Chapter 2
Basic Properties of Undervalued Hardwoods

John I. Zerbe
Volunteer, USDA Forest Products Laboratory

Among the most abundant of our undervalued hardwoods are the soft maples. However, other species that are also underutilized include some species of birch and some lower grades of the hard maples. This chapter covers physical, mechanical, and other important properties of different soft maples, hard maples, and yellow birch and compares them with the properties of benchmark species. The benchmark values are taken to be average values for eight species of southern yellow pine.

Properties of Soft Maples

Red maple *(Acer rubrum)* is the predominant species in the commercially marketed soft maple category. Silver maple *(Acer saccharinum)* is also sold as soft maple. Other species that are sometimes included in this market category are boxelder *(Acer negundo)* and big leaf maple *(Acer macrophyllum). It* is more likely that only silver maple and boxelder could be mixed with red maple to be sold as soft maple or red maple lumber, as these species grow together in the East. In the South, in the Mississippi Delta Region, about 70 percent of the soft maple lumber is red maple, 25 percent silver maple, and 5 percent boxelder (Koch 1985). A more common species mixture throughout most of their overlapping ranges is red maple and silver maple. Hybrid varieties of these latter two species have also been reported (Little 1979). Big leaf maple comes from the Pacific Coast and would normally be marketed separately.

Maples are shade-tolerant and tend to increase as a percentage in a stand at a faster rate than intolerant species that compete less successfully for species establishment and growth. Red maple is also considered a pioneer species or

sub-climax species. Therefore, there is an abundance of soft maple on cutover lands, and it tends to accumulate faster than it may be utilized with the current demand for it.

On poor sites red maple is apt to have poor form and many defects (Koch 1985). Koch (1985) states that red maple ranks low in resistance to ice and snow damage. The species is very susceptible to fire injury, and because red maple is a preferred deer food, it is subject to much damage where the deer population is high (Koch 1985). It responds well to thinning, and it is a species that may reach a height of 120 feet and a diameter of 5 feet under ideal conditions. However, average mature trees are 60 to 90 feet high and 1.5 to 2.5 feet in diameter.

On poor or wet sites silver maple may be managed for cordwood, and on good sites it may be managed for sawtimber. Silver maple also has potential for short rotation intensive culture for wood fuel biomass plantations (Little 1979).

The wood of soft maple, as the name implies, is not as hard as that of hard maple. It is about two-thirds as hard as that produced from sugar maple *(Acer saccharum)* and black maple *(Acer nigrum)*. The wood of soft maples is white, but silver maple has a lighter shade of white than red maple. Red maple heartwood is slightly darker than the heartwood of the other maple species. The soft maple species may be readily glued, and they can be successfully bent. As would be expected because of their lower density, the soft maples shrink less than the hard maples. Silver maple is moderately difficult to treat with preservatives.

The heartwood of maples is slightly- or non-resistant to decay. Table 2.1 list some machining and related properties of undervalued hardwoods from the *Wood Handbook* (USDA 1999). Tables 2.2 and 2.3 list strength properties of maples, yellow birch, and southern pine.

Properties of Hard Maples

The woods of sugar maple *(Acer saccharum)* and black maple *(Acer nigrum)* have special qualities that make them uniquely qualified for certain products such as cutting blocks and bowling pins. Sugar maple is the primary source of maple sugar and syrup; black maple is also important as a source of these products.

The sugar maple tree is slightly larger than black maple. It varies in height from 90 to 120 feet. Depending on where it grows, black maple reaches heights of 70 to 110 feet. Hard maple is susceptible to wind damage caused by ice storms and winter freezes. De-icing salts often damage sugar maples that grow along roadways. Individual trees within the overstory are susceptible to pollutants such as sulfur oxides, nitrogen oxides, and fluorides. Sugar maple is vul-

Table 2.1. - Machining and related properties of undervalued hardwoods.

	Soft maple	Hard maple	Big leaf maple	Birch
			(%) -------	
Planing perfect pieces	41	54	52	63
Shaping good to excellent pieces	25	72	56	57
Turning fair to excellent pieces	76	82	80	80
Boring good to excellent pieces	80	99	100	97
Mortising fair to excellent pieces	34	95	80	97
Sanding good to excellent pieces	37	38		34
Steam bending unbroken pieces	59	57		72
Nail splitting'	58	27		32
Screw splitting'	61	52		48

[a] Free from complete splits.

Table 2.2. - Strength properties of maples, yellow birch, and southern pine from the *Wood Handbook* (USDA 1999).

			Static bending		
Species	Moisture content	Specific gravity	Modulus of rupture	Modulus of elasticity	Work to maximum load
			(lbf/in^2)	(x10^6 lbf/in^2)	(in-lbf/in^3)
Red maple	Green	0.49	7,700	1.39	11.4
	12%	0.54	13,400	1.64	12.5
Silver maple	Green	0.44	5,800	0.94	11.0
	12%	0.47	8,900	1.14	8.3
Big leaf maple	Green	0.44	7,400	1.10	8.7
	12%	0.48	10,700	1.45	7.8
Sugar maple	Green	0.56	9,400	1.55	13.3
	12%	0.63	15,800	1.83	16.5
Yellow birch	Green	0.55	8,300	1.50	16.1
	12%	0.62	16,600	2.01	20.8
Southern pine	Green	0.45 to 0.55	6,800 to 8,700	1.02 to 1.59	7.5 to 10.9
	12%	0.47 to 0.59	10,800 to 16,300	1.41 to 1.98	8.6 to 13.7

nerable to logging injuries, which often permit the entrance of decay. Cankers, root rot, and wilt also affect these species, and they are subject to insect attack.

Table 2.3. — Strength properties of maples from the *Wood Handbook* (USDA 1999).

Species	Moisture content	Compression parallel to grain	Compression perpendicular to grain	Shear parallel to grain	Tension perpendicular to grain	Side hardness
			(psi)			(lbf)
Red maple	Green	3,280	400	1,150		700
	12%	6,540	1,000	1,850		950
Silver maple	Green	2,490	370	1,050	560	590
	12%	5,220	740	1,480	500	700
Big leaf maple	Green	3,240	450	1,110	600	620
	12%	5,950	750	1,730	540	850
Sugar maple	Green	4,020	640	1,460		970
	12%	7,850	1,470	2,330		1,260

Hard maple wood is tough, hard, heavy, and strong. It is particularly highly resistant to abrasion and wear. This makes it well-suited for flooring, particularly where floors receive hard usage as in gymnasiums. It also has good steam bending properties. It machines and turns well and glues satisfactorily. It has white sapwood that may be stained and polished to an excellent finish. Special figures in hard maple (birds-eye, curly, fiddleback) may occur irregularly, and these characteristics are generally available commercially in significant quantities only as veneer.

Hard maple dries slowly with high shrinkage. It ranks low in resistance to splitting during nailing or screwing, and pre-boring is recommended for these operations. The species are rated as slightly- or non-resistant to heartwood decay. The heartwood is resistant to preservative treatment, but the sapwood is permeable.

Properties of Yellow Birch

Yellow birch *(Betula alleghaniensis)* grows in Northern forests, often as a component of stands that also contain hard maples. It is a somewhat smaller tree, although occasionally it attains a height of 85 feet and a diameter of 2 to 3 feet. It is the largest of the native birch trees.

Birch wood has properties similar to sugar maple wood. The color of birch ranges from almost white to dark brown. It is heavy, hard, and sometimes has a wavy grain. More often it is straight-grained with a fine, even texture. Because of

a tendency to split, it is recommended that yellow birch be pre-drilled before nailing or screwing. It glues, stains, and finishes well. Because of its excellent turning properties, yellow birch is used for items such as spools, dowels, and bowls.

Literature Cited

Koch, Peter. 1985. Utilization of Hardwoods Growing on Southern Pine Sites. Agricultural Handbook 605. USDA Forest Service, Washington, DC. I: 69-73. 3,710 pp.

Little, Elbert L. 1979. Checklist of United States Trees (Native and Naturalized). Agriculture Handbook 541. USDA Forest Service, Washington, DC. 375 pp.

USDA Forest Service, Forest Products Laboratory (USDA). 1999. Wood Handbook: Wood as an Engineering Material. Forest Products Society, Madison, WI.

Undervalued Hardwoods
for Engineered Materials and Components

Robert J. Ross
Project Leader
USDA Forest Products Laboratory
Madison, WI

John R. Erickson
Director (retired)
USDA Forest Products Laboratory
Madison, WI

Forest Products Society
Madison, WI

Northern Initiatives
Marquette, MI

Financial support for the development of this publication was provided to Northern Initiatives through the USDA Forest Service Northeastern Area's Rural Development Through Forestry Program.

ISBN 1-892529-32-7

Publication No. 7234

Printed in the United States of America.

0510500

Ross, R.J. and J.R. Erickson. 2005. Undervalued Hardwoods for Engineered Materials and Components. Forest Products Society, Madison, WI. 132 pp.