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Hyeronima clusioides (Tul.) Muell-Arg., known as cedro macho, grows only in Puerto Rico. It is a tall, straight tree with rough, brown bark (fig. 1) and elliptical leaves with long petioles. Cedro macho heartwood is somewhat hard and heavy and weathers to a rich dark brown. It can be made into fine furniture and other useful items and would see much greater use if it were more abundant.

HABITAT

Native Range

Cedro macho is endemic to Puerto Rico (5, 7). It has been noted throughout the moist upland area of the Island (fig. 2), particularly in the northern limestone hills region (7). Most reports of naturally regenerated trees are from areas that were never completely cleared.

Climate

Areas in which cedro macho grows range in mean annual precipitation from 1400 to 2400 mm and have mean annual temperatures ranging from 22.0 to 25.5 °C (2). The precipitation is fairly evenly distributed with slightly drier periods during February–March and July–August. Frosts do not occur in the native range.

Soils and Topography

Cedro macho grows mainly in the valleys between limestone hills in north and central Puerto Rico, in the western lower Cordillera, and on foothills of the Central and Luquillo Mountains. The soils are mostly clays and clay loams, usually Ultisols or Inceptisols. These soils may be deep, or shallow over fractured rock or peralithic material. Parent material is frequently limestone but may be any of a variety of sedimentary, metamorphic, or igneous rocks. Occasional individual trees are noted growing directly on medium-sized rocks with roots descending to the soil below. Soil pH of the upper profile usually ranges from 5 to 6.

Associated Forest Cover

A hill site in the moist limestone hills in northern Puerto Rico where cedro macho grows also supports *Guarea guidonia* (L.) Sleumer, *Andira inermis* (W. Wright), DC., *Cecropia schreberiana* Mig., *Erythrina poeppigiana* (Walp) O.F. Cook, *Thouinia striata* Raklk., and *Calophyllum calaba* L. (author, personal observation). The cedro macho is a rem-

nant of partial clearing carried out more than 50 years ago for subsistence farming. The other species are early secondary natives and exotics. Typical dominant species of the moist limestone hills, besides cedro macho, are *Bucida buceras* (L.), *Bursera simaruba* (L.) Sarg., *Cedrela odorata* L., *Clusia rosea* Jacq., *Ochroma pyramidale* (Cav.) Urban, *Sapium laurocerasus* Disf., and *Zanthoxylum martinicense* (Lam.) DC. (7).

LIFE HISTORY

Reproduction and Early Growth

Flowering and Fruiting.—Tiny, yellowish-green flowers, 3 mm across, are borne on small leafless lateral branches. Male and female flowers are produced on separate



Figure 1.—*Cedro macho* tree (*Hyeronima clusioides*) planted in Puerto Rico.

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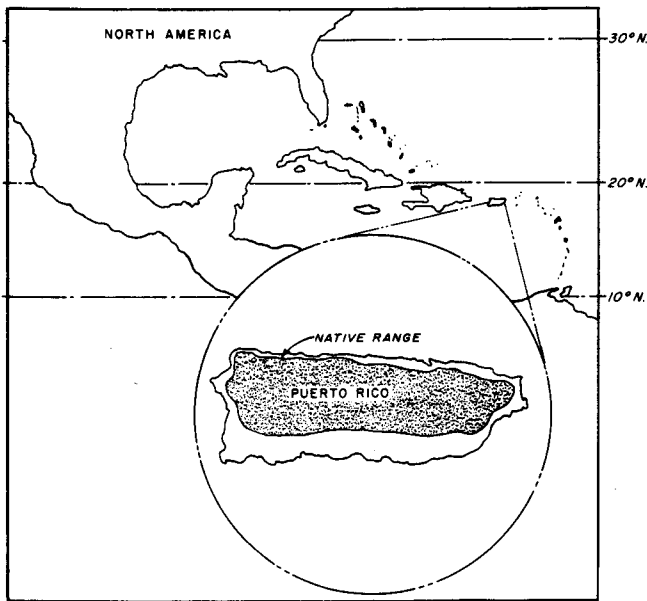


Figure 2.—Native range of *cedro macho* (*Hyeronima clusioides*), an endemic tree species in Puerto Rico.

(dioecious) trees. Flowering takes place mainly in summer and fall followed by fruiting in late summer to winter (7). The fruits measure only about 2 mm long (1); the seeds are nearly round and about half the size of the fruit. Cedro macho fruit sampled averaged 0.0176 g per fruit.

Seed Production and Dissemination.—Air-dry seeds averaged 0.0049 g per seed or 200,000 seeds per kg (author, personal observation). The presence of a sweet, purple fruit around the seeds suggests that they may be disseminated by birds.

Seedling Development.—A sample of cleaned seed incubated on blotter paper began germinating in 20 days. Fifty-three percent germinated over a 2.5-month period (author, personal observation). Germination is epigeous. Twenty seedlings grown in nursery bags reached 32 cm tall (a plantable size) 11 months after germination. Growth is rather slow until the seedlings reach about 20 cm. Then the distance between leaves increases, resulting in faster height growth. Seedlings demonstrate the same straight form as the adult trees. Seedling leaves and stems are quite fleshy at first, but gradually become more leathery and woody.

Vegetative Reproduction.—Young trees will coppice when cut. Of 13 hardwood cuttings collected from saplings then covered with moist soil to half their length in a shadehouse, 1 rooted in 8 months (author, personal observation). There is a tendency for some individual trees to produce many epicormic branches, even in closed, shady stands. No root suckering has been noted.

Sapling and Pole Stage to Maturity

Growth and Yield.—In 1939, a few trees that had been grown in a nursery were planted with a ball of earth around the roots in openings in the forest along a road in the moist limestone hills in Puerto Rico. After 7 years, they ranged from 5.0 to 7.6 cm diameter at breast height (d.b.h.) and 2.7

to 5.5 m tall. At 15 years old, they ranged from 7.6 to 15.2 cm d.b.h. and had a maximum height of 14 m (10). One large planting of cedro macho was established in Puerto Rico. In 1952, 30,000 seedlings were underplanted in stagnant areas of plantations of *Thespesia grandiflora* DC. and *Suietenia macrophylla* King. There was no record of what type or size of seedlings was used. The weather was favorable and survival was good. Apparently, no release cutting was ever applied, so 37 years later, only individual trees and small patches remained. Heights ranged from 18 to 29 m, and d.b.h. ranged from 12 to 36 cm (author, personal observation). Studies of five 10-m radius plots placed in small blocks of the plantation revealed a mean total basal area of 27 ± 2 m²/ha, of which 14 ± 3 m²/ha was cedro macho (author, personal observation). Mean annual volume increment of just the cedro macho component in this plantation (using a volume index estimator of 0.5 basal area multiplied by height) averaged 4.3 ± 1.2 m³/ha. A fully stocked and well-managed plantation of this species is probably capable of 8 m³/ha annual volume increment.

The largest cedro macho tree (a naturally regenerated tree) known to the author measures 1.63 m in d.b.h. and is 27 m tall. It is hollow but still vigorous. Judging by the growth rate of plantation trees of known age, this tree probably is from 160 to 220 years old.

The following tentative guidelines for managing cedro macho are proposed. Seedlings, saplings, poles, and small sawlog trees of cedro macho should be favored in stand management operations. New stands will probably have to be established by planting. A spacing of 3 by 3 m has worked well for many similar species and would be a sound starting point. Seedlings should have protection from weeds for 2 or more years. Thinnings for fenceposts, poles, and small sawlogs should be carried out to maintain a reasonably low basal area (about 20 m²/ha) and improve the quality of the residual stand. Final harvest on a rotation of 45 to 65 years will yield saw trees with d.b.h.'s of 40 to 60 cm. If the area is to be replanted, clearcutting in one or two stages may be employed. Cedro macho lives long enough that it can be used as a shelterwood for more tolerant species such as *Guarea guidonia* (L.) Sleumer that frequently regenerate underneath.

Rooting Habit.—Seedlings produce a fleshy taproot with a moderate number of laterals. Cedro macho trees develop small buttresses, and some have associated fluting in the lower bole. Large, older trees can have some lateral roots exposed at the soil surface.

Reaction to Competition.—Cedro macho is intolerant of shade. Understory seedlings do not persist in a closed forest, and suppressed adult trees weaken and die within a few years. However, seedlings planted under light shade (1952 plantation) did make slow but continuous growth. After 2 years, they ranged from 75 to 120 cm tall (10). Presumably, trees of this species must get their start in disturbed areas, in rocky terrain where competition is at a minimum, and in tree-fall gaps. Adult cedro macho trees are never very common, and reproduction is never abundant. The species is apparently absent in secondary forest on abandoned farmland. It is not known whether this is a result of lack of seed dispersal into these sites, improper germination environment, or fierce early competition in new secondary stands. Twenty-five trees from plantations in Puerto Rico had an

average crown ratio (crown diameter/d.b.h.) of 21.6 (author, personal observation).

Damaging Agents.—Sawn and dried cedro macho wood is susceptible to attack by the dry-wood termite, *Cryptotermes brevis* (Walker) (13). The wood is also consumed by the wet-wood termite, *Nasutitermes costalis* (Holmgren) (9). However, termite trails and nests are infrequent in cedro macho trees (author, personal observation). The wood of cedro macho has demonstrated moderate resistance to marine borers (*Toreda* spp. and *Limnoria* spp.) in a test in Hawaiian waters (3). Aphids tended by ants were noted on many nursery seedlings (author, personal observation). The heartwood is probably durable in contact with the ground, as are other members of the genus (8). Cores (heartwood) of cedro macho trees that die in plantations remain many years after the sapwood decays. However, heartrot does occur in some old trees (author, personal observation). Cedro macho has been listed as susceptible to breakage in high winds (11).

SPECIAL USES

Freshly cut heartwood of cedro macho is chocolate brown, reddish brown, or sometimes red streaked with purple. Much of the red color fades after several weeks of exposure to light, and the wood becomes a rich brown or reddish brown similar to that of old mahogany (*Swietenia mahagoni* Jacq.). Cedro macho sapwood is pink and about 4 cm thick (8). The grain is interlocked resulting in a striped or ribbon-grain effect. Growth rings are visible. Cedro macho wood is moderately coarse in texture and has a low luster. The wood of a related species (*H. laxiflora* (Tul.) Muell.-Arg.) is reported to contain stones of calcium oxalate (4). Three samples of heartwood from a cedro macho tree grown in a plantation averaged 0.77 g/cm³ oven-dry (author, personal observation). Cedro macho wood is rated moderately difficult to air-season (8). Surface checking, end checking, warp, crook, and slight case-hardening can occur. It dried somewhat slower than pine in tests (8). Shrinkage of *H. laxiflora* from green to oven-dry is 5.3 percent radially, 9.4 percent tangentially, and 14.4 percent volumetrically (12). Other woods in the same genus have demonstrated good working properties except for occasional problems with planing (8). Experience with one piece of cedro macho wood sawn and planed by the author support these conclusions.

Because of its beauty, cedro macho wood has been used for furniture and should have a limited place in the local furniture industry. The limited supply will restrict its use to custom and specialty pieces. Used as furniture, it should be protected from dry-wood termites with insecticides and varnish. The wood should serve equally well for decorative veneer, crafts, and trim. Uses for lower quality material could include marine pilings, fenceposts, rough construction, fuel, and charcoal.

GENETICS

There are about 30 poorly defined species of *Hyeronyma* (also spelled *Hieronyma* (7), all of which are native to tropical America (5). *Hyeronyma caribaea* Urban from several of

the Lesser Antilles, was once thought to be synonymous with cedro macho (6), but has been found to be indistinguishable from *H. laxiflora* of Central America and northern South America (5).

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