A NOTE ON THE RELATIONSHIP BETWEEN BRANCH- AND STEMWOOD PROPERTIES OF SELECTED HARDWOODS GROWING IN THE MID-SOUTH

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(Received 27 December 1976)

ABSTRACT

Specific gravity and fiber length values are reported for both stemwood and branchwood of eight southern hardwoods. Branchwood fibers are significantly shorter than stemwood fibers of each species. Branchwood specific gravity is higher than stemwood specific gravity for some species and lower for other species. The only statistically significant difference was in red oak which had higher specific gravity wood in branches than in stems.

No statistically significant differences in either fiber length or specific gravity were found between branches from the top and bottom of the crown, nor between sampling points within branches.

Keywords: *Liquidambar styraciflua*, *Nyssa sylvatica*, *Liriodendron tulipifera*, *Quercus falcata*, *Quercus nigra*, *Quercus stellata*, *Carya ovata*, *Carya tomentosa*, specific gravity variation, fiber length variation.

INTRODUCTION

New methods for harvesting southern species often involve chipping entire trees, including branch wood as well as stem wood. Hence, information regarding the relationship of branch- and stemwood properties may prove useful in developing the processing technology for using fiber harvested in this manner.

In conifers, tracheids at the base of branches are reported to be similar in length to tracheids near the pith in the adjacent stem (Panshin and deZeeuw 1970). In the stem, tracheid length increases markedly in successive growth increments, but in branches there is little reported change in the length of tracheids in successive branch growth increments. So, branch tracheids are reported to be shorter than stem tracheids (Dinwoodie 1961; Fegel 1941; Greene 1966). Within the same growth ring, tracheid length increases along the branch for one-fifth its length and then decreases to the tip (Panshin and deZeeuw 1970).

A highly significant positive relationship has been shown between the length of tracheids in stems and branches of loblolly pine (Greene 1966). The correlation is significant, regardless of whether stem tracheids are long or short in comparison to the species average.

The relationship between branch and stem wood of 22 southern hardwoods was reported recently by Manwiller (1974) who macerated discs taken at 48-inch intervals along stems and branches of ten small trees (6-inches dbh) of each species. In every species, branch fibers were significantly shorter than stem fibers. For all species combined branch fibers were 25% shorter than stem fibers. The smallest difference was in red maple, which had branch fibers 20% shorter than stem fibers, and the largest difference was in yellow poplar, which had branch fibers 30% shorter than stem fibers. This result agrees with the work of Fegel (1941), who reported that branch fibers were 25% shorter than stem fibers of certain northeastern trees. However, in a study of *Castanea crenata*, branch fibers were reported to be only 2 to 5% shorter than stem fibers (Ito 1957).

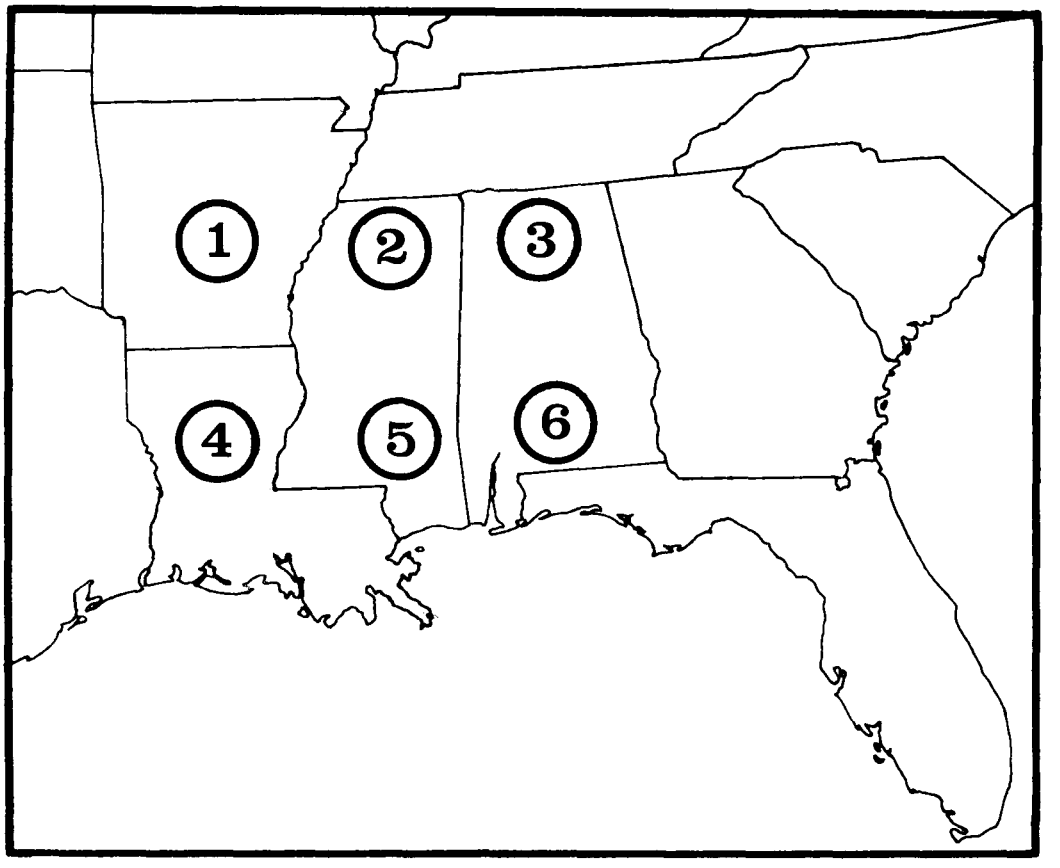

FIG. 1. Locations of sampling areas. National forests involved were: 1—Ouchita, 2—Holly Springs, 3—Bankhead, 4—Kisatchie, 5—DeSoto, 6—Conecuh.

PROCEDURE

Six symmetrically located sampling sites were selected on national forest land in the Mid-South (Fig. 1). Eight hardwood species were chosen for study. They were:

Sweetgum—*Liquidambar styraciflua* L.
Blackgum—*Nyssa sylvatica* Marsh.
Yellow Poplar—*Liriodendron tulipifera* L.
Southern Red Oak—*Quercus falcata* Michx.
Water Oak—*Quercus nigra* L.
Post Oak—*Quercus stellata* Wangenh.
Shagbark Hickory—*Carya ovata* (Mill.) K. Koch
Mockernut Hickory—*Carya tomentosa* Nutt.

At each sampling site, two trees of each study species native to the location were selected. Selected trees were approximately 11 inches dbh with no visible evidence of disease or mechanical damage and with no lean at the breast-height sampling point. The height and diameter of selected trees were measured and recorded.

The trees were felled, and cross-sectional discs were removed at heights of 5, 10, 20, 30, etc. feet up the stem (Fig. 2). Two branches from the base and two branches from the top of the crown were selected from each felled tree. Cross-sectional discs were removed at one-fourth and one-half the length of each branch (Fig. 2).

Wedge-shaped sections, along each of the cardinal directions of the stem discs,

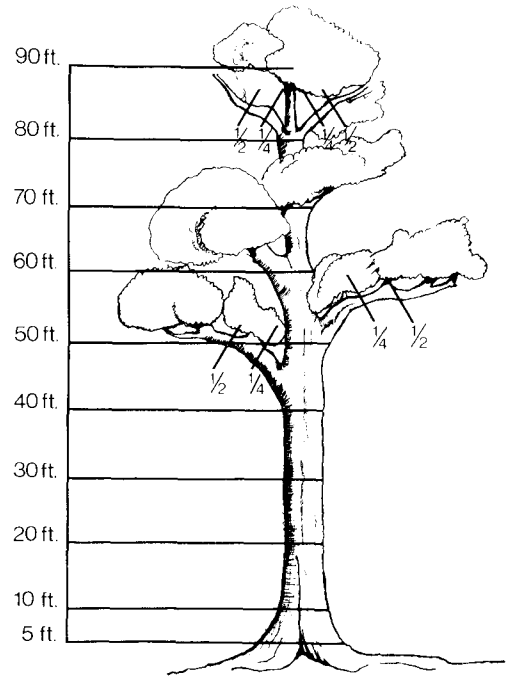

FIG. 2. Location of sampling points within trees. Sample discs were removed at 5 feet, 10 feet, and at successive 10-foot increments up the stem. Two branches near the bottom of the crown and two branches near the top of the crown were sampled at ¼ and ½ their length.

were used for specific gravity determination. The numerical average of the four specific gravity values from each stem disc was recorded as the specific gravity of the stem at that sampling height. Disc specific gravity values were weighted according to the amount of the tree volume they represented to calculate an average stem specific gravity.

For branch wood, the specific gravity of entire discs was determined. For both branch and stem wood, specific gravity was based upon dry weight and green volume.

Stem fiber length measurements were made on mature wood (growth increments 21 to the bark) at the five-foot sampling height of each tree. Branch fiber length measurements were made on wood removed from the largest diameter of each branch section. This sampling procedure assured both normal fibers from the bottom of branches and gelatinous fibers from the upper side of branches in the sample. The length of 50 whole fibers of macerated tissue, from each sampling location, in both stems and branches was measured by the procedure described by Taylor (1975).

RESULTS

Differences of wood properties between the sampling points in branches and among branches within the crown were analyzed. There were no statistically significant differences in either specific gravity or fiber length between top and bottom branches in the tree crown or between the ¼- and ½-branch length sampling points. Data for average values of the trees sampled at Holly Springs are presented in Table 1 to illustrate the range of values observed.

Although differences were not statistically significant, fibers were usually longer at the ¼-branch length sampling point and near the bottom of the crown. Since branches are normally larger near the bottom of the crown and are always larger at the ¼-length sampling point than at the ½-length sampling point, the correlation of fiber length and branch diameter was determined. The small correlation coefficients (Table 2) indicate that fiber length may be related to factors in addition to branch diameter. However, in every species long fibers were associated with large diameter branches, and in several species the relationship was statistically significant.

Average branchwood and stemwood specific gravity values are reported in Table 3. The average stemwood specific gravity in the table was the species average of the weighted averages for trees. The average branchwood specific gravity of species was a numerical average of each of the eight branch sampling points selected from the crown of each tree.

For five of the species, branch wood had a higher specific gravity than stem wood (Table 3). However, the increase was statistically significant only in southern red oak. In three species (black gum, shagbark hickory, and mockernut hickory), branch

TABLE 1. *Average values of specific gravity and fiber length at different positions in branches and in the crown of trees sampled in the Holly Springs National Forest*

Species	Tree	Specific Gravity				Fiber Length, mm			
		Crown Position		Branch Sampling point		Crown Position		Branch Sampling Point	
		Top Branches	Bottom Branches	1/4	1/2	Top Branches	Bottom Branches	1/4	1/2
Water Oak	1	0.62	0.63	0.64	0.61	0.98	1.01	0.99	1.08
Water Oak	2	0.65	0.64	0.66	0.64	1.12	1.04	1.01	1.08
Red Oak	1	0.60	0.60	0.60	0.59	0.98	1.19	1.12	1.04
Red Oak	2	0.63	0.60	0.62	0.62	1.16	1.16	1.20	1.12
Post Oak	1	0.62	0.61	0.69	0.70	0.95	0.88	0.96	1.12
Post Oak	2	0.63	0.64	0.67	0.66	0.90	0.98	1.06	1.06
Sweetgum	1	0.44	0.45	0.45	0.44	0.98	1.10	1.09	0.99
Sweetgum	2	0.43	0.44	0.44	0.42	1.17	1.10	1.14	1.12
Black Gum	1	0.48	0.51	0.48	0.49	1.28	1.44	1.38	1.34
Black Gum	2	0.50	0.52	0.51	0.50	1.37	1.31	1.33	1.35
Yellow-Pop.	1	0.51	0.46	0.48	0.48	0.95	1.04	1.04	0.98
Yellow-Pop.	2	0.48	0.47	0.48	0.48	0.98	1.03	0.95	1.03
Shagbark Hic.	1	0.62	0.61	0.63	0.60	0.92	0.91	0.94	0.90
Shagbark Hic.	2	0.65	0.64	0.64	0.65	0.96	0.98	0.94	1.00
Mockernut Hic.	1	0.71	0.71	0.70	0.72	1.08	1.30	1.24	1.13
Mockernut Hic.	2	0.64	0.65	0.66	0.64	0.97	1.04	1.03	0.98
Average		0.575	0.573	0.584	0.577	1.047	1.094	1.089	1.082

wood had a lower specific gravity than stem wood, but this difference was not statistically significant. If branch wood is assumed to be physiologically similar to juvenile wood, high specific gravity values for branchwood of southern red oak would be predicted on the basis of Hamilton's report (1961), which stated that specific gravity decreases from pith to bark in red oak.

TABLE 2. *Correlation coefficients determined by regression of branch diameter and fiber length values of each branch sampling point*

Species	Correlation coefficient (r)
Water Oak	0.38**
Red Oak	0.39**
Post Oak	0.28*
Sweetgum	0.26*
Black Gum	0.08
Yellow-Poplar	0.22
Shagbark Hickory	0.20
Mockernut Hickory	0.34**

* significant at 1% level
** significant at 5% level

TABLE 3. *Average stemwood and branchwood specific gravity of hardwoods in the Mid-South*

Species	Stemwood Specific Gravity	Branchwood Specific Gravity
Water Oak	0.60	0.62
Red Oak	0.61	0.64
Post Oak	0.64	0.66
Sweetgum	0.46	0.48
Black Gum	0.52	0.51
Yellow-Poplar	0.46	0.50
Shagbark Hickory	0.67	0.64
Mockernut Hickory	0.68	0.65

TABLE 4. *Average stemwood and branchwood fiber lengths of hardwoods in the Mid-South*

Species	Stemwood Fiber Length mm	Branchwood Fiber Length mm
Water Oak	1.49	1.03
Red Oak	1.58	1.06
Post Oak	1.37	0.99
Sweetgum	1.78	1.12
Black Gum	1.93	1.28
Yellow-Poplar	1.89	1.03
Shagbark Hickory	1.32	0.93
Mockernut Hickory	1.36	1.02

In each species, branch fibers were significantly shorter than mature stemwood fibers (Table 4). This agrees with the work of Manwiller (1974) who reported that branch fibers were shorter than stem fibers in small (6-inch dbh) trees.

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