COMPARISONS OF SPECIES OF WOOD FOR GUNSTOCKS

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COMPARISONS OF SPECIES OF WOOD FOR GUNSTOCKS

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The use of large quantities of black walnut for gunstocks, with its consequent inroads upon merchantable stands, prompted the Forest Products Laboratory during the present war to investigate the possibility of gunstock production from other species. Studies of alternative species showed black cherry (Prunus serotina), red maple (Acer rubrum), yellow-poplar (Liriodendron tulipifera), sugar maple (Acer saccharophorum), and yellow birch (Betula lutea) to be suitable for such use.

A comprehensive study of black walnut by the Forest Products Laboratory provided a basis for its comparison with other species.[2] Data were obtained on the rate of growth of black walnut, its variation in specific gravity for both open-grown and forest-grown trees, measurements of shrinkage in the radial, tangential, and longitudinal directions with respect to the orientation of samples in the trees, and tests of hardness for wood representing various types of growth.

Subsequent studies produced comparative data on these characteristics for a number of other species recommended as of possible usefulness for gunstocks (tables 1 and 2 and figure 1). In addition to the Laboratory tests of wood quality, gunstock blanks were experimentally machined by several cooperating gunstock manufacturers, who subjected the recommended species to the manufacturing procedure and proofing tests given black walnut stocks.

The species studied were also considered with respect to their availability. Several are more abundant than black walnut in certain areas and doubtless can be brought to shipping and manufacturing points with greater ease and lower hauling and transportation costs than can black walnut. Such advantages may be enhanced by logging of more than one species in the same forest. Differences in log prices ordinarily favor these so-called "substitute" species.

Comparison of Species

Black cherry closely resembles black walnut in most of the characteristics investigated. Samples gave a somewhat smaller range in specific

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

[2] "Black Walnut for Gunstocks," by B. H. Paul. Southern Lumberman, April 15, 1943.

gravity, with an average of 0.49 as compared with 0.52 for black walnut. In radial, tangential, and end hardness, black cherry wood averaged a little lower than black walnut in the green condition. In the dry condition, however, end hardness of black cherry averaged slightly more than that of black walnut. Differences were greater toward the upper limits of the ranges than at the lower limits; that is, while much black walnut was considerably harder than black cherry, none of the black cherry was softer than the softest black walnut.

Average shrinkage in volume was 12.9 percent for black cherry and 13.2 percent for black walnut. Tangential shrinkage of black walnut averaged 9.0 percent, that of black cherry 8.7 percent. Radial shrinkage of black cherry was decidedly less, averaging only 4 percent as compared with 5.9 percent for black walnut. There was only a slight average difference between longitudinal shrinkage of black cherry and black walnut, the averages being 0.27 and 0.25 percent, respectively.

Black cherry is reported to be rather plentiful in the northern Appalachian region, particularly in Pennsylvania, West Virginia, and New York. Many second-growth stands now of merchantable size contain a considerable proportion of black cherry.

Red maple follows closely the specific gravity range of black cherry with a low value of 0.40 and a high value of 0.60. The average is 0.51, very close to the average for black walnut. In hardness, red maple and black cherry were about the same in the green condition. This was also true for side hardness of these species when dry, but average end hardness of dry red maple exceeded that of dry black cherry by about 10 percent.

Shrinkage values for red maple in all directions are well within or close to corresponding limits for black walnut and black cherry. Its radial shrinkage is relatively small, ranging from 2.6 to 4.4 percent and averaging 4.0 percent, the same as black cherry. Longitudinal shrinkage keeps well within the range for black walnut but averages slightly more.

Red maple grows from Canada to Florida and from the Atlantic Coast westward to Texas and the Plains States. It is a common tree in moist situations, becoming a swamp tree in the South. Red maple is fairly abundant in many parts of its range, far exceeding either walnut or black cherry in total volume and availability.

Second-growth yellow-poplar frequently produces wood of relatively high density well within the specific gravity range of black walnut. Trees selected for high density produced wood ranging in specific gravity from 0.34 to 0.60. More than 75 percent of the samples tested fell within the specific gravity range of black walnut and coincided fairly well with the ranges of black cherry and red maple. Yellow-poplar having a specific gravity of less than 0.42, based on its weight when oven-dry and its volume when green, is not recommended for gunstocks.

Shrinkage of yellow-poplar is relatively low. Radial shrinkage averaged 4.2 percent, tangential shrinkage 7.7 percent, and longitudinal shrinkage 0.27 percent.

Hardness of yellow-poplar in the green condition averaged lower than that of the other species investigated, but most of the individual values for samples with a specific gravity above 0.42 were within the hardness range of black walnut. The same was true for material tested in the air-dry condition (figure 1). While greater care must be taken to select yellow-poplar trees that contain material of suitable weight and hardness, such trees give a high yield in gunstocks because of their relative freedom from large knots, cross grain, and other defects.

Yellow-poplar grows from central New York and southern Michigan to northern Florida, west as far as Illinois and, in the South, as far as southeastern Missouri, eastern Arkansas, and northeastern Louisiana. The high-density wood is found in thrifty second-growth trees on good sites. In order to utilize this species successfully for gunstocks, a method of selection of the trees in the woods is useful.[3]

Specific gravity values of sugar maple are within the range of black walnut but occur most frequently in the upper part of its range. The average value for sugar maple is 0.58, as compared with 0.52 for black walnut. In the United States sugar maple has ordinarily been considered somewhat too heavy for gunstocks. It has, however, been used for British stocks produced in Canada as well as in the United States to fill lend-lease orders, and evidently has given satisfactory service.

Sugar maple averages a little higher than black walnut in tangential shrinkage, yet the range 8.4 to 11.0 was no greater. Radial shrinkage values for sugar maple fell within a narrower range and averaged lower than black walnut. Along with higher specific gravity values, sugar maple has greater hardness than the other species under consideration.

Birch has been used as a source of gunstocks in Europe, and our native yellow birch has been used to supply machine gun butts and stocks for nonmilitary guns. Its use for this purpose has, however, been restricted by the freezing of this species for aircraft veneer. Nevertheless, there are considerable quantities of yellow birch in logs below veneer grade that could be used advantageously for gunstocks. This is a source of supply that could be considered for lend-lease gunstocks or gunstock blanks.

The specific gravity range of yellow birch is closer to that of sugar maple than to that of the other species investigated, the total range being 0.47 to 0.63 and the average value 0.55. Its radial shrinkage, 5.9 percent, averages higher than that of any of the other species, while its average tangential shrinkage is midway between that of black walnut and sugar maple. The hardness of yellow birch is about the same as that of black cherry when tested in a green condition and slightly higher than that of black cherry when tested in an air-dry condition.

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[3] "A Field Method of Determining Specific Gravity by Use of Increment Cores or Auger Chips," Forest Products Laboratory Report No. 1587.

Yellow birch grows in the Lake States, New England, New York, New Jersey, Pennsylvania, and south along the mountains into Georgia. There are still large stands of yellow birch saw timber in the Lake States, the Northeast, and the northern Appalachian region.

Broaden Sources of Supply

The wide range found in the important characteristics of black walnut indicates that, unless some special attention is given to the selection of black walnut, the other species investigated can supply material having equal physical and mechanical properties. Regardless of the species chosen, the best results in manufacture will be obtained if an attempt is made to segregate the material on a basis of uniform weight and exclude material with extremely high or extremely low values.

The use of additional species having satisfactory characteristics from the standpoint of wood quality will facilitate gunstock production in the following ways: (1) create a larger source; (2) make it possible to log for more than one species in a locality; (3) shorten log hauls, thus expediting production and cutting logging costs; (4) reduce length of rail shipments of gunstock blanks; (5) expedite kiln drying by using species that will dry in a shorter time than black walnut; and (6) utilize species of lower commercial value.

Table 1.--Comparison of ranges and averages of specific gravity and radial, tangential, and longitudinal shrinkage of species recommended for gunstocks

Species	Specific gravity[1]		Shrinkage[2]					
			Radial		Tangential		Longitudinal	
	Range	Average	Range	Average	Range	Average	Range	Average
			Percent	Percent	Percent	Percent	Percent	Percent
Black walnut	0.40-0.67	0.52	4.0-7.2	5.9	6.0-14.0	9.0	0.0 -1.23	0.25
Black cherry	.42- .58	.49	3.4-4.6	4.0	6.1-13.0	8.7	.0 - .85	.27
Red maple	.40- .60	.51	2.6-4.4	4.0	5.6-11.6	8.5	.12-1.03	.31
Yellow-poplar (second growth)	.34- .60	[3].45	3.2-5.1	4.2	4.6- 9.5	7.7	.9 - .49	.27
Sugar maple	.49- .67	.58	4.3-5.4	4.9	8.4-11.0	9.5	.....	.....
Yellow birch	.47- .63	.55	5.9-8.4	7.2	5.6-11.4	9.2	.....	.....

[1]Based on weight when oven-dry and volume when green.

[2]Green to oven-dry condition, percentage of green dimensions.

[3]Average value is for samples having a specific gravity of 0.42 or higher, based on weight when oven-dry and volume when green.

Table 2.--Comparison of range and average hardness[1] of species recommended for gunstocks for both green and air-dry material

Species	Green				Dry			
	Side hardness (average radial and tangential)		End hardness		Side hardness (average radial and tangential)		End hardness	
	Range	Average	Range	Average	Range	Average	Range	Average
	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
Black walnut	422-1,505	933	600-1,498	954	594-2,162	1,134	620-2,200	1,263
Black cherry	416-1,125	750	598-1,169	830	624-1,732	988	825-2,130	1,300
Red maple	542-1,745	744	596-1,244	813	609-1,742	997	1,069-2,325	1,512
Yellow-poplar[2]	398- 845	607	520- 946	703	530-1,098	739	795-1,342	1,042
Sugar maple	830-1,629	1,047	785-1,546	1,098	1,090-1,928	1,401	1,332-2,455	1,897
Yellow birch	552-1,248	820	602-1,169	823	1,010-1,765	1,402	1,322-2,039	1,689

[1] Load required to embed a 0.444-inch ball to one-half its diameter.

[2] Values given for yellow-poplar include only tests on samples having a specific gravity of 0.42 or above, based on weight when oven-dry and volume when green.

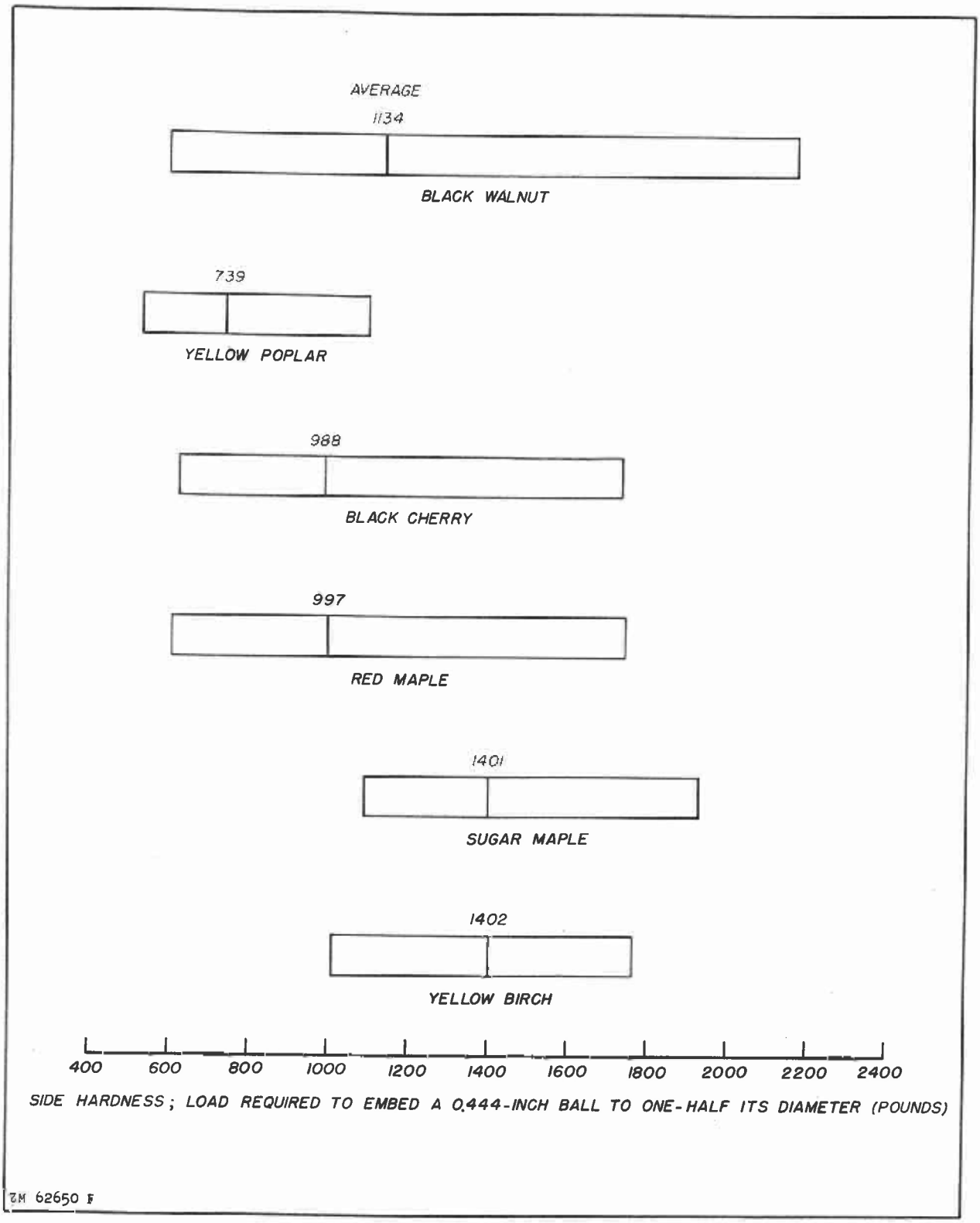

Figure 1.--Comparison of side hardness of species for gunstocks tested when air-dry. Values given for yellow-poplar include only tests on samples having a specific gravity of 0.42 or above, based on weight when oven-dry and volume when green.