FOREIGN WOOD SERIES

PRIMAVERA

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UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
In Cooperation with the University of Wisconsin

PRIMAVERA

Cybistax donnell-smithii (Rose) Siebert

Family: Bignoniaceae

By

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Introduction

Primavera has been used extensively in the United States for many years and actually was known in the American market long before the tree was botanically described by Dr. J. N. Rose, who named it Tabebuia donnell-smithii in 1892. It is regarded as one of the primary light-colored woods, but its use has been limited because of its rather restricted range and the relative scarcity of wild trees within its natural growing area. Plantations now coming into production will, no doubt, increase the availability of this species and also provide a more constant source of supply. Because of the likelihood that the majority of primavera wood will be derived from plantations, this report is concerned primarily with plantation-grown wood.

Distribution and Habitat

The natural distribution of primavera is restricted to southwestern Mexico, the Pacific coast of Guatemala and El Salvador, and north central Honduras. It occurs in mixed forest on well-drained limestone, volcanic, or alluvial soils in the tropical rain forest and tropical moist forest formations or semi-evergreen seasonal forest formations. On the western coastal plain of Guatemala, where primavera was at one time abundant, the climate is tropical, with a marked dry season and a rainy season with rainfall reaching 100

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

inches annually. The tree grows naturally from sea level to elevation of about 800 feet (2). [2]

Primavera plantations exist in Mexico, Guatemala, and Honduras. In other areas of Central America and the West Indies, where the tree is not native, ecological conditions appear suitable for the growth of this species.

The Tree

In the wild state, primavera trees attain heights of 80 feet or more and diameters of up to 3 feet with long, smooth trunks. Plantation trees growing under optimum conditions have attained diameters of 12 inches and heights of 30 feet in 9 years. The fact that high-quality wood can be produced by trees growing at this phenomenal rate has produced some skepticism in the trade. However, the quality of the plantation-grown wood is equal in all respects to that obtained from wild trees.

Gross Features of the Wood

The wood of primavera is whitish to straw-yellow with a very high degree of luster. In some logs the yellowish shade is tinted with a very pale brown or with occasional pinkish streaks. The difference in color between sapwood and heartwood is very slight and cannot be detected in the dried lumber or veneer. The figure in primavera is traceable primarily to interlocked grain and consists of alternating and seemingly light and dark streaks on the quartered surface that run parallel to the grain or at a slight angle to it. The banding thus produced is accentuated because the fibers in the different layers are oppositely oblique to the surface and so reflect the light at different angles. The bands are often further dissected into a wide variety of cross-figures, the most common of which are mottle, and a narrow fiddle-back design. Although unrelated to mahogany, primavera possesses so much of the figure and texture of mahogany that it was for a time called "white mahogany." It is a fine cabinet wood on its own merits.

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[2] Underlined numbers in parentheses refer to Literature Cited at the end of this article.

Specific Gravity

The specific gravity of primavera varies appreciably not only within old-growth, but within second-growth and plantation-grown material as well. Table 1 illustrates the variability encountered in different test samples.

The 10 bolts derived from 5 Guatemalan plantation trees ranged in specific gravity from 0.41 to 0.46 based on the ovendry weight and ovendry volume. The range of values for the individual test specimens was from 0.35 to 0.54 which probably covers the range for primavera.

Moisture Content

In the plantation material tested at the Forest Products Laboratory, no significant differences were found in moisture content from the pith outward. There were, however, appreciable differences between butt logs and second logs. The average moisture content for the 5 butt logs was 127 percent as compared to 97 percent for the second logs. For shipping purposes, green butt logs would weigh approximately 55 pounds per cubic foot and upper logs would weigh approximately 48 pounds per cubic foot.

Seasoning

Primavera was easily and rapidly kiln dried in about 9 days with little or no degrade from warping and checking. The modified T6-F3 drying schedule given in table 2 should give satisfactory results (3). There appeared to be no difference in the drying characteristics of sapwood and heartwood in drying the lumber from 8 bolts at the Laboratory.

Shrinkage and Movement

Shrinkage determinations made at Yale University (1) and the Forest Products Laboratory are in very close agreement and show that primavera possesses excellent dimensional stability.

It will be noted from table 4 that, although the total radial shrinkage is 3.14 percent and the total tangential shrinkage is 5.28 percent, the dimensional changes that can be expected under normal service conditions (between 65 and 30 percent relative humidity) will average 1.01 percent radially and 1.36

percent tangentially. The dimensional changes may be somewhat less than those in finished wood, because finishes tend to slow the rate at which wood gains or loses moisture. The average tangential movement in service would also be somewhat less than the table value because flat-sawn boards frequently contain some proportion of quartered and intermediate wood. The movement values are comparable to those of Central American mahogany.

Log Defects

The most common defect found in manufacturing primavera logs into lumber or veneer is referred to in the trade as "wild" or "wandering" heart. What causes the pith to deviate excessively from the center of the log is not known at the present time. The condition occurs in the wild trees as well as plantation-grown material. Whether it can be controlled through genetic selection of planting stock remains to be investigated. Brown stain, which occurs in streaks or patches, was present in the logs tested at the Forest Products Laboratory. Logs showing the brown streaks contained living beetle larvae, and the stain was found to extend upward and downward from the point of attack of the larvae. As with other species, the sapwood is vulnerable to attack by pinhole borers and fungus stain. These, however, can be readily controlled by the application of appropriate insecticides and fungicides immediately after the trees are felled.

Grade Yields

Lamb (2) has reported on the grade yields of 90 plantation-grown trees in Guatemala 32 years after planting. These trees produced 241 veneer logs from 18 to 31 inches in diameter and from 6 to 12 feet in length with a total log scale by the Doyle rule of 37,378 board-feet; and 208 logs not suitable for veneer from 12 to 17 inches in diameter and 6 to 12 feet long producing 15,286 board-feet of sawn lumber. The lumber grade yield was 20 percent Firsts and Seconds and 47 percent No. 1 common and better. The lumber from 8 logs at the Forest Products Laboratory graded out 25 percent Firsts and Seconds and 47 percent No. 1 common and better. The yield of upper grades is remarkably good by United States standards. Five of the principal hardwoods native to the United States average 43 percent of No. 1 common and better as compared with 72 percent for primavera.

Machining Properties

Although plantation-grown primavera has considerable grain variation which shows up as interlocked, spiral, and mild fiddleback the wood machines remarkably well. In planing, shaping, and sanding, primavera was well above the average, or about on a par with the better native species tested. In turning, boring, and mortising, primavera was average or very close to the average of 25 native hardwoods. Comparative percentage values obtained in tests made at the Forest Products Laboratory are given in table 5.

The planing tests were conducted under the following typically commercial conditions. Moisture content of test material 6 percent, depth of cut 1/16 inch, cutterhead speed 3,600 r. p. m., feed rate 36 f. p. m., cutting angle 30 degrees, knife bevel 40 degrees. Chipped grain, which usually accompanies the planing of woods with as much interlocked grain as primavera has, was entirely lacking. Although this set of conditions gave excellent results, more recent tests have shown that a 20° cutting angle is slightly better than a 30° cutting angle and that both are substantially better than a 40° angle.

Veneering Characteristics

Primavera flitches were heated in hot water at 200° F. for approximately 40 hours before slicing. The veneer produced under these conditions was tighter and smoother than the veneer cut at 180° F. Conditioning at the higher temperature appears to be the more desirable because of the very irregular grain of the wood. Primavera veneer of good quality was produced using slicer settings similar to those found satisfactory for slicing other face veneer woods (table 6). Iron tannate was not noticed on any of the veneer. Smoother and tighter veneer was produced by quarter slicing than by flat slicing.

Optimum conditions for drying the veneer were 200° F. for 7 minutes which produced a moisture content ranging from 3 to 7 percent. The shrinkage both in the quarter and flat dimension was low when compared to that of other commonly used face veneer woods. This highly desirable property indicates primavera would compare favorably with other face veneer species in such properties as freedom from face checking and warping. Sample panels of veneers were satisfactorily hot pressed with Tego film and probably could be glued readily with any of the commonly used wood glues.

Durability

Tests made at Yale University (4) rated the heartwood of primavera as very durable to durable upon exposure to both white-rot and brown-rot fungi.

The heartwood of primavera occupies a position intermediate between white oak and mahogany in resistance to moisture absorption. The weathering characteristics are good.

Mechanical Properties

The mechanical properties of primavera are given in table 7 and compared with mahogany (Swietenia macrophylla) from Central America. Mahogany is the heavier wood and in the green condition exceeds primavera proportionately in practically all properties. In the air-dry condition the differences are not as great, although, mahogany still maintains superiority in most properties. Air-dry primavera is superior to mahogany in shear parallel to the grain.

Because strength is not particularly essential in a cabinet wood, hardness was the only mechanical property determined on the plantation-grown material tested at the Forest Products Laboratory. The results of the hardness test are not included in the values given for this property in table 7. A total of 46 samples were taken from 8 of the logs and 4 hardness impressions were made on each specimen or a total of 184 side grain impressions. The average side hardness value of 720 pounds was obtained with the samples at an average moisture content of 11.2 percent. This value conforms with the average value for side hardness obtained on other samples at 12 percent given in table 7.

Uses

Primavera has been used in the furniture and cabinet industry of both Europe and the United States for many years, principally in the form of fine veneers and undoubtedly its future demand will be primarily for the same uses. The dimensional stability, ease of working, and pleasing appearance recommend primavera for solid furniture, paneling, interior trim, pattern, boat planking, and special exterior uses.

Wood Structure

Growth rings are demarcated by a narrow zone of marginal parenchyma. The growth rings may in some specimens be prominently marked by zones of larger pores in the earlywood or by a zone of darker wood in the latewood portion. The largest pores are just barely visible to the unaided eye and are solitary and in short radial multiples. The pores may be uniformly distributed or show a tendency toward an oblique or tangential arrangement, particularly in wide growth rings. Glistening greenish tyloses occur in the pores of the heartwood. The wood rays are just barely visible on transverse surfaces and indistinct on longitudinal surfaces. The wood rays are commonly 4- to 6-seriate, although wider rays up to 8-seriate may be found. Ripple marks or storied structure varies from regular to irregular and involves all the elements. The ripple marks are just barely visible to the unaided eye and occur at the rate of 80 to 100 per inch on the longitudinal surfaces.

Literature Cited

(1) Dickinson, Fred E., Hess, Robert W., and Wangaard, Frederick F.
1949. Properties and Uses of Tropical Woods I. Tropical Woods No. 95, pp. 104-108. Yale University, New Haven, Conn.

(2) Lamb, F. Bruce
1951. Primavera, Important Furniture Wood of Central America. Caribbean Forester Vol. 12, No. 2, pp. 75-83.

(3) Torgeson, O. W.
1957. Schedules for the Kiln Drying of Wood. U. S. Forest Products Laboratory Report No. D1791, Madison, Wis.

(4) Wangaard, Frederick F., and Muschler, Arthur F.
1952. Properties and Uses of Tropical Woods, III. Tropical Woods No. 98, pp. 149-154.

Table 1.--Specific gravity of primavera

Where tested and growth type	Specific gravity[1]
First Forest Products Laboratory shipment (old growth)	0.42
Second Forest Products Laboratory shipment (old growth)	.47
Yale University (old growth), 1 tree	.41
Yale University (second growth), 2 trees	.41 and .50
Forest Products Laboratory Guatemala plantation grown, 5 trees	.43

[1]Based on ovendry weight and ovendry volume.

Table 2.--Kiln-drying schedule for 4/4 primavera[1]

Moisture content		Dry-bulb temperature	Wet-bulb depression	Wet-bulb temperature
From	To			
Percent	Percent	°F.	°F.	°F.
Green	70	120	5	115
70	50	120	8	112
50	40	120	19	101
40	30	120	35	85
30	20	130	50	80
20	15	150	50	100
15	Final	180	50	130

[1]Modified T6-F3 Schedule (3).

Table 3.--Shrinkage of primavera from the green to ovendry condition

Where tested and growth type	Radial	Tangential	Longitudinal	Volumetric
	Percent	Percent	Percent	Percent
Yale University (old growth and second growth), 4 trees	3.1	5.1	0.24	9.1
Forest Products Laboratory (plantation grown), 5 trees	3.1	5.3	.28	8.5
Nine-tree average	3.1	5.2	.26	8.8

Table 4.--Shrinkage and movement in plantation-grown primavera[1]

	Number of tests	Shrinkage from green condition to			Movement from	
		65 percent relative humidity	30 percent relative humidity	Ovendry	Green to 65 percent relative humidity	65 to 30 percent relative humidity
		Percent	Percent	Percent	In. per ft.	In. per ft.
Radial	44	1.43	2.44	3.14	5/32	4/32
Tangential	122	2.90	4.26	5.28	11/32	5/32
Volumetric	92	.....	.....	8.50	.....	.....
Longitudinal	111	.108	.182	.277	Insignificant	Insignificant

[1] Five-tree average.

Table 5.--Machining characteristics of primavera compared with mahogany and the average of 25 American hardwoods

	Primavera	Mahogany	American hardwoods
	Percent	Percent	Percent
Planing -- perfect pieces	86	80	61
Shaping -- good to excellent pieces	46	68	25
Turning -- good to excellent pieces	82	89	79
Boring -- good to excellent pieces	100	100	89
Mortising -- fair to excellent pieces	88	100	70

Table 6.--Slicer settings used to cut primavera

Feed of knife carriage (veneer thickness)	Slicer knife		Pressure bar		
	Bevel	Angle of face	Bevel	Vertical opening	Horizontal opening
In.	Degrees	Degrees-min.	Degrees	In.	In.
1/28 (0.036)	22	90-20	12	0.030	0.028

Table 7.--Mechanical properties of primavera (Cybistax donnell-smithii) and Central American mahogany (Swietenia macrophylla)

Properties	Primavera[1]		Mahogany[2]	
	Moisture condition		Moisture condition	
	Green	12 percent	Green	12 percent
Specific gravity -- Ovendry weight and volume at test	0.39	0.46	0.45	0.49
Static bending				
Fiber stress at proportional limit...p.s.i.	4,450	7,760	6,280	7,790
Modulus of rupture.....p.s.i.	7,710	10,900	9,350	11,760
Modulus of elasticity.....1,000 p.s.i.	980	1,220	1,270	1,540
Work to proportional limit..in. lb./cu. in.	1.14	2.77	1.68	2.24
Work to maximum load.....in. lb./cu. in.	6.94	10.25	9.69	8.12
Compression parallel to grain				
Fiber stress at proportional limit...p.s.i.	2,990	4,530	3,960	4,660
Maximum crushing strength.....p.s.i.	3,630	6,140	4,550	6,680
Impact bending -- Height of drop causing complete failure (50-pound hammer).....in.	21	18	26	22
Compression perpendicular to grain -- Fiber stress at proportional limit.....p.s.i.	730	1,030	720	1,170
Shear parallel to grain -- Maximum shearing strength.....p.s.i.	1,050	1,710	1,320	1,310
Hardness				
End.....lb.	780	1,030	830	1,060
Side.....lb.	660	700	660	800
Toughness (5/8-inch specimen).....in.-lb.	94.0	.....	88.2	74.6
Total number of mechanical tests.....	200	274	291+	1,756

[1] Mechanical properties of primavera are based on the total number of tests made at Yale University School of Forestry and the Forest Products Laboratory.

[2] Except for the value for green toughness which was determined at Yale University, all data are derived from tests made at the Forest Products Laboratory. The Laboratory tests were made on logs and lumber obtained from various commercial sources and consisted of 7 logs, 20 test blanks presumed to be from different trees, and 38 backboards collected at five different veneer mills.

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