WOOD ANATOMY OF THE NEOTROPICAL SAPOTACEAE

XX. MANILKARA

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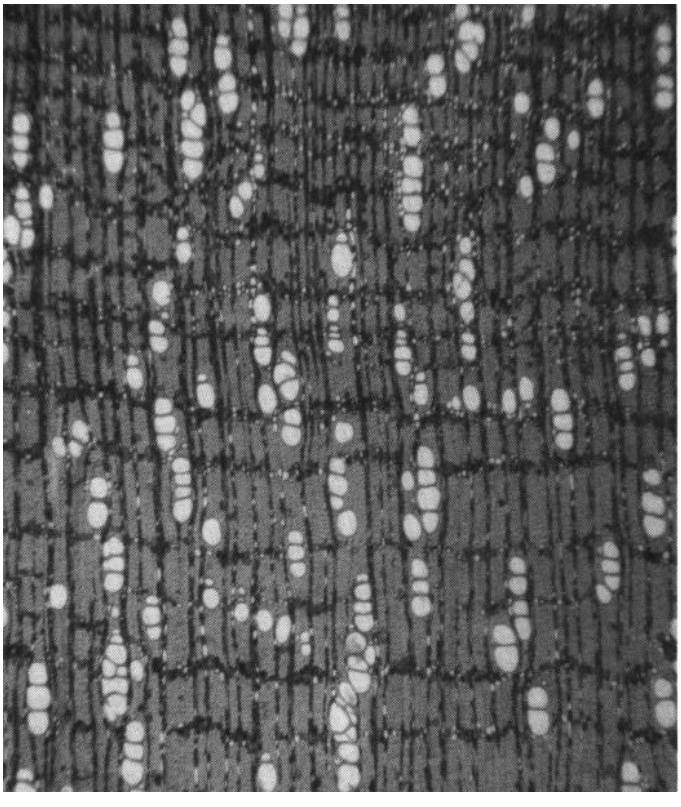

Abstract

Consisting of about 32 neotropical species, the genus Manilkara has a widespread distribution in the Americas ranging from southeastern Brazil and northern Bolivia as far north as southern Florida. It is probably the most important of the American genera, being the source of commercial timbers, fruits, and gums. Manilkara, as constituted here, consists of a generic complex that includes Achras, Muriaeanthe, Schaferodendron, Manilkariopsis, and Chiclea. This "complex" exhibits remarkable anatomical uniformity; the variability exhibited between "genera" is no greater than that which may be encountered within a single species.

Preface

The Sapotaceae form an important part of the ecosystem in the neotropics; for example, limited inventories made in the Amazon Basin indicate that this family makes up about 25 percent of the standing timber volume there. This would represent an astronomical volume of timber, but at present only a very small fraction is being utilized. Obviously, better information would help utilization-- especially if that information can result in clear identification of species.

The Sapotaceae represent a well-marked and natural family, but the homogeneous nature of their floral characters makes generic identification extremely difficult. This in turn is responsible for the extensive synonomy. Unfortunately, species continue to be named on the basis of flowering or fruiting material alone, and this continues to add to the already confused state of affairs.

This paper on Manilkara is the twentieth in a series describing the anatomy of the secondary xylem of the neotropical Sapotaceae. The earlier papers, all by the same author and under the same general heading, include:

I. Bumelia--Res. Pap. FPL 325
II. Mastichodendron--Res. Pap. FPL 326
III. Dipholis--Res. Pap. FPL 327
IV. Achrouteria--Res. Pap. FPL 328
V. Calocarpum--Res. Pap. FPL 329
VI. Chloroluma--Res. Pap. FPL 330
VII. Chrysophyllum--Res. Pap. FPL 331
VIII. Diploon--Res. Pap. FPL 349
IX. Pseudoxythece--Res. Pap. FPL 350
X. Micropholis--Res. Pap. FPL 351
XI. Prieurella--Res. Pap. FPL 352
XII. Neoxythece--Res. Pap. FPL 353
XIII. Podoluma--Res. Pap. FPL 354
XIV. Elaeoluma--Res. Pap. FPL 358
xv. Sandwithiodoxa--Res. Pap. FPL 359
XVI. Paralabatia--Res. Pap. FPL 360
XVII. Gambeya--Res. Pap. FPL 361
XVIII. Gomphiluma--Res. Pap. FPL 362
XIX. Chromolucuma--Res. Pap. FPL 363

Publication in this manner will afford interested anatomists and taxonomists the time to make known their opinions, and all such information is hereby solicited. At the termination of this series the data will be assembled into a single comprehensive unit.

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XX. *MANILKARA*

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Introduction

The genus *Manilkara* was described by Adanson in 1763 but was generally reduced to the earlier described (1753) *Mimusops* of Linneaus. Revived by Dubard in 1915, the first species assigned to *Manilkara* was the Asiatic species *M. kauki* (L.) Dub., and this has generally been considered to be the type. Much has been written regarding the relative merits of *Mimusops* versus *Manilkara*, but it is now generally conceded that the American species once attributed to *Mimusops* now properly belong to *Manilkara* which is pantropical in distribution. The genus *Mimusops* is now restricted to Africa and Asia.

The nomenclatural situation with regard to *Achras*, now usually included in *Manilkara*, is beyond the scope of this paper and the reader is referred for details to Gilly (7), Monachino (10), and others.[3/] The genus *Muriea*, once represented by the single American species *Muriea albescens* (Griseb.) Hartog ex Baill., is now restricted to south and east Africa, and the *M. albescens* has been transferred to *Murieanthe albescens* (Griseb.) Aubr. by Aubréville (1) and accepted by Baehni (2). However, Cronquist (3) made the new combination *Manilkara albescens* (Griseb.) Cronq. In 1942 Gilly (6) described two species in his new genus *Shaferodendron*, based on *Mimusops mayarensis* Ekm. ex Urb., and both were placed in synonomy under *Manilkara mayarensis* (Ekm.) Cronq. (3). In his studies of the "Sapodilla-Nispero complex," Gilly (7) created four new subgenera in the genus *Manilkara*, one of which, *Manilkariopsis*, was elevated to generic status by Lundell (8) in 1975. The latest addition to this already very complex "complex" was the description of the new genus *Chiclea* by Lundell (9) in 1976. For the latter, two species are described as new, and *Manilkara staminodella* Gilly is reduced to synonomy under *Chiclea staminodella* (Gilly) Lundell.

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3/ Underlined numbers in parentheses refer to literature cited at the end of this report.

From the anatomical point of view, the genus Manilkara (including the aforementioned segregate genera) is remarkably uniform, and the observed differences appear to be only quantitative. The anatomical differences between the segregate genera appear to be no greater than those existing between the different species of Manilkara. Cronquist (3) observes, "Our species of Manilkara are in general separated by strong floral characters, although they may be vegetatively very similar. Sterile specimens may be difficult or even impossible to determine with certainty, even after one is familiar with the entities involved, except as vegetatively similar species are eliminated by geographic considerations." To this must be added the observations of Ducke (5), "The greatest difficulty in studying species of Manilkara on herbarium specimens is the high variability in size and shape of the leaves which often appear successively on the same tree in two very different season-forms. At the principal flowering period, usually at the end of the rainy season, branchlets densely covered with flowers have comparatively small and stiff leaves, often with rounded apex. At all other seasons, however, on the same tree few-flowered branchlets are sometimes observed with leaves similar to those of the sterile branches, namely comparatively large and thin and often a little acuminate at the apex."

Record (11) provided general and anatomical descriptions of the wood of Achras and Manilkara, which are practically identical, and at the time did not mention the great similarity in the anatomy of the "two" genera. The occurrence of vascular tracheids was not mentioned for Manilkara, but in the general family description their occurrence was noted for Bumelia, Henoonia (Solanaceae), and Paralabatia.

Cronquist (3) cites 13 species of Manilkara native to Florida, the Caribbean, Mexico, and-Central America. Three of these are known only from the type localities, and several others have rather restricted ranges. Monachino (10) listed 22 species for the South American area, three of which also occur in the Caribbean and Central America.

Twenty-six named species were available for this study, but two of these (amazonica and huberi) have been reduced to synonomy by Monachino (10), and nitida was reduced to synonomy by Cronquist (3). In addition, four of Gilly's species (catingae, froesii, negrosensis, and solimoesensis) apparently are herbarium names only, and their status is uncertain. For comparative purposes the wood of the generic type (M. kauki) has been included here. Because of the large number of wood specimens examined (254) which came from all parts of the known range of Manilkara, it is safe to assume that the examination of additional species would not alter to any significant degree the already observed variability.

Manilkara is probably the most important genus of the neotropical Sapotaceae, providing timbers of commercial significance, delicious fruits, and the balata gum and chicle.

Description

This study is based on the examination of 254 specimens representing the entire range of Manilkara in the neotropics. The wood of M. kauki was included here for comparative purposes since it is the generic type. Twenty-six named species plus the southeast Asia kauki were available for this research and are given as follows (numbers in parentheses refer to the number of wood specimens available for each species): albescens (Griseb.) Cronquist (13), amazonica Chev. (8), bidentata (A. DC.) Chev. (49), catingae Gilly (1), chicle (Pittier) Gilly (11), elata (Fr. Allem.) Monachino (9), excelsa (Ducke) Standley (1), floribunda (Mart.) Dubard (4), froesii Gilly (1), huberi (Ducke) Chev. (13), inundata (Ducke) Ducke (1), jaimiqui (Wright) Dubard (15), kauki (L.) Dubard (2), longiciliata Ducke (1), longifolia (A. DC.) Dubard (2), meridionalis Gilly (1), negrosensis Gilly (2), nitida Dubard (1), paraensis (Huber) Standley (1), rufula (Miq.) Lam (3), salzmannii (A. DC.) Lam (3), sideroxylon (Griseb.) Dubard (1), solimoesensis Gilly (6), staminodella Gilly (1), surinamensis (Miq.) Dubard (7), williamsii Standley (1), zapotilla (Jacq.) Gilly, and unassigned (48). Table 1 lists the specimens that are backed or believed to be backed by herbarium material at some herbarium. Specimens from commercial or trade sources, even though named, have been eliminated from this listing because their specific identity will always remain in doubt.

General: Heartwood a drab red-brown when freshly cut, soon changing to shades of brown or dark brown to almost black (superficially) in old specimens. Sapwood appreciably lighter in color and usually separated from the heartwood by a transitional zone. Growth rings vague and indistinct. Wood hard, heavy, straight-grained (occasionally curly figure) with little if any luster. Specific gravity (at a moisture content of 6-7 pct) ranges from 0.73 to 1.23, the lowest values found in juvenile wood or specimens free of heartwoods. Species averages range from 0.91 to 1.13 with an overall average of 1.03. Heartwood of albescens and jaimiqui frequently have an oily appearance and feel somewhat oily.

Anatomical:

Pores essentially diffuse in most species (figs. 1,3); tending to echelon arrangement (fig. 5) or a clustered-echelon arrangement (fig. 7). Pores commonly in radial multiples of 2 to 4 and occasionally to 6; infrequently longer. Maximum pore diameter of individual specimens ranges from 89 to 197 µm; smallest in the generic type kauki (aver. 83 µm), largest in specimens of huberi and surinamensis (aver. 181 and 1.97 µm, respectively). Generic average is 122 µm.

Vessel member length averages 690 µm) for all species; shortest in williamsii (480 µm) and longest in nitida (890 µm). These particular species were represented by a single specimen and hence the values cannot be considered representative. A more representative range of averages may be attributed to jaimiqui (with the shortest average of 550 µm) and huberi (with the longest aver. of 760 µm). Tyloses commonly thin-walled but frequently thick-walled or sclerotic in the denser specimens. Very large crystals were observed frequently in the tyloses of albescens and jaimiqui, in most instances would be classified as two-sized; lacking or very sporadic occurrence in the other species examined. Intervessel pitting of 6 to 8 µm diameter was common to all specimens, a most unusual situation considering the number of species and specimens examined. Perforation plates simple.

Axial parenchyma typically banded (figs. 1-8), variably spaced, frequently discontinuous; locally diffuse. The individual bands irregularly 1 to 3 seriate. Many to all of the heartwood cells filled with brown organic deposits. Crystalliferous strands common in the North American specimens and frequently two-sized, particularly in albescens and jaimiqui; in most South American specimens the cells may contain 2 to 4 rhombic crystals or occur in short multiples thereof; crystals were found to be completely lacking in a few South American specimens (at least in the material available for study). Silica and microcrystals not observed.

Wood rays 1 to 2 seriate and may be, in part, 3 to 4 seriate; heterocellular, vertical fusions frequent. The maximum body height of the 1 to 4 seriate portion ranges from 79 to 552 µm; very inconsistent between and within species and of no diagnostic value. Vessel-ray pitting irregular in shape and size. Brown deposits very common. Rhombic crystals commonly present in the square or erect cells of albescens and jaimiqui and frequently two-sized; occurring in vertical files of four crystals in the tall erect marginal cells and as a cluster of four crystals in the square marginals. Crystals generally much less abundant in the other species. Short, horizontal files of small crystals were observed in the tabular cells of several specimens. Lateral walls of square and erect marginal cells conspicuously pitted, occasionally approaching the disjunct condition. Silica and microcrystals not observed.

Wood fibers thick walled; the fiber length averages for all specimens ranging from 1.07 mm to 186 mm with an overall species average of 1.51 mm. Vascular tracheids common (paratracheal).

For the species summary, see table 2.

Diagnostic features: Heartwood dull red-brown to brown and dark brown; majority of heartwood specimens (thoroughly dry) will sink in water; parenchyma banded; pores diffuse to echelon arrangement; axial parenchyma

with few to many crystals; silica absent. The only possible confusion could be with Dipholis and Mastichodendron both of which have crystal strands and are silica free but differ from Manilkara in that both have reticulate parenchyma.

Notes

Manilkara kauki, the generic type from southeast Asia, is practically identical with specimens of jaimiqui from southern Florida. The growth rings are relatively distinct in kauki, and if this is a constant feature it would represent the only character that would separate these species.

During the sectioning of Manilkara wood blocks, it was observed that some of the blocks were apparently "overdone" when utilizing the time-temperature schedule for softening in 4 percent ethylenediamine, particularly those that were dark colored and with specific gravities in excess of 1.00. In these instances it was observed that the ethylenediamine solution would become opaque after the sectioning blocks had been soaking for a 24-hour period. It is well known that extractives contribute to the specific gravity value as does also the ash content. To determine precisely the amount of extractive and ash, two samples were selected of the same specific gravity. The specimens so tested were a dark heartwood sample of albescens and a lighter colored heartwood sample of bidentata, each with a specific gravity of 1.07. Sawdust prepared from these specimens was extracted with a solution of 4 percent ethylenediamine and the following results were obtained: bidentata produced an extractive content of 14.05 percent and albescens 22.10 percent. These results, in effect, reduced the specific gravity of bidentata to 0.92 and that of albescens to 0.83. The total ash content determined for bidentata was 0.63 percent and 4.29 percent for albescens, findings which further reduced the specific gravity values to 0.91 and 0.80 respectively. Subsequently, the heating time in ethylenediamine was reduced by approximately one-half to compensate for the lowered or "true" specific gravity, producing a marked increase in the quality of the transverse sections cut on the microtome.

Table l.--Herbarium-backed wood specimens of *Manilkara* utilized in this study

Species	Collector and number	Source	Wood collection and numbers[1/]
albescens	Fors 35	Cuba	SJR 13366
	Graves s.n.	Cuba	SJR 4996
	Scarff 3	Dominican Republic	SJR 32186
	Scarff 9	Dominican Republic	SJR 32192
	Scarff 18 E	Dominican Republic	SJR 35359
	Schiffino 2	Dominican Republic	SJR 35213
	Schiffino A 2	Dominican Republic	SJR 35136
amazonica	Bastos s.n.	Brazil	RB 3086
	Ducke 88	Brazil	SJR 21347
	Krukoff 1440	Brazil	MAD 32865
	Oliveira 3121	Brazil	
	Pires et al. 51770	Brazil	MAD 21463
	Rodrigues and Coehlo 1936	Brazil	INPA 829
bidentata	BAFOG 258	French Guiana	SJR 50882
	BAFOG 263	French Guiana	SJR 50886
	BAFOG 1240	French Guiana	SJR 32964
	BAFOG 1272	French Guiana	MAD 32966
	Beard (318) 511	St. Lucia	SJR 49521
	Bertin 3039	French Guiana	SJR 12733
	Bertin s.n.	French Guiana	SJR 6401
	BW 36 Uw2262	Surinam	MAD 32931
	Conservator of Forests	Guyana	SJR 32838
	Cox 2	Panama	SJR 6734
	Englerth-Goytia	Puerto Rico	MAD 20007
	Forest Department 54	Guyana	SJR 5104
	Forest Department 2936	Guyana	MAD 4188
	Goytia 161	Puerto Rico	MAD 23165
	Goytia 162	Puerto Rico	MAD 23166
	Goytia 172	Puerto Rico	MAD 23176
	Holdridge 6208	Panama	MAD 24806
	Kluge 55	Panama	SJR 7345
	Maguire 23506	Guyana	MAD 11912
	Miller 1622	Puerto Rico	MAD 20851
	Navy-Yale 163	Puerto Rico	SJR 45556
	Navy-Yale 204	Guyana	SJR 45565
	Navy-Yale 205	Guyana	SJR 45566
	Navy-Yale 206	Guyana	SJR 45567
	Navy-Yale 242	Surinam	SJR 45573
	Pittier 2699	Panama	MAD 19266
	Pittier 4318	Panama	MAD 5803
	Pittier 11848	Venezuela	SJR 7945
	Rose 18	Venezuela	SJR 2673
	Smith, A.C. 3204	Guyana	SJR 35858
	Stahel 4	Surinam	SJR 41084
	U.S. Trop. Station 21	Puerto Rico	SJR 50524
	Woodworth 206	Virgin Islands	SJR 40173

Table 1.--Herbarium-backed wood specimens of *Manilkara* utilized in this study--con.

Species	Collector and number	Source	Wood collection and number[1/]
catingae	Froes 437	Brazil	A 27502
chicle	Conservator of Forests 229	Belize	SJR 37257
	Dugand 535 (181)	Colombia	SJR 27081
	Dugand 772 (343)	Colombia	SJR 29620
	Dugand 1042 (490)	Colombia	SJR 33781
	Forgeson 67 A	Panama	SJR 50969
	Stevenson 54	Belize	SJR 8822
	Stevenson 184	Belize	SJR 35106
	Whitford and Stadtmiller 75	Guatemala	MAD 10848
	Williams 9432	Mexico	SJR 34855
	Williams 9574	Mexico	MAD 16146
elata	Filho and Magnani	Brazil	RB 2957
	Filho and Rizzini	Brazil	RB 5473
	Froes 834	Brazil	A 27536
	Froes 1079	Brazil	A 28018
	Servico Florestal 42	Brazil	SJR 44736
excelsa	Krukoff 5496	Brazil	MAD 18711
floribunda	Froes 1031	Brazil	A 4561
	Froes 1032	Brazil	A 18223
	Froes 1044	Brazil	A 28001
	Froes 1055	Brazil	A 28006
froesii	Froes 1068	Brazil	A 28012
huberi	Bastos s.n.	Brazil	RB 3107
	Black 47-963	Brazil	SJR 45799
	Capucho 367	Brazil	SJR 21670
	Dahlgren 11	Brazil	SJR 16790
	Ducke 140	Brazil	SJR 22600
	Krukoff 1723	Brazil	MAD 32867
	Michigan 3926	Brazil	SJR 21082
	Michigan 3929	Brazil	SJR 21083
	Monteira da Costa 319	Brazil	MAD 23664
	Nagib Saddi M-16 (898)	Brazil	RB 6243
	Oliveira 3107	Brazil	
	Silva 3374	Brazil	
inundata	Krukoff 4745	Brazil	MAD 18543

Table 1.--Herbarium-backed wood specimens of Manilkara utilized in this study--con.

Species	Collector and number	Source	Wood collection and number[1/]
jaimiqui	Caldwell 8748	Florida	SJR 49275
	Conservator of Forests 66	Jamaica	SJR 47996
	Fors 55	Cuba	SJR 13371
	Gill and Whitford 81	Cuba	SJR 9092
	Marts and Smith s.n.	Florida	SJR 45000
	Stern 112	Florida	SJR 49438
	Stern and Brizicky 239	Florida	SJR 51082
	Stern and Brizicky 295	Florida	SJR 51124
	Stern and Brizicky 503	Florida	SJR 51285
kauki	Forest Department 4463	Java	SJR 22417
	Smith, A. C. 1450 (3373)	Fiji	SJR 28229
longiciliata	Azevedo 2025	Brazil	SJR 47874
longifolia	Filho and Rizzini s.n.	Brazil	RB 5488
	Froes 1080	Brazil	A 28019
meridionalis	Fors 105	Cuba	MAD 13806
negrosensis	Froes 833	Brazil	A 27535
	Krukoff 8691	Brazil	MAD 32851
nitida	Bernardi	Venezuela	MAD 24286
paraensis	Rosa, N. A. 1384	Brazil	
rufula	Froes 1042	Brazil	A 24658
	Froes 1052	Brazil	A 28005
	Froes 1056	Brazil	A 28007
salzmannii	Curran 17	Brazil	SJR 4687
	Souza 33	Brazil	SJR 36087
sideroxylon	IICA J-14	Jamaica	MAD 33912
solimoesensis	Froes 247	Brazil	A 26367
	Froes 250	Brazil	A 27421
	Froes 251	Brazil	A 27422
	Froes 253	Brazil	A 27424
	Froes 276	Brazil	A 27432
	Krukoff 8628	Brazil	MAD 32852
	Krukoff 8643	Brazil	MAD 36348
staminodella	Stevenson 5	Belize	SJR 8940

Table 1. --Herbarium-backed wood specimens of *Manilkara* utilized in this study--con.

Species	Collector and number	Source	Wood collection and number[1/]
surinamensis	Lao 56 and 90	Peru	MAD 22227
	Williams 893	Peru	SJR 17455
	Williams 2260	Peru	SJR 17853
	Williams 5735	Peru	SJR 18221
	Wurdack and Adderley 42737	Venezuela	SJR 54116
williamsii	Williams 11860	Venezuela	MAD 32888
zapotilla	Caldwell 8753	Florida	SJR 49280
	Conservator of Forests 50	Belize	MAD 32882
	Conservator of Forests s.n.	Belize	MAD 7398
	Conservator of Forests s.n.	Belize	SJR 7401
	Durland 35	Dominican Republic	SJR 5055
	Fors 71	Cuba	MAD 13781
	Haufe et al. 34	Honduras	MAD 23103
	Kluge 27	Mexico	SJR 6192
	Maina 111	Mexico	MAD 25228
	MEXF 115	Mexico	MAD 25220
	Stern 34	Florida	SJR 49393
	Stern 119	Florida	SJR 49445
	Stern and Brizicky 309	Florida	SJR 51134
	Stevenson s.n.	Belize	SJR 8828
	Stevenson 183	Belize	SJR 35105
	Steyermark 44636	Guatemala	MAD 7659
	Whitford and Stadtmiller 86	Guatemala	SJR 3745
	Williams 8260	Mexico	SJR 34543
	Wilson F-25	Florida	MAD 15968
unassigned	Breteler 5046	Venezuela	SJR 55685
	Cuatrecasas 16707	Colombia	SJR 43098
	Froes 1091	Brazil	A 28023
	Froes 2000	Brazil	A 28024
	Irmay 124	Bolivia	SJR 47774
	Irmay 131	Bolivia	SJR 47781
	Krukoff 4681	Brazil	MAD 18531
	Krukoff 6292	Brazil	MAD 12401
	Krukoff 6624	Brazil	MAD 12575
	Shank 10	Nicaragua	SJR 46804
	Stevenson 8	Belize	SJR 8943
	Williams 14489	Venezuela	SJR 41591
	Williams 15640	Venezuela	SJR 42229

1/ A = Harvard University, Cambridge, Mass.; INPA = Instituto National de Pesquisas da Amazonia, Manaus, Brazil; MAD = Forest Products Laboratory, Madison, Wis.; RB = Jardim Botanico do Rio de Janeiro, Brazil; SJR = Samuel J. Record Memorial Collection, formerly at Yale University but now housed at Madison, Wis.

Table 2.--*Manilkara* species summary

Species	VML[1/] range	Average	FL range	Average	MP range	Average	MB range	SP GR range	Average	SP
	µm		mm		µm		µm			
albescens	460-740	630	1.07-1.63	1.42	102-142	119	118-355	0.96-1.16	1.07	13
amazonica	580-800	690	1.27-1.56	1.42	87-158	129	134-323	0.94-1.12	1.03	8
bidentia	600-880	720	1.25-1.80	1.50	79-158	125	118-434	0.88-1.19	1.05	49
catingae		640		1.42		102	102		1.09	1
chicle	570-820	680	1.52-1.84	1.66	102-134	119	197-394	0.96-1.07	1.01	11
elata	620-760	700	1.35-1.68	1.54	79-158	131	165-433	0.89-1.10	0.97	9
excelsa		750		1.64		142	394		0.99	1
floribunda	580-700	640	1.43-1.55	1.50	87-110	97	252-331	0.95-1.06	1.01	4
froesii		690		1.52		110	276		0.91	1
huberi	680-850	760	1.43-1.75	1.61	118-181	149	181-418	0.98-1.11	1.05	13
inundata		770		1.76		165	433		1.04	1
jaimiqui	430-660	550	1.10-1.41	1.22	87-135	111	134-355	0.85-1.09	0.99	15
kauki	620-730	675	1.29-1.47	1.38	79- 87	83	118-236	0.98-1.12	1.05	2
longiciliata		710		1.36		102	220		1.11	1
longifolia	660-730	695	1.41-1.60	1.50	110-134	122	236-355	0.96-0.98	0.97	2
meridionalis		560		1.32		126	236		1.09	1
negrosensis	650-760	705	1.33-1.63	1.48	142-142	142	173-236	1.02-1.07	1.04	2
nitida		890		1.74		110	95		1.00	1
paraensis		790		1.67		110	220		1.00	1
rufula	580-710	650	1.50-1.60	1.55	87-134	110	213-276	0.97-1.02	1.00	3
salzmannii	700-760	730	1.54-1.70	1.61	110-142	131	394-489	0.96-1.11	1.02	3
sideroxylon		690		1.66		142	276		1.08	1
solimoesensis	520-870	740	1.36-1.67	1.50	110-165	135	158-315	0.93-1.12	1.03	6
staminodella		610		1.55		126	197		0.97	1
surinamensis	580-860	690	1.30-1.86	1.53	95-197	130	173-552	0.90-1.06	0.98	7
williamsii		480		1.29		95	315		1.13	1
zapotilla	510-870	640	1.17-1.77	1.49	79-173	117	95-394	0.73-1.23	1.05	47
unassigned	600-980	740	1.33-1.73	1.57	79-165	130	79-512	0.85-1.16	1.04	48
Genus	430-980	690	1.07-1.86	1.51	79-197	122	79-552	0.73-1.23	1.03	

1/ VML = vessel member length; FL = fiber length; MP = maximum tangential pore diameter; MB = maximum height of 2 to 4 seriate portion of wood ray; SP GR = specific gravity based on weight and volume at approximately 6 to 7 pct; SP = number of specimens examined.

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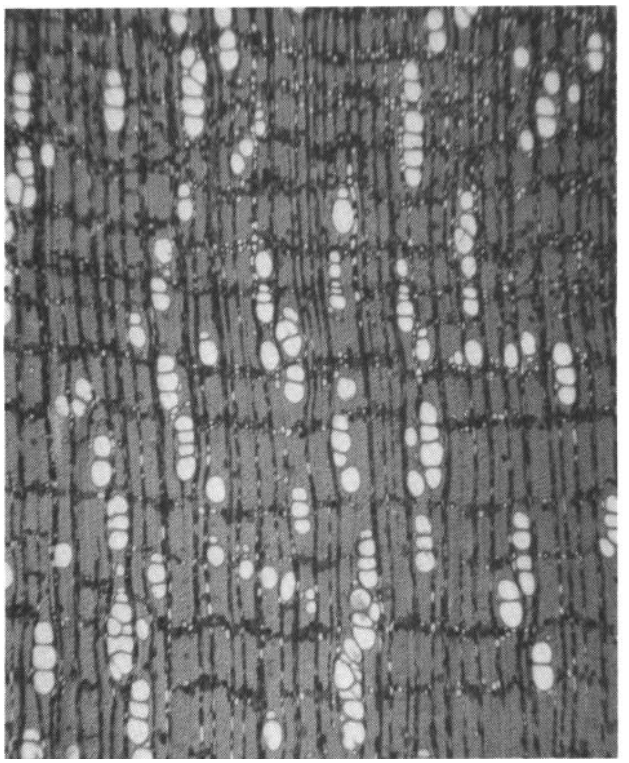

Figure 1. --Manilkara rufula, pore and parenchyma arrangement (Froes 1052) x 30.

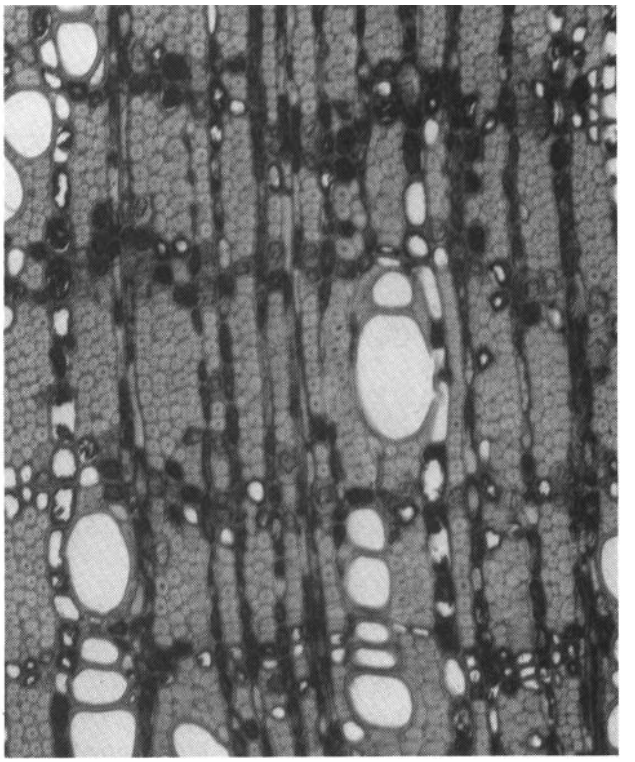

Figure 2. --M. rufula, detail of parenchyma variations (Froes 1052) X 110.

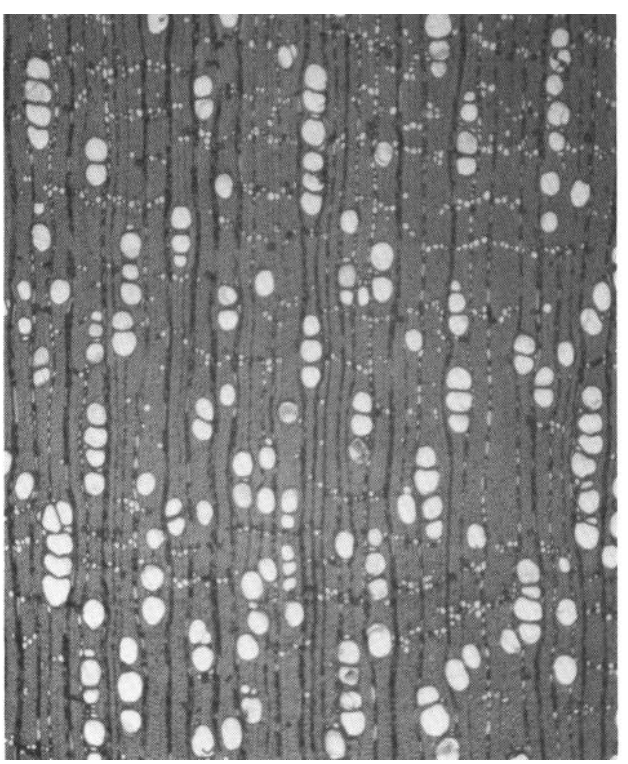

Figure 3. --M. bidentata, pore and parenchyma arrangement (Goytia 163) X 30.

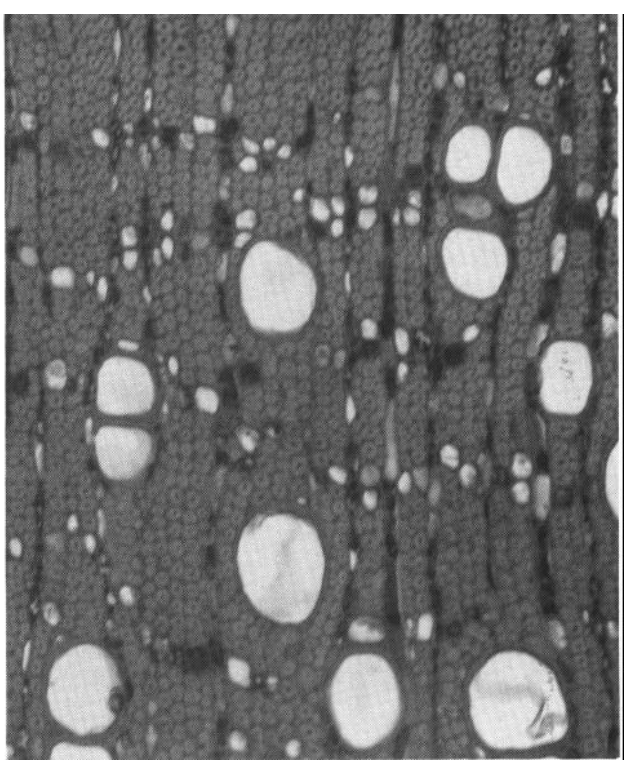

Figure 4. --M. bidentata, detail of parenchyma variations (Goytia 163) X 110.

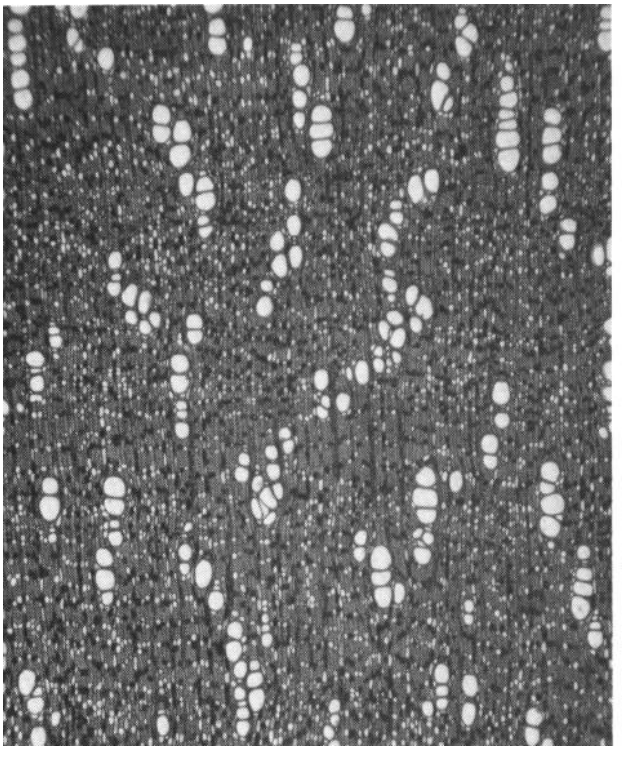

Figure 5.--M. jaimiqui, pore and parenchyma arrangement (Marts and Smith) X 30.

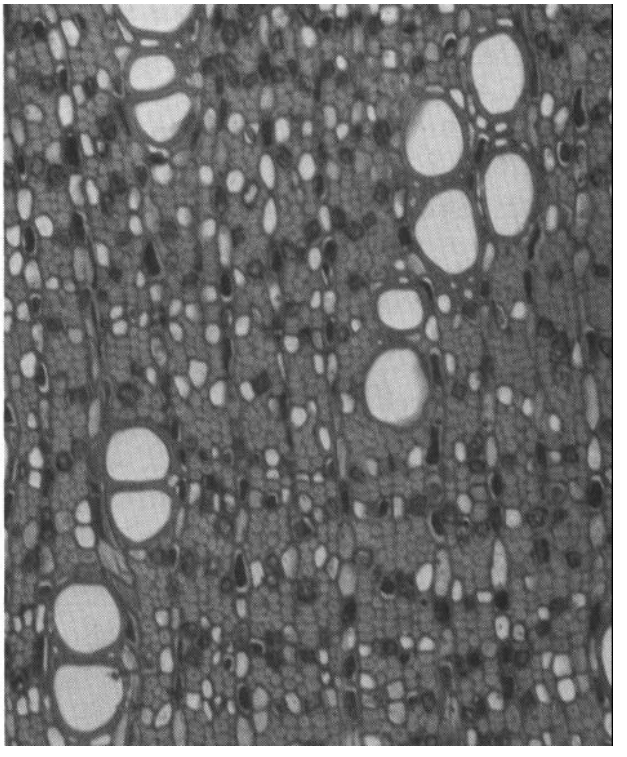

Figure 6.--M. jaimiqui, detail of parenchyma variations (Marts and Smith) X 110.

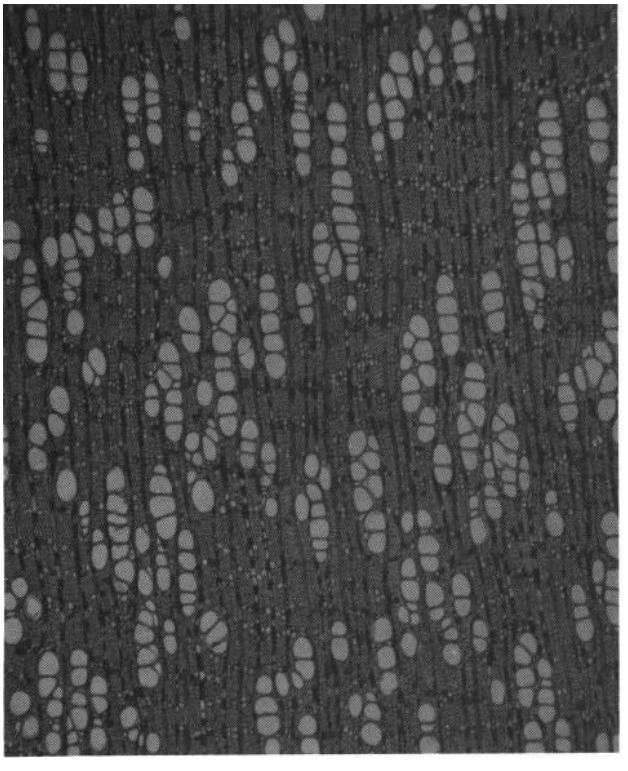

Figure 7.--M. sp., pore and parenchyma arrangement (Froes 1091) X 30.

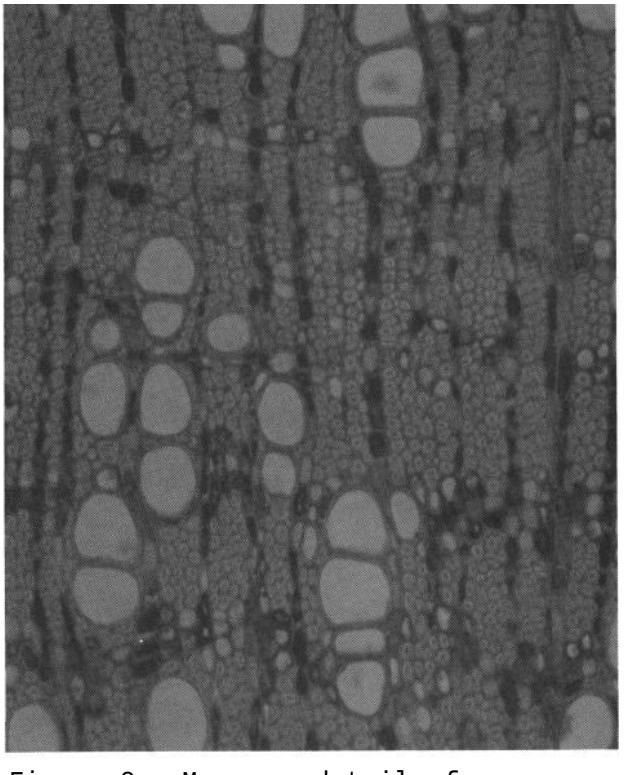

Figure 8.--M. sp., detail of parenchyma variations (Froes 1091) X 110.

U.S. Forest Products Laboratory

Wood Anatomy of the Neotropical Sapotaceae: XX. Manilkara, By B. F. Kukachka, Madison, Wis., FPL
14 p. (USDA For. Serv. Res. Pap. FPL 371).

Consisting of about 32 neotropical species, the genus Manilkara has a widespread distribution in the Americas ranging from southeastern Brazil and northern Bolivia as far north as southern Florida. It is probably the most important of the American genera, being the source of commercial timbers, fruits, and gums. Manilkara, as constituted here, consists of a generic complex that includes Achras, Muriaeanthe, Schaferodendron, Manilkariopsis, and Chiclea. This "complex" exhibits remarkable anatomical uniformity; the variability exhibited between "genera" is no greater than that which may be encountered within a single species.

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