Terminalia amazonia (J.F. Gmel.) Exell

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COMBRETACEAE (INDIAN ALMOND FAMILY)

Chuncoa amazonia J.F. Gmel. (Systema Naturae, ed 13 2: 702; 1791); *Chuncoa amazonica* J.F. Gmel. (systema Naturae, ed 13 2: 702; 1791); *Gimbernatea obovata* Ruiz & Pav. (Flora Peruvianae et Chilensis Prodromus 138; 1794); *Chuncoa obovata* (Ruiz & Pav.) Pers. (1168 1: 486; 1805); *Terminalia obovata* (Ruiz & Pav.) Steud. (Nomenclator Botanicus.Editio secunda 2: 668; 1841); *Terminalia excelsa* Liebm. ex Hemsl. (Biologia Centrali-Americani, …Botany…1: 402; 1880); *Myrobalanus obovatus* (Ruiz & Pav.) Kuntze (Revisio Generum Planatarum 237; 1891); *Terminalia odontoptera* van Heurck & Mòll. Arg. (Observationes Botanicae 217; 1871); *Terminalia hayesii* Pittier (Contributions from the U.S. National Herbarium 18 [6]: 239; 1917)

Aceituno, adamaram, alasuhabu, almendro, amarillo, amarillo carabazuelo, amarillo caraqueío, amarillo carruajero, amarillo del río, amarillo pijua, amarillo real, amarillo sólido, amarillón, anangostii, araca, araca d'agua, arispin, arpino, boesi-amandra, broadleaf, bullywood, canolté, canshán, canxán, canxón, carboncillo, chicharro, chicharrón, chicharrón amarillo, chicharrón de monte, chicharrón prieto, cochun, coffee mortar, cuiarana, fukadi, gindja-oedoe, guaba, guayabí amarillo, guayabí-ré, guayabí-saiyu, guayabillo, guayabo, guayabo de montaña, guayabo león, guayo, hill fukadi, jucarillo, karalawai jakoenepele, langousi, lanza, lanza amarilla, lapachillo, mapurite blanco, mashipe, membrillo, merendiba branca, nagosse, nagossi, naharu, nangocy, naranjo, nargusta, níspero macho, olivier mangue, palo amarillo, palo prieto, pardillo negro, pau mulato brancho, poirier, pookadi, puete, querebere, rifari, roble amarillo, roble coral, sarandí amarillo, shapana, sombrerete, suchi amarillo, swamp fukadi, tanibouca, tepesóchil, volador, white olivier, yumbin, yumbingue (Flores 1994h, Longwood 1971, Record and Hess 1949)

Terminalia amazonia is an emergent tree in the canopy of the humid tropical forests, common on slopes and flat lowlands. The geographic range of the species extends from Mexico in the Atlantic watershed to the Guianas in South America (Brako and Zarucchi 1993, Flores 1994h, Hall and Seymour 1978, Jorgensen and León-Yáñez 1999). It also grows in the Antilles (Trinidad-Tobago).

The species is a tall, evergreen, fast-growing tree reaching more than 50 m in height in the Amazonian and Central American forests and up to 70 m in the evergreen forests of Mexico (Flores 1994h, Macbride 1941, Pennington and Sarukhán 1968, Standley and Williams 1962). The bole is quite straight, asymmetrical, and frequently grooved in the basal third. It has conspicuous buttresses, which are longer and wider when the species grows in seasonally flooded or swampy areas. The axis is monopodial; the branches arising at the end of each growth flux are sympodial and plagiotropic (Hallé and others 1978). When they become old, the distal end turns downward; this is a distinctive characteristic of the species (Flores 1994h). The bark is thin (1 cm), dull, and grayish brown or grayish yellow and has shallow vertical fissures. It exfoliates medium-sized flecking plates. Phyllotaxy is spiral; internode reduction leads to spur shoot formation at the branch end. Leaves are petiolate, simple, exstipulated, coriaceous or chartaceous, obovate, depressed obovate or oblanceolate, with entire margin, abruptly acuminate, round or obtuse apex, and attenuate base. They are slightly pubescent, especially abaxially. The leaf is hypostomatic; stomata are anomocytic. The foliar ptyxis is conduplicate; young leaves are reddish brown. Leaf size and shape vary within a given tree or spur shoot. Trees inhabiting nearly dry zones lose their foliage; the production of new leaves is synchronized with blooming (Flores 1994h). The species is frequently riparian and grows well in red or dark soils that are lateritic, deep, and derived

from alluvial or igneous materials. It grows in clay, sandy, or poor soils, but it reaches its best growth in clay soils (Flores 1994h, Longwood 1971, Pennington and Sarukhán 1968, Record and Hess 1949, Woodson and Schery 1958). The temperature range in these areas is 22 to 35 °C and the annual rainfall 600 to 1500 mm. The elevation varies from 40 to 1200 m.

The sapwood is pale grayish yellow in green condition, and the heartwood is darker; in dry condition, the sapwood is orange or yellowish and the heartwood is reddish yellow, brownish yellow, light yellowish brown, or yellowish olive, with darker reddish stripes. The wood oxidizes rapidly when exposed to air and light (Flores 1994h). It has straight or interlocked grain, medium-to-high luster, medium texture; it is odorless and tasteless (Flores 1994h, Llach 1971, Longwood 1971, Picado and others 1983). The wood is heavy or very heavy (green weight 1020 to 1100 kg per m^3, with 50 to 80 percent moisture content; basic specific gravity is 0.51 to 0.70). The timber has high quality and good physical and mechanical properties. Volumetric contraction (12.5) is moderate for the wood density; the radial contraction is low (4.8), and the tangential is normal (7.9) (Flores 1994h, Llach 1971, Longwood 1971, Picado and others 1983). Drying is moderately difficult, but it varies with wood origin. The wood may show splitting, checking, and slight warping. Working properties are medium; finishing of radial planes is difficult. Natural durability varies with origin. Resistance to fungal and termite attack is moderate. The wood is difficult to impregnate and preserve. Of the trees with diameters of more than 60 cm, 90 percent have hollow piths. The timber is used in heavy general construction, interior and exterior construction, cabinetwork, floors, bridge foundations, beams, fences, veneers, parquet, barrels, railroad ties, and ships. It is also suitable for making paper (Peteri's coefficient of flexibility is 76; Runkel factor is 0.82) (Llach 1971, Longwood 1971, Picado and others 1983).

Blooming occurs from January through April, with variations in the beginning and ending of the flowering period along the geographic range of the species. The inflorescences arise from the axil of spur shoot leaves. They are racemes bearing numerous flowers whose rachis may reach a length of 15 to 16 cm. The rachis and peduncle have ferruginous pubescence. Flowers are protogynous and the species is allogamous. Flowers are hermaphroditic, actinomorphic, and epigynous. They are shortly pedicellated. The calyx is pentamerous, gamosepalous, tubular, pentasulcate, pubescent, and yellowish green or whitish; it is fused to the androecium and gynoecium in the basal two-thirds. The distal-free third is cupuliform; calyx lobes are deltoid and pubescent on both surfaces. The androecium has 10 stamens distributed in 2 whorls; the external whorl alternates with the sepals while the inner verticil is opposite to the sepals. There is an annular, nectariferous, pentalobate disc surrounding the style; its secretion is slightly sugary. The gynoecium is unilocular, with two anatropous, bitegmic, crassinucellate ovules; placentation is suspended. Pollination seems to be entomophilous with medium-size bees acting as pollinating agents (Bawa and others 1982); however, there is a strong possibility of a partial anemophilous pollination (Flores 1994h).

Fruit ripening occurs from February through May, although regional variations occur. Most flowers develop a fruit, but many fruits lack seeds. The fruit is a short, pedicellate, five-winged samara. The two larger wings extend transfersely while the three smaller wings are sometimes vestigial; there are two on one side of the samara while the remaining one is on the opposite surface. The samara is pubescent, especially in the center. The exocarp is thin and papyraceous, the mesocarp is parenchymatic, and the endocarp fibrous and woody (Flores 1994h). Fruits are wind-dispersed and because of their aerodynamic design are considered rolling autogyros (Augspurger 1986). Fruit weight is 4.0 to 4.6 mg. Fruits average approximately 200,000 per kg.

The seed is enclosed by the fibrous endocarp. It is cylindrical-oblanceolate or cylindrical-elliptic and has a long funiculus. The seedcoat is dull and yellow. The percentage of fruits containing seeds ranges from 0 to 40 percent, depending on the entry, and approximately 8 percent are not viable. Fruits collected in stands with several trees have a higher number of viable seeds than fruits coming from isolated parent trees. Fruits collected from the tree have a higher moisture content and sometimes are immature; those lacking seeds are lighter (Flores 1994h).

Seed-producing trees must be selected from stands, and tree diameters must be more than 70 cm. Samaras must be mature and dry; seeds from immature samaras do not germinate well. Determining the period of seed viability is very difficult due to the high and variable percentage of sterile fruits in different fruit entries and because the seed is enclosed by the samara.

Germination is epigeal and the seedling is phanerocotylar. Under greenhouse and nursery conditions, germination is gradual. The radicle emerges at 60 to 70 days.

Samaras must be sown in boxes filed with sand, germination beds, or bancales. They require moderate shade and constant moisture. Seedling survival in the nursery is about 95 percent, with approximately 10 percent having a slower growth rate (Flores 1994h). The seedlings must be transplanted to plastic bags before the first eophyll extends. The bags must be kept under moderate shade for 2 to 3 weeks. Soil fertilization or application of foliar nutrients increases seedling growth and vigor. The seedlings can be transferred to the field 8 to 12 months after germination. Root and leaf pruning before

outplanting is convenient. When seedlings are placed in beds, two root prunings are recommended: one when the seedling is 20 cm long, another 1 month before transplanting. Seedlings and saplings must be transferred to the field in adobe.

Terminalia amazonia has been planted at distances of 3 by 3 m, sometimes 2 by 2 m. In experimental plots located in the northern zone of Costa Rica, sapling longitudinal growth averaged 1.2 m per year and annual diameter growth was 1.4 cm; the annual increment in basal area was 0.5 m^2 per ha. In southern Costa Rica, 14-year-old trees reached an average diameter of 12.7 cm and a height of 12.4 m (Flores 1994h). Seedlings and saplings in nurseries and plantations are predated by ants (*Atta cephalotes*, *Acromyrmex*); they cause shoot damage and may promote shoot branching (Flores 1994h, Nichols and González 1992).

ADDITIONAL INFORMATION

Linnaeus named this genus *Terminalia* because of the peculiar system of branching and the production of leaves at the distal end of each spur shoot. The name of the species refers to the origin of the specimen type (Flores 1994h). *Terminalia amazonia* is the most widely distributed neotropical species of the genus.

There are two to six marginal extrafloral nectaries at the leaf base proximal end and numerous abaxial domatia, surrounded by ferruginous trichomes. The areoles have translucent dots; they correspond to mesophyll idioblasts. Venation is eucamptodromous. The midrib is thick with a straight course, and projects abaxially; the secondary veins have an acute angle of divergence with respect to the midvein. Tertiary veins are transverse and form an angle of 80 to 90° with respect to the midvein; the pattern is distinctive for this species.

Stamen filaments are 2.0 to 2.5 mm long; they are filiform, glabrous, and yellowish. The anthers are subglobose, small (0.3 to 0.4 mm long), extrorse, dorsifixed, and yellow; anther dehiscence is longitudinal. Pollen is abundant and liberated in monads; pollen grains are hexacolpate, and the exine is slightly ornamented. The style is thin and glabrous; the stigma is truncate, glandular, hollow and greenish yellow (Flores 1994h, Pennington and Sarukhán 1968, Woodson and Schery 1958).

Testa and tegmen form the seed. The mature seed is exospermic and lacks perisperm. The endosperm is nuclear and is absorbed during embryo development. The embryo is small, oblong, and whitish. It is straight and has contorted foliar cotyledons. Although the ovary has two ovules, only a single ovule develops, is fertilized, and forms a seed.

After 6 to 8 days, the hypocotyl begins its development; the cotyledons appear 10 to 12 days later. The pericarp and the seedcoat fall down 6 to 7 days later. Cotyledons are reniform, pedicellated, green, and foliaceous. After they are outside, they continue growing for several days. They remain attached to the seedling for more than 3 months; abscission takes place at the petiole base (Flores 1994h). The eophylls have conduplicate ptyxis; they are geenish brown or reddish brown. The first flux of growth ends 4 to 5 months later and the first group of plagiotropic lateral branches is produced.


2cm
1mm
1cm