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Citharexylum fruticosum L., commonly known as pendula, pendola, fiddlewood, old woman's bitter, palo de guitarra, and café-marrón (17), is a small to medium-sized tree in forests and fencerows of the West Indies (fig. 1). Besides providing shade for livestock and food for wildlife, wood from this tree is useful for fenceposts and other rough construction where resistance to termites and rot are required.

HABITAT

Native Range

The native range of pendula extends from southern Florida and the Bahamas through the Greater and Lesser Antilles to Venezuela and the Guyanas on the northern coast of South America, stretching from latitudes 27° N. to 5° N. (fig. 2) (2, 8, 9, 15, 22). There is no evidence from the literature of successful introduction or naturalization outside the native range.

Climate

Pendula endures wide temperature fluctuations in the northern extreme of its range. In southern Florida, the mean July temperature is about 27.5 °C, January temperatures average 16 °C, and occasional light frosts occur (18). On the other extreme, mean annual temperature in the northern South American habitat is 27.5 °C, with little variation in temperature throughout the year (5). Mean annual precipitation ranges from 1000 to 2000 mm (5, 18). Precipitation in some parts of the range is more or less evenly distributed over the year; in others, there is a short dry season of 2 to 3 months.

Soils and Topography

Pendula thrives on most upland soils. Entisols, Inceptisols, Alfisols, Ultisols, and Oxisols are all represented. Soils where the pH ranges from 5.0 to 8.0 and textures ranging from sands to clays are suitable. Skeletal (very gravelly) soils and shallow soils over porous limestone are important habitats. The species occasionally grows on somewhat poorly drained sites. Pendula is common in coastal areas, small islands, limestone hills, dry mountains, and moist foothills. Pendula can grow from sea level to a 900-m elevation (14).

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Associated Forest Cover

In Puerto Rico, pendula is most conspicuous along fencerows of fields and pastures. Its associates commonly include *Ficus citrifolia* Mill., *Bursera simaruba* (L.) Sarg., *Spondias mombin* L., and *Mangifera indica* L. In Florida, pendula is a pioneer on freshly burned pine lands and forms a part of the climax hammock communities in fire-free areas (19). In Cuba, the species grows in semideciduous and dry forests (2). In the limestone hills (subtropical moist forest) of Puerto Rico, slopes supported the following associates of pendula (listed in descending order of total basal area): *Tetrazygia elaeagnoides* (Sw.) DC., *Sabina florida* (Vahl) DC., *Ardisia obovata* Desv., *Margaritaria nobilis* L.F., *Thouinia striata* Radlk., *Coccoloba diversifolia* Jacq., *Guettarda scabra* (L.) Vent., and *Andira inermis* (W. Wright) H.B.K. (21). Ridge positions in the same forest had the following important associates: *C. diversifolia*, *Ardisia obovata* Desv., *Bumelia salicifolia* (L.) Sw., *Terebraria resinosa* (Vahl) Sprague, *Eugenia rhombea* (Berg) Krug+Urban, and *Bursera simaruba* (L.) Sarg. On another site with igneous parent material in the subtropical moist forest of Puerto Rico, the following tree associates were



Figure 1.—A pendula tree (*Citharexylum fruticosum*) growing in Puerto Rico.

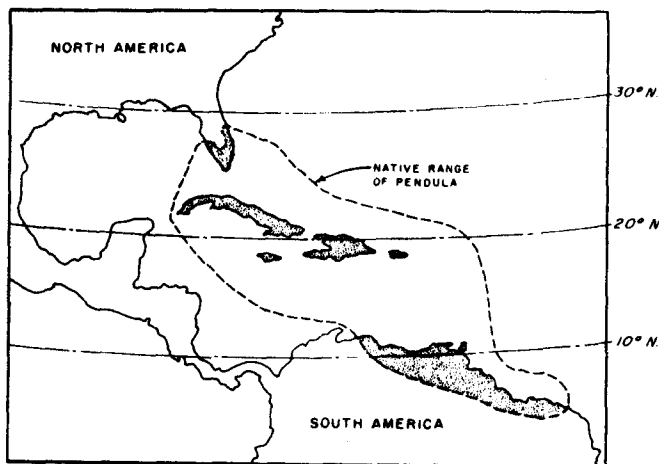


Figure 2.—The approximate native range of pendula (*Citharexylum fruticosum*) in the Neotropics.

noted: *Inga fagifolia* (L.) Willd., *Ocotea leucoxydon* (Sw.) Mez, *O. coriacea* (Sw.) Britt., *Byrsonima spicata* (Cav.) H.B.K., *Tetragastris balsamifera* (Sw.) Kuntze, and *Casearia arborea* (L.C. Rich.) Urban (21).

LIFE HISTORY

Reproduction and Early Growth

Flowering and Fruiting.—Fragrant small white flowers are borne in axillary or terminal spikes (3, 7, 22). It has been reported or implied that pendula flowers are perfect (functional male and female parts in the same flower) (3, 22). However, in Florida the plant is dioecious (male and female flowers on different plants), with male and female flowers that look almost identical; male trees can be noted after flowering by the empty spikes that bear no fruit (19). Empty spikes on part of the trees have been noted in Puerto Rico as well (author, personal observation). In most of the range, pendula flowers and bears fruit throughout the year (10). This is not true in Florida (19), where most trees that flower do so in the spring (March to May), and fruit ripens in the late summer or fall. Flowering and fruiting begins before age 10 for open-grown trees. The fruits are round, reddish brown to black, 6 to 10 mm in diameter, and sweet tasting (7, 10). A sample of fresh fruit in Puerto Rico averaged 0.28 g per fruit. Each fruit contains two two-seeded nutlets (3).

Seed Production and Dissemination.—A sample of air-dry pendula seeds from Puerto Rico yielded $20,600 \pm 20$ seeds per kilogram (author, personal observation). The production of seeds by an open-grown tree can be very high, but fluctuates from year to year. Seeds can be easily collected by clipping branches and stripping the ripe fruits from them. The fruits must be ground and washed to remove the sugary pulp. After drying, the seeds can be separated from the waste. Birds apparently disperse the seeds as shown by the abundance of seedlings appearing below stands used for roosting¹.

¹ Personal communication from John Parrotta, Center for Energy and Environment Research, Río Piedras, Puerto Rico.

Seedling Development.—Germination of pendula is epigeous. Unscarified seeds planted in moist plotting media began germinating within 13 days. The seedlings were transplanted into nursery bags when about 5 cm tall (1 month after germination) and moved to about 25-percent shade. Four months after sowing, the seedlings were 42 ± 1 cm tall and ready to outplant (author, personal observation). Seedlings grown in another test in Puerto Rico² grew better under full sunlight than in shade. At 4 months from sowing, seedlings in sun averaged 73 cm in height while shaded seedlings averaged 38 cm. Growth is continuous. Seedlings are somewhat resistant to desiccation. Survival of bare-root seedlings in test plantings in Puerto Rico was reported to be high, but growth was slow on the poor sites used³. Measured when 7 or 8 years old, these seedlings averaged only 1 to 8 m tall, depending on site quality.

Vegetative Reproduction.—Young trees coppice vigorously, but large trees are weak coppicers. It is not known whether cuttings can be rooted.

Sapling and Pole Stage to Maturity

Growth and Yield.—Pendula has not been grown to maturity in plantations. The mostly codominant pendula, which made up about 1 percent of the basal area on a site in the subtropical moist forest (shallow clay soil over porous limestone on a sideslope) in Puerto Rico, grew 0.15 cm/yr in diameter at breast height (d.b.h.) over a 6-year period (21). In another forest in the same life zone but with somewhat higher rainfall and a deep clay soil over igneous rock, pendula made up 0.5 percent of the basal area and grew 0.12 cm/yr in d.b.h. The above information and field observations indicate that growth rates for open-grown trees are moderate, and growth in closed stands is slow.

Individual trees in the Dominican Republic are reported to reach a 9-m height and 38 cm in d.b.h. (1). The largest pendula in Puerto Rico known to the author is a roadside tree 22 m tall and 86 cm in d.b.h.

Rooting Habit.—Pendula seedlings rapidly extend a fibrous taproot in the first weeks of growth. The lateral root system then develops gradually. A very small buttress is eventually formed. The roots are not damaging to sidewalks or foundations.

Reaction to Competition.—Pendula is intolerant of shade. Seedlings generally require full or nearly full sunlight to grow. However, pendula saplings have been noted in stands of *Albizia lebbek* (L.) Benth., which allows plenty of sunlight to reach the understory. In dry and moist forests, they assume a dominant or codominant position early and maintain it for one or two decades. Except in very rocky hilltops, where it has a competitive advantage, pendula is overtopped by other larger growing species. Pendula then usually survives in an intermediate canopy position for another 10 to 20 years. In Florida, pendula is able to survive as a member of the climax community on hammocks (low, sandy ridges on swampy plains) in fire-free areas (11, 19).

² Data on file at the Institute of Tropical Forestry, Río Piedras, Puerto Rico.

³ Memorandum (1953) in the files of the Institute of Tropical Forestry, Río Piedras, Puerto Rico.

Basal areas of 12 to 15 m²/ha were measured on three sites supporting a component of pendula in Puerto Rico (21).

No guidelines for spacing and management are available. Because of slow growth, it is unlikely that pendula will be planted for sawtimber; however, plantings for firewood, posts, wildlife food, and reforestation of degraded lands are possibilities. Pure plantings for small diameter roundwood or reforestation should be on spacings of between 2 by 2 m and 3 by 3 m. Alternately, pendula could be planted at close spacing between widely spaced timber trees. Pendula planted for wildlife food should be planted on fencerows or in openings at wide spacing. In natural forests, pendula trees with good form should be maintained as crop trees if they do not interfere with more valuable trees of other species. Ample free crown space should be provided to avoid very slow growth rates. More than 50 years are required to produce a sawtimber tree.

Damaging Agents.—Insects of the orders Homoptera, Isoptera, and Lepidoptera have been reported feeding on pendula in Puerto Rico (12). Probably the only important pest is *Pyrausta certata* (F.) of the order Lepidoptera, which occasionally causes limited defoliation in the middle elevations of the island. Feeding by the wet-wood termite, *Nasutitermes costalis* (Holmgren), is extremely rare. In a test of untreated fenceposts in Puerto Rico, of 32 species, pendula was one of 5 undamaged by termites (20). However, pendula wood is susceptible to attack by the dry-wood termite *Cryptotermes brevis* (Walker) (23). As posts and boards, the wood has a local reputation for being resistant to decay when exposed or in contact with the ground. Old trees, however, may be attacked by heartrot fungi. Mistletoe is common in the crowns of pendula in Puerto Rico.

SPECIAL USES

Pendula has been extensively planted as an ornamental (7). While its compact size, fragrant flowers, and hardiness are positive features, a rough, irregular appearance detracts considerably from its value for this purpose (22). Pendula trees frequently serve as living fenceposts around pastures and fields. The species is probably an important food source for birds. The fruits are also edible (7), although rarely consumed by humans. The tree is a good honey plant (10).

There is confusion over the color of pendula wood. The sapwood is reported to be yellow, gray, or white; thin or thick (4, 16, 17); merging gradually to a light brownish or red heartwood (6, 16). The wood of three large trees cut in Puerto Rico was ivory to light tan, with no observable differentiation between sapwood and heartwood (author, personal observation). Pendula wood is close-grained, hard, and strong, with a specific gravity from 0.65 to 0.95 g/cm³ (4, 6, 17). One 19-cm d.b.h. tree cut from a forest stand in Puerto Rico had 49 percent of its dry weight as bolewood and a 56-percent moisture content (bole water/bole dry weight).⁴ The wood sands to a fine finish (17) and is used locally for furniture, trim, guitar parts, rough farm construction, posts, and charcoal (4, 7, 10).

⁴Personal communication with Peter Weaver, Institute of Tropical Forestry, Río Piedras, Puerto Rico.

GENETICS

The genus *Citharexylum* contains about 130 species, varieties, and natural hybrids (13). In addition to the typical *C. fruticosum*, one form and three varieties are recognized (14). The English name fiddlewood (hence *Citharexylum*) is a corruption of the French name "bois fidèle" (reliable wood) (3, 16).

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