

INFORMATION LEAFLET
FOREIGN WOODS

Forest Products Laboratory, ¹/₂ Forest Service
U. S. Department of Agriculture
1952



GONÇALO ALVES

Astronium fraxinifolium Schott, and
Astronium graveolens Jacq., including var. Planchonianum
(= A. Planchonianum Engl.)
Family: Anacardiaceae

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Distribution and Habitat

The genus Astronium, important as a source of useful timber, includes about 12 species of medium-sized to large trees. The genus is divided into two subgenera, Euastronium and Myracrodruon. The woods likewise show distinguishing features and can be separated into their respective subgenera by the presence or absence of characteristic blackish bands; Euastronium shows such bands, Myracrodruon lacks them.

Astronium fraxinifolium Schott, with four botanical "forms," and A. graveolens Jacq. (including the variety Planchonianum Engl.) are the sources of the timber known as gonçalo alves. Both species belong to the subgenus Euastronium and occur together throughout most of the range of the genus. They are best known commercially from the coastal mountain regions of eastern Brazil but occur also in upland forests of many regions from Mexico and Central America through Ecuador, Colombia, and Venezuela (2, 5, 10, 20, 30).²

¹Maintained at Madison, Wis., in cooperation with the University of Wisconsin.

²Underlined numbers in parentheses refer to the list of numbered references at the end of the article.

Other Common Names (5)

Ciruelillo (Honduras)	Ormigo (Guatemala)
Ciruelo (Guatemala)	Palo de Culebra (Mexico)
Gateado (Venezuela)	Ronroñ (Salvador, Honduras, Costa Rica)
Guasango (Ecuador)	Zebrawood (Britain)
Gusanero (Colombia)	Zorro (Panama)

The Tree

The gonçalo alves (*Astronium fraxinifolium* and *A. graveolens*) of eastern Brazil may attain a height of about 100 feet and is obtainable in long, very straight and sound logs 12 to 24 inches in diameter (2, 20). In Colombia the source of gonçalo alves is probably exclusively *A. graveolens*. It may form a medium-sized tree from 75 to 120 feet tall and 2 to 3 feet in diameter, with a commercial length of 50 feet (4, 5, 20, 21). The tree is usually symmetrical and only slightly buttressed (2, 4, 5, 20, 21).

The bark is of a brown or grayish color, firm-textured and not much fissured, but somewhat rough. It is about half an inch in thickness (2, 20, 21).

The Wood

Color

The sapwood of gonçalo alves is dingy yellowish or grayish white, about 2 to 4 inches in width, and very distinct from the heartwood. The heartwood is regarded as one of the most beautiful woods in Brazil. It varies from russet, brown, or orange-brown to reddish brown or red, but is typically reddish brown, more or less conspicuously marked with vertical dark-brown or blackish bands of variable widths and spacing. It often shows a roey figure that is striking and attractive. The wood has been compared to golden ebony or coromandel, but it has a warmer tone. When mottled, it approaches Brazilian rosewood (*Dalbergia nigra* Fr. Allem.). It deepens in color on exposure, so that there is less contrast between the light and dark bands (1, 2, 5, 10, 20, 30). Minute droplets of an oily substance may often be found on the face of the wood after planing, and these cause the surface to feel greasy, as in the case of teak. The oiliness is particularly noticeable on specimens darkened by exposure. The rays are very numerous, but they are exceedingly fine and are generally not visible on the radial surface (2, 11).

Grain, Texture, and Figure

The wood is occasionally straight-grained, but frequently it shows somewhat interlocked and undulating or roey grain. The texture is fine, firm, and uniform. The figure often shows a rather regular stripe of alternating light and dark colors, or a mottle, but the finest figure is found in wood

that combines roey grain with irregular bands of color. Although the name "zebrawood" is given to at least eight other timbers,² it really best describes the markings of gonçalo alves (2, 5, 10, 15, 30).

Luster

The luster is medium to rather high (10).

Odor and Taste

The wood is odorless and tasteless.

Weight

The wood varies from moderately heavy to extremely heavy (5, 10, 14, 20). The specific gravity (air dry ranges from 0.85 to 1.28, or a weight of 53 to 80 pounds per cubic foot (10). Specific gravity based on oven-dry weight and green volume varies from 0.72 to 1.00 (average of 0.84) (5). The darker-colored wood is usually denser (10, 20).

Mechanical Properties

The values obtained for the mechanical properties of gonçalo alves (Astronium graveolens) are considerably higher in practically all respects than any of the well-known domestic species (5, 30). When compared with other species of equal density, however, the wood is rated below average in most properties, including all static-bending properties, crushing strength, hardness, and toughness; slightly below average in shear; and average in compression and tension across the grain (5). Strength values for gonçalo alves from Venezuela and Honduras are presented in table 1.

Seasoning and Shrinkage

Gonçalo alves is rated as moderately difficult to season. Precautions should be taken to prevent checking, crooking, and bowing (31).

Shrinkage is relatively low, especially for a wood of such high density, and there is high resistance to moisture absorption (5, 30). Shrinkage data for gonçalo alves and some comparable American hardwoods are given in table 2 (5).

²Other timbers called zebrawood are;

Centrolobium sp. -- eastern and northern South America.

Brachystegia fleuryana -- west Africa.

Diospyros kurzi and D. oocarpa -- eastern India.

Diospyros marmorata -- Andaman Islands.

Connarus guianensis -- Br. Guiana.

Pithecolobium racemiflorum -- Guiana; northern Brazil.

Caesalpinia paraense -- Trinidad.

Durability

The darker wood is said to be very durable, particularly with respect to deterioration by both white rot and brown rot (31). It weathers well. In Colombia it is considered the best local timber for house posts (1, 2, 5, 10, 21, 31).

Working Characteristics

Gonçalo alves varies from fairly easy to rather difficult to work. It turns and carves readily, finishes smoothly, and takes a high natural polish (2, 5, 10, 14).

Uses

Gonçalo alves is highly valued because of its strength, durability, and beauty. It has long been used for fine furniture and cabinet work, such as pianos, interior trim, and Pullman car finish, and has recently been utilized for handles of knives and other implements. It veneers well, and in this form is suitable for use for inlaid strips in high-grade furniture, such as those for which Macassar ebony is used. It is adapted for purposes in which unusually high strength and durability are required, as for railway cross ties, posts, bridge timbers, shipbuilding, wheels, floors, and general construction (1, 2, 5, 10, 12, 14, 20, 35).

The similarity of many of its characteristics to those of dogwood (Cornus florida) should enable gonçalo alves to be substituted for dogwood in textile manufacture and turning. It should also be adaptable for insulator pins and other specialty uses of black locust (Robinia pseudoacacia), for it combines low shrinkage with high strength and durability (5).

Importation

In the United States, gonçalo alves is often included with shipments of rosewood, from which, however, it is quite distinct. The wood has been used in England (11), but the actual amount used outside of Brazil has been relatively small.

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Table 1.--Mechanical properties of gonçalo alves^{1, 2}

Species.....	Gonçalo alves (<i>Astronium graveolens</i>)	
Tests.....	Column 1 ¹	Column 2 ²
	Yale School of Forestry Tests:	University of Michigan, School of Forestry Tests
	(Average strength values for the species):	
Source and number of logs.....	Venezuela - : 3 logs Honduras - : 1 log	Venezuela - : 1 log
Moisture content.....percent:		
Green.....	46.2	32.5
Air dry ²	13.4	13.2
Specific gravity		
Green volume - oven-dry weight.....	.84	.99
Oven-dry volume - oven-dry weight.....	.94	1.11
Static bending		
Fiber stress at proportional limit, lb. per sq. in.:		
Green.....	8,510	11,200
Air dry ²	11,320	15,800* ²
Modulus of rupture.....lb. per sq. in.:		
Green.....	12,140	16,500
Air dry ²	16,620	29,600*
Modulus of elasticity.....1,000 lb. per sq. in.:		
Green.....	1,940	2,580
Air dry ²	2,230	3,300*
Work to proportional limit.....in.-lb. per cu. in.:		
Green.....	2.28	2.75
Air dry ²	3.34	4.22*
Work to maximum load.....in.-lb. per cu. in.:		
Green.....	6.7	15.4
Air dry ²	10.4	19.5*
Compression parallel to grain		
Fiber stress at proportional limit, lb. per sq. in.:		
Green.....	4,620	8,660
Air dry ²	7,800	10,180*
Maximum crushing strength.....lb. per sq. in.:		
Green.....	6,580	9,500
Air dry ²	10,320	13,060*

Table 1--Mechanical properties of gonçalo alves^{1, 2} (continued)

Species.....	Gonçalo alves (<u>Astronium graveolens</u>)	
Tests.....	Column 1 ¹	Column 2 ²
	:(Average strength values: for the species):	
Compression parallel to grain (continued)		
Modulus of elasticity.....1,000 lb.per sq.in.:		
Green.....	2,230	2,870
Air dry ²	2,620	3,370*
Hardness ⁴		
Green - end.....lb.:	1,640	1,690
Green - side.....lb.:	1,910	2,100
Air dry ² - end.....lb.:	2,020	2,630*
Air dry ² - side.....lb.:	2,160	2,570*
Compression perpendicular to grain - stress at proportional limit.....lb.per sq.in.:		
Green.....	1,840	2,490
Air dry ²	2,110	3,200*
Tension perpendicular to grain.....lb.per sq.in.:		
Green.....	1,000	940
Air dry ²	840*	.....
Shear.....lb.per sq.in.:		
Green.....	1,760	1,770
Air dry ²	1,960	1,910*
Cleavage.....lb.per in.of width:		
Green.....	420	450
Air dry ²	450	.....
Toughness ⁵.....in.-lb.per specimen:		
	139.0	.....

¹Column 1 shows results of tests on gonçalo alves made by the Yale School of Forestry in cooperation with the Office of Naval Research and the Bureau of Ships, U. S. Navy Department. Average strength values for all the logs tested are presented (31).

²Column 2 shows results of tests on gonçalo alves (gateado) made at the School of Forestry & Conservation of the University of Michigan (14, 31).

³Air-dry values adjusted to 12 percent moisture content except where designated (*), in which case the actual moisture content at time of testing (see Moisture Content in table) applies.

⁴The load in pounds required to embed a 0.444-in. steel ball to half its diameter.

⁵Toughness values are the average of tests of green and air-dry specimens 5/8 by 5/8 by 10 inches loaded on the tangential face over an 8-inch span.

Table 2.--Shrinkage characteristics of gonçalo alves and comparable

American woods

Results of tests on gonçalo alves made by the Yale School of Forestry in cooperation with the Office of Naval Research and the Bureau of Ships, U. S. Navy Department (5).

Species and source	Shrinkage			
	Radial	Tangential	Longitudinal	Volumetric
	Percent	Percent	Percent	Percent
Gonçalo alves	:	:	:	:
(<u>Astronium graveolens</u>)	:	:	:	:
Honduras.....	4.2	7.1	0.55	11.1
Venezuela.....	3.7	8.2	.31	8.9
Average.....	4.0	7.6	.43	10.0
Venezuela ²	3.2	8.6	.....	10.4
Dogwood ³	:	:	:	:
(<u>Cornus florida</u>)	:	:	:	:
United States.....	7.1	11.3	.....	19.9
White oak ³	:	:	:	:
(<u>Quercus alba</u>)	:	:	:	:
United States.....	5.3	9.0	.....	15.8
Black locust ³	:	:	:	:
(<u>Robinia pseudoacacia</u>)	:	:	:	:
United States.....	4.4	6.9	.....	9.8

¹Shrinkage values represent shrinkage from the green to oven-dry conditions expressed as a percentage of the green dimension.

²Kynoch and Norton (14).

³U. S. Dept. Agr. Tech. Bull. 479 (16).