin 1982). The tree is an occasional or frequent element of the canopy in primary dry tropical forests and transitional to humid forests.

Samanea saman is a large tree reaching 50 m in height and 250 cm d.b.h., with a branch spread of about 60 m in very old trees. Commonly, the trees are 25 to 35 m in height and 40 to 120 cm d.b.h. (Holdridge and Poveda 1975, National Academy of Sciences 1979, Salas-Estrada 1993). The crown is wide spreading and umbrella-shaped with feathery foliage. The tree is deciduous in deciduous forests and evergreen in rain forests; flowering and refoitation are synchronized (Janzen 1983e). The young twigs are green or gray, aureo-pubescent, becoming glabrate with sparse lenticels. They can be hollowed and inhabited by ants (Salas-Estrada 1993, Woodson and Schery 1950, Zamora 1991). The bole is irregular and twisted; the basal third is branch free. The bark is blackish gray with verti-

cal fissures and horizontal cracks forming blocks in young trees and narrow scaly plates in old trees; the inner bark is whitish, light pink, or light brown and fibrous, with a fresh potato scent and bitter taste (Holdridge and Poveda 1975, Salas-Estrada 1993). Leaves are compound, alternate, bipinnate, paripinnate, 12 to 36 cm long, and 13 to 34 cm wide, with two to six pairs of pinnae. Each pinna bears two to eight pairs of opposite pinnules. Pinnules are sessile, oblong, elliptic or rhombic, and 1.5 to 6.0 cm long by 1.0 by 3.0 cm wide; they have entire margin, obtuse apex, and acute and unequal base (Brenes 1994, Salas-Estrada 1993).

The tree grows on plateaus and flatlands (slopes of 5 percent or less) with moderate drainage, where temperatures range from 20 to 38 °C and annual rainfall fluctuates from 600 to 2500 mm with a mean of 1400 mm (Hartshorn and Poveda 1983, National Academy of Sciences 1979). It is also found in open country, cultivated areas, and pastures and is used as a shade and garden tree (Janzen 1983e). It can survive 2 to 6 months of dryness. The species is indifferent to soil texture and pH, but good or adequate drainage is important (Brenes 1994). The elevation range is 0 to 1100 m.

The sapwood is light yellowish gray in green condition and the heartwood is reddish brown. In dry condition the sapwood is orange-gray and the heartwood is grayish brown (Laboratorio de Productos Forestales 1981). The wood has a slightly interlocked grain with wide stripes, medium texture, regular luster, and figure characterized by overlapping arcs; it is odorless and tasteless. Frequently, the wood has blue stain spots due to fungal attack (Laboratorio de Productos Forestales 1981). The species has a strong, hard, moderately heavy wood with a basic specific gravity of 0.45 to 0.53. The green wood varies from 0.72 to 0.88 g per cm³ (Laboratorio de Productos Forestales 1981). The volumetric contraction is low (1.8), and the mechanical properties vary from very low to medium; the wood is of the structural type C. It is moderately easy to work, saw, and polish although it presents rolling grain (Herrera and Morales 1993). The wood is comparable to that of black walnut (*Juglans nigra*; National Academy of Sciences 1979) and *Enterolobium cyclocarpum* (Jacq.) Griseb. (Cozzo 1951). Air-drying is moderately slow; it takes 24 to 29 weeks depending on ambient temperature and moisture (Laboratorio Productos Forestales 1981); the wood shows some twisting and fissures at the ends and moderate splitting on the sides. The sapwood is very susceptible to insect and fungi attack while the heartwood is moderately resistant (Herrera and Morales 1993). Wood impregnation is easy; the sapwood is completely and uniformly penetrated. The Runkel factor is 0.78 and the Peteri's coefficient 16 to 18; the wood is good for making paper (Laboratorio de Productos Forestales 1981). The wood is harvested commercially in Costa Rica and other countries of the Mesoamerican region for bowls, trays, carvings, furniture, veneers, posts (treated wood), paneling and turnery; Hawaii is well-known for its monkey pod bowls (National Academy of Sciences 1979). In Central America the wood is used for two-wheeled carts (Allen and Allen 1918).

Samanea saman is a nitrogen-fixing tree (National Academy of Sciences 1979, Nitrogen Fixing Tree Association 1987b). The pods have edible pulp; when ripe the pulp is soft and sugary with a licorice-like flavor attractive to children. The foliage and young twigs have a high protein content (24 to 30 percent) and the fruits have 13 to 18 percent (Herrera and Morales 1993). The pods can also be dried and ground into a meal excellent as animal fodder (National Academy of Sciences 1979). In silvo-pasture systems, the tree provides shade and nutritious pods for livestock and fosters the growth of nearby grasses (National Academy of Sciences 1979). The bark, seeds, and flowers produce a saponin-like alkaloid, pithecolobine (samanin D), C₂₂H₄₆N₄O₂ (Allen and Allen 1981, Van Italie 1932, Varshney and Khanna 1978, Varshney and Vyas 1976, Weisner and others 1953). The boiled bark is applied externally to cure constipation (Grijalva 1992).

Although the tree is not currently used in reforestation programs, established plantations are successful.

The tree flowers January through May, with variations along its geographic range. The flowering peak occurs in April and May. In Central America, the species may bloom in May or June. The flowers are small, pinkish or whitish, hermaphrodite, and crowded in axillary, subterminal or terminal umbellate inflorescences, 4.5 to 5.5 cm long (Holdridge and Poveda 1975, Salas-Estrada 1993, Zamora 1991). The calyx is pentamerous and gamosepalous; the corolla is gamopetalous, valvate, and infundibular (Bentham 1875, Holdridge and Poveda 1975, Zamora 1991). The androecium has many stamens; gynoecium is monocarpellar, and placentation is laminar. Pollination is entomophilous and bees are the primary pollinators, although some butterflies are common visitors and perhaps pollinate some flowers (Brenes 1994).

The fruit is a pod. It initiates development immediately after pollination, but after reaching a length of 3 to 4 cm begins an 8-month period of dormancy. It resumes growth at the end of the rainy season, reaching maturity in the forthcoming dry season. Fruit ripening occurs February through May and the main crop occurs in April and May. The pod is indehiscent, woody, flat, 10 to 25 cm long, straight or curved, 2.5 to 3.5 cm wide, and almost 1 cm thick. A pair of thick, woody valves with prominent ventral and dorsal sutures forms the fruit's pericarp. The epicarp is reddish brown or brown, glossy, and slightly carved on the lateral surfaces; the mesocarp is poorly developed and indistinguishable; the endocarp is dull, septate, and forms a sticky pulp that is whitish, creamy, or light brown. Seeds are separated by the endocarp septa.

The seeds are oblong, laterally compressed, 1.0 cm long, 0.7 cm wide, and 0.5 cm thick. The yield of viable seeds per fruit is about 20 percent; 15 percent are abortive seeds and the remainder are damaged by different insect larvae and weevils.

The pods must be collected February through April and placed in open sacks. Seeds are extracted by hand. They must be removed from the pod immediately and washed in running water; after washing, they are exposed to full sunlight for several hours. Seeds average 4,000 to 5,000 per kg (Brenes 1994). The sweet, sticky endocarp promotes an intense insect attack which must be avoided (Brenes 1994). Seed behavior is orthodox and moisture content in fresh seeds varies from 12 to 18 percent. Seeds can be stored at 4 °C with 6 to 8 percent moisture content. Seeds stored at 5 °C keep their viability longer than 1 year (Quiroz and Chavarria 1990).

Fresh seed germination is about 36 to 50 percent without pregerminative treatment. Seeds soaked in hot water (80 °C) for 1 minute followed by a bath in lukewarm after (30 to 40 °C) for 24 hours produce 90 to 100 percent germination if damaged seeds have been discarded. After imbibition the

seeds are sown in greenhouse beds filled with sand, in plastic bags or directly in the soil. Germination is epigeal and the seedling is phanerocotylar. Radicle protrusion occurs in 4 to 5 days and is quite uniform in pretreated seeds. In the nursery, seedlings are predated by defoliating lepidopterans (*Ascalapha odorata* and *Mocis latipes*) (Brenes 1994).

In monospecific plantations with close spacing, the species grows well and branching diminishes, providing longer and straighter boles (National Academy of Sciences 1979). Initial growth is slow, but survival is good. Two months after planting, the seedlings begin to grow and look vigorous. Pseudocuttings or bare-root seedlings are commonly planted with success. In Estación Experimental Horizontes (Guanacaste, Costa Rica), the best results have been reached using seedlings planted in plastic bags and transplanted in adobe (Brenes 1994). Pruning has been employed in 2-year-old saplings to improve tree form by diminishing undesirable branching. Growth in height and diameter is fast in the first years. In the mixed experimental plantations of Estación Experimental Horizontes (*Enterolobium cyclocarpum*, *Simarouba glauca* DC., *Hymenaea courbaril* L., *Samanea saman*), the 2-year-old trees reached an average height of 2.93 m; in monospecific plantations located in Nicoya, Guanacaste, the juveniles planted at a distance of 3 by 3 m reached a height of 4.78 m and 6.6 cm d.b.h. (Brenes 1994).

ADDITIONAL INFORMATION

The Spanish term *saman* derives from the French Caribbean vernacular *zamang* which means rain tree (Allen and Allen 1981). This name is used because it “rains from the branches

the juice of the cicadas” and the grass is green beneath the canopy (Hargreaves and Hargreaves 1965, National Academy of Sciences 1979).

Leaf petiole is ferruginous, and pulvinate basally. The pulvinus is adaxial and oblong. The rachis is wide and also pulvinate. Petiolules have basal adaxial pulvinuli. Leaf blades are shiny, almost glabrous, green or dark green adaxially, ferruginous, and silky pubescent abaxially. The leaves are nyctinastic, closing at night.

Flowers are short pedunculate; peducles are tomentose and sulcate. The calyx is valvate, campanulate, toothed, pubescent, and greenish; the receptacle is subglobose. Stamens are long, pinkish distally, and basally adnate to the corolla, forming a tube. There are several ovules; the ovules are anatopous, bitegmis, and crassinucellated. In the umbel, the central flower differs morphologically from the others; its perinth is different and the gynoecium does not complete its development.

Seeds are perpendicular to the pod and have a thick, glossy, brown, halonate, dichrome (if fresh and healthy), and hard testa. The lateral faces have a yellowish brown pleurogram, a linear fissura, and fracture lines. The linear fissura opens at the micropylar end. Endosperm and perisperm are lacking. The embryo is large, straight, laterally compressed; the plumule is well developed; cotyledons are large, thick, fleshy, ovate, concealing all but the tip of the radicle.

The bruchid *Merobruchis columbinus* oviposits the immature fruits and the developing larvae damage and kill 50 to 70 percent of developing seeds. If the fruit is opened and the seeds are exposed, *Stator limbatus* oviposits them (Janzen 1977, 1983e).

