

Astronium graveolens Jacq.

W. A. MARÍN and E. M. FLORES

Escuela de Biología, Universidad de Costa Rica and
Academia Nacional de Ciencias de Costa Rica, Costa Rica, respectively

ANACARDIACEAE (CASHEW FAMILY)

Astronium fraxinifolium Schott ex Spreng. [Systema Vegetabilium ed. 16 4(2): 404. 1827];
Astronium fraxinifolium var. *glabrum* Engl. (Monographiae Phanerogamarum 4:456. 1883);
Astronium graveolens var. *brasiliense* Engl. [Flora Brasiliensis 12(2):399. 1876]; *Astronium graveolens*
var. *inodorum* Triana & Planch. (Annales des Sciences Naturelles; Botanique, sér.5, 14: 268. 1872);
Astronium graveolens var. *planchoniana* Engl. (Monographiae Phanerogamarum 4: 455. 1883);
Astronium planchonianum Engl. [Flora Brasiliensis 12 (2): 399. 1876]

Algarrobo, almendro macho, arantha, barcino, bauwana, bolaquivo, cero, ciruelillo, ciruelo, ciruelo de montaña, copaiva, cuchi blanco, culebra, diomate, foncotín, gateado, gateado barcino, glassy wood, gomavel, gonçaleiro, gonçalo, gonçalo alves, gonçalo do matto, guacamaya, guaritá, guasango, gusanero, jejuira, jocote de fraile, jovillo, kulimche, masicarán, muira-catiara, muira-coatiara, muria-quatiara, palo de cera, palo de cruz, palo de culebra, palo mulato, palo obrero, pau gonçalo, pimientillo, potro, quebracho, quiebrahacha, quitacalzón roble gateado, ronron, sangolica, sangualica, sangue-sugueira, sirguelillo, tibigaro, tirigaro, urunday-ibá, urunday-para, urunday-pytá, yaga-biche, yoke, yomate, zongolica, zorro (Jiménez 1993, Record and Hess 1949, Salas 1993)

Astronium graveolens grows in southern Mexico, Central America, Colombia, Venezuela, Trinidad, Guyana, Ecuador, Bolivia, Paraguay, and Brazil (Croat 1978, Pennington and Sarukhan 1968, San Roman and others 1981).

Astronium graveolens is a medium-to-large tree that reaches 8 to 35 m in height and 35 to 100 cm d.b.h. The tree is symmetrical with a straight bole, small narrow buttress flanges 1 to 2 m tall, and a spreading or round dense crown. Young twigs are gray, green, or grayish brown with dark and protruding punctiform lenticels (Blackwell and Dodson 1968, Record and Hess 1949). The bark is 8 to 20 cm thick, with an outer pinkish layer underlined by a yellow layer. The bark is ragged and light or dark gray; it exfoliates in plates leaving light yellow or white areas, which exudate very sticky and transparent resins. The resin has a turpentine odor and flavor (similar to vinegar); it is astringent and slightly sweet. Lenticels are numerous. Leaves are alternate, imparipinnate, spirally arranged, and 11 to 36 cm long including the petiole, with 5 to 15 pairs of leaflets, opposite or subopposite, sometimes alternate and lanceolate or oblong-lanceolate, with entire or slightly serrate margin. The leaflet apex is acuminate; the base is asymmetrical, obtuse or rounded, with reticulate venation,

pinnate-eucamptodromous. The secondary veins have an acute-wide divergence angle of 65 to 80°. The leaflet blade is shiny dark green adaxially and dull light green abaxially. There are numerous dark spots throughout the leaflet blade and frequent ovoid galls at the margin. The old leaflets turn yellow before abscission. The tree is deciduous and sheds its leaves before flowering; the new leaves appear together with the flowers at the end of the dry season.

The species grows well in poorly drained limestone soils or rocky and alluvial soils. *Astronium graveolens* grows on moderate mountain slopes at elevations ranging from 150 to 1000 m. In Central America, the species is most abundant along the Pacific coast, at elevations between 500 and 600 m (Centro Agrónomico Tropical de Investigación y Enseñanza 1998b). It is a subcanopy or canopy species in the tropical dry premontane or low montane forest with temperatures of 20 to 32 °C and annual rainfall from 750 to 3000 mm (Salas 1993).

The timber color varies from light to dark brown or reddish, is more or less conspicuously marked with vertical blackish bands of variable spacing, and often produces a very striking and beautiful figure. There is a considerable range of density among different specimens and also within the

same sample, the dark zones being the heavier (Record and Hess 1949). When fresh, the sapwood is light brown-grayish or dark brown-yellow, while the heartwood is gray-orange or reddish brown to bright red with narrow to wide irregular stripes of medium to very dark brown. After exposure to air and light the wood becomes brown, red, or dark reddish with nearly black stripes. The grayish or brownish-white sapwood is 4 to 9 cm wide and sharply demarcated (Chudnoff 1984). The timber has some resemblance in figure and texture to golden ebony or coromandel (*Diospyros quaesita* Thw.), although it has a warmer tone. Sometimes the wood exhibits a mottled figure that resembles Brazilian rosewood (*Dalbergia nigra* (Vell.) Allemao ex Benth.) (Record and Hess 1949). Growth rings are visible to the naked eye, with an average of 12 rings per 5 cm. The grain varies from straight to intercrossed; the texture is fine and homogenous; and the luster is regular or high.

The wood is very heavy, with a basic specific gravity of 0.75 to 0.78 (Creemers and Lemckert 1981, San Roman and others 1981). The green weight is 1120 kg per m³ with 50.2 percent moisture content and 1228 to 1230 kg per m³ with 46 to 47 percent moisture content. The dry weight is 850 to 860 kg per m³. The rupture module is 1511 kg per cm² when dry and 955 kg per cm² when green (Chichignoud and others 1990, Herrera and Morales 1993, San Roman and others 1981, Simpson and Sagoe 1991, Wangaard and Muschler 1952). The wood is fairly easy to rather difficult to work, turns readily, finishes very smoothly, and takes a high natural polish; it is noteworthy for its durability. The wood is moderately difficult to season. There is some crook and bow accompanied by a slight tendency to twist; checking is slight. Wood air-drying occurs at a moderate rate. Shrinkage in green to oven-dry wood is quite normal for this type of wood (radial 4 percent, tangential 7.6 percent, volumetric 10 percent) (Chudnoff 1984). Air-drying takes approximately 29 weeks (San Roman and others 1981). There are slight drying defects, such as cracking at the ends and small lateral cracks, in less than 5 percent of the material (Herrera and Morales 1993, San Roman and others 1981). The wood weathers well and is highly resistant to moisture absorption. It is difficult to glue (Chudnoff 1984). The timber is very resistant to insect attack. The wood is very resistant if it is not in contact with the soil (Bultman and Southwell 1976); however, it is susceptible to white and brown-rot fungi when left at the forest floor, with slight damage after 12 months. When in use, the wood can be damaged by *Brasilianus mexicanus* (Cerambycidae) or by termites after 2 years (Jiménez 1993). *Astronium graveolens* is among the most outstanding for heavy, durable, construction timbers, and it is also highly favored as a wood for fine furniture, cabinets, and decorative veneers. It is used for specific items, such as knife handles, brush backs,

archery bows, and billiard cue butts, and in turnery and carving (Chudnoff 1984).

Flowering occurs during the dry season (in Mexico it flowers March through May; in Honduras, February through April; and in Costa Rica, December through February), with most fruits maturing February to May (Brenes 1994, Jiménez 1993, Nichols and González 1992, Pennington and Sarhukán 1968). The species is dioecious, with flowers grouped in glabrous axilar or terminal panicles up to 20 cm long; the inflorescence has small, deciduous, pink bracts. The staminate flowers are small, actinomorphic, and pentamerous. The calyx has ovate orbicular sepals, with a round apex; the sepals are imbricate and glabrous. The corolla has green petals, glabrous, elliptic or ovate, with a round apex. The androecium has 5 to 7 stamens with compressed subulate filaments and oblong anthers. The flowers have a small, central, nectariferous disc, pentalobed, patelliform, and glabrous. The pistillate flowers are actinomorphic and have articulated pedicels. The calyx has ovate or elliptical sepals, imbricate, glabrous, and rounded at the apex. The petals are yellow-green, glabrous, elliptic, imbricate, and round at the apex. The androecium has five staminoids, separated from the gynoecium by a glabrous, patelliform, lobed, and nectariferous disc. The ovary is superior and unilocular with a single anatropous ovule. There are three curved, short styles, which end in a disciform and a papillary stigma.

After fertilization the sepals enlarge and surround the fruit, masking the petals, which are persistent but do not grow. In the unit of dispersal (diaspore), the petals are shiny brown-yellow, papyrus-like, and acrescent. They open and extend in a star-like shape when the fruit is maturing and contribute to its wind dispersal, acting in a samara-like fashion. The fruit is ellipsoid; 10 to 15 mm long; brown, bluish, or blackish when mature; with a single seed. It is often crowned by the styles. The fruit has a chartaceous exocarp and a yellow resinous mesocarp. The hard brown endocarp surrounds the membranous seedcoat. The seed is oblong or ellipsoid, 9 to 10 mm long, and 4 to 6 mm wide. The embryo is fleshy and ellipsoidal.

Fruits (seeds) must be collected directly from the tree before wind dispersal. Once collected, the fruits are placed on the floor and dried for 3 to 4 hours. A kilogram of diaspores contains about 18,000 seeds (Centro Agronómico Tropical de Investigación y Enseñanza 1998b).

The seeds keep their viability for 3 months if they are stored at 15 °C with an average moisture content of 15 to 25 percent. However, there is no germination (0 percent) after 1 year of storage (Centro Agronómico Tropical de Investigación y Enseñanza 1998b). The seeds lose viability in less than 1 month if stored at ambient temperature and humidity. The seed is suspected to be recalcitrant, as are other members of

the family such as mango (*Mangifera indica* L.). Fresh seeds have shown 80 to 90 percent germination without any special treatment (Brenes 1994).

Germination is epigeal, and the seedling is cryptocotylar. Germination starts 4 to 8 days after sowing and is complete after 15 to 18 days. The seedlings grow slowly in the nursery

(20 cm in 3 to 4 months) and they require moderate shade and humidity during the first weeks. The seedlings are ready for outplanting 5 months after sowing, when they reach a height of 35 to 40 cm. *Astronium graveolens* is grown in plantations at a planting distance of 2 by 2 m or 2.5 by 2.5 m) to prevent branching. The sapling grows best under full light.

