USDA Forest Service Research Paper SE-107 May 1973

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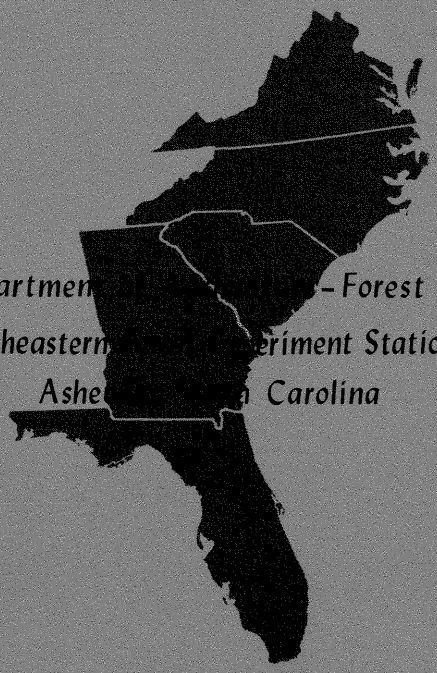

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# Volume and Weight Tables for Plantation-Grown Sycamore

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American sycamore (Platanus occidentalis L.) is well suited for short-rotation management. It can be regenerated easily, has produced excellent early growth on good sites, and lends itself to mechanized harvesting. Steinbeck et al.[1] concluded that spacings of 4 by 4 feet or more and rotation ages from 4 to 10 years hold considerable promise from the standpoints of production, utilization, and management. This paper presents cubic-foot volumes, green weights, and dry weights for the tree sizes expected under these conditions.

## DATA COLLECTION

Measurement data were collected from an 11-year-old sycamore plantation located on a well-drained Piedmont river bottom in Greene County, Georgia (fig. 1). The 4-acre planting site was disk plowed and then hand-planted with 1-0 seedlings spaced 8 by 8 feet during the winter of 1960-61. The seedlings were cultivated and fertilized during the first growing season and then thinned and fertilized again in 1968. The entire plantation was harvested after leaf fall in November 1971.

Measurements were taken on 103 sample trees randomly selected from 4- to 10-inch diameter classes. Data collected on each tree included

1. Diameter at breast height (d.b.h.)

2. Diameter outside bark at 5-foot intervals up the tree

3. Merchantable height (top diameter of 3 inches outside bark)

4. Total tree height

[1]Steinbeck, Klaus, McAlpine, Robert G., and May, Jack T. Short rotation culture of sycamore: a status report. J. For. 70: 210-213. 1972.

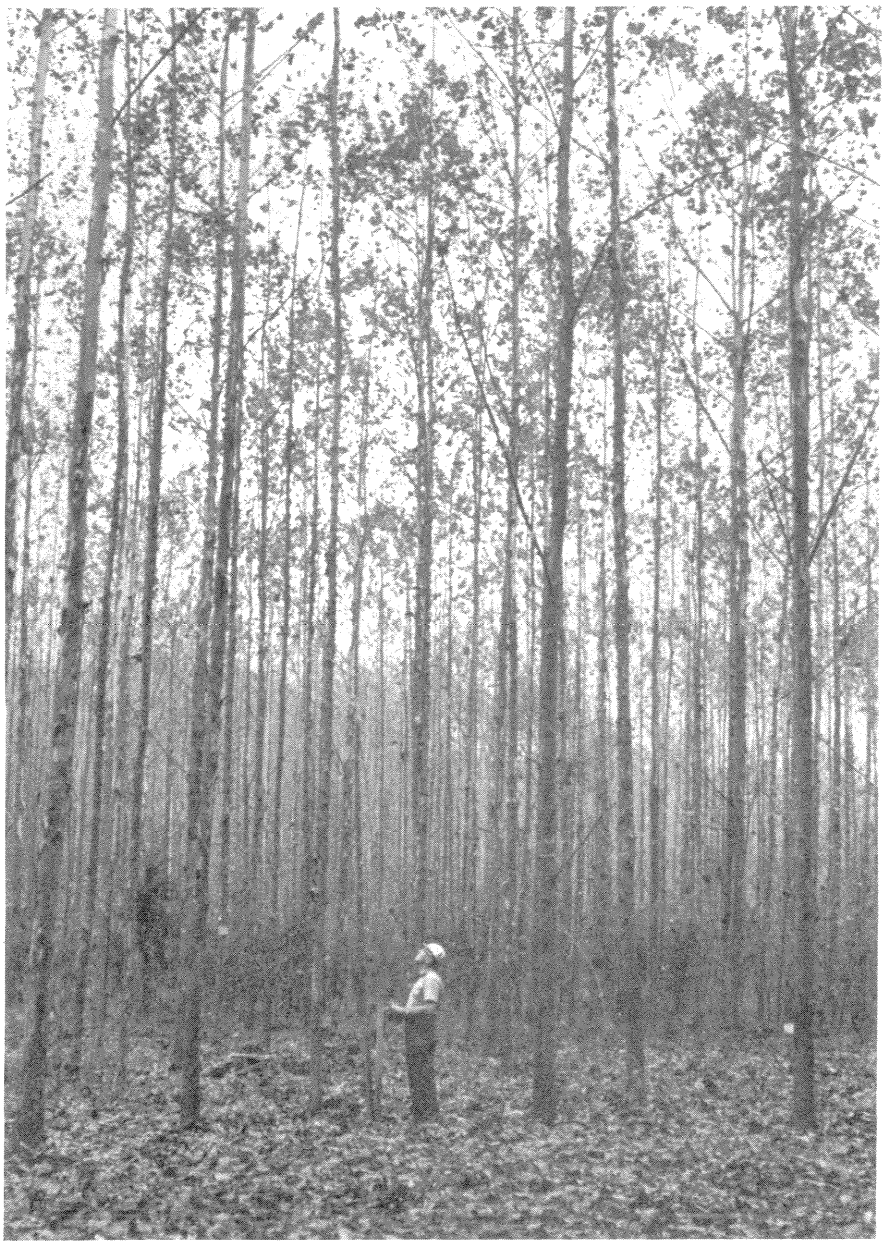

Figure 1.--Eleven-year-old sycamore plantation in Greene County, Georgia. Average d.b.h. in the plantation was 5.8 inches; average height was 63 feet.

5. Green weight (including bark) of each 5-foot bolt to the 3-inch top

6. Green weight (without branches) of the top

7. Green weight (without leaves) of the live branches.

A subsample of 31 trees was selected for more intensive measurements. These data included

8. Green weight of individual sample disks, 1 to $1\frac{1}{2}$ inches in thickness, taken from the base of the tree, at successive 10-foot intervals up the merchantable stem and at the 3-inch top diameter

9. Green weight of disks taken at 5-foot intervals up the remaining top stem

10. Combined green weight of branch disks, taken randomly from the lower, middle, and upper crown

11. Ovendry weights of the disks from the stem, top, and branches.

## EQUATIONS

### Cubic Foot

Cubic-foot volume (V) was calculated for each bolt from Smalian's formula

$$V = \frac{B + b}{2} L \tag{1}$$

where B equals the area of the lower base in square feet, b equals the area of the upper base in square feet, and L equals the length of the bolt in feet. Volume of the top portion was computed from the formula

$$V = \frac{BL}{3} \tag{2}$$

Volumes of the merchantable stem and total stem were calculated for each tree. Standard linear regression procedures were used to compute the following prediction equation for merchantable stem volumes:

$$\text{Merchantable stem volume (3-inch top outside bark)} = -0.34456 + 0.00246(D^2H) \tag{3}$$

A constrained regression (intercept = 0) was used to develop the following equation for total stem:

$$\text{Total stem volume} = 0.00252(D^2H) \tag{4}$$

For both equations, D is diameter at breast height in inches and H is total tree height. Variation explained by the constrained regression was computed from the formula

$$\frac{b\Sigma XY - \frac{(\Sigma Y)^2}{n}}{\Sigma (Y-\bar{Y})^2} \tag{5}$$

where b is the regression coefficient for slope, X is $D^2H$, Y is cubic-foot volume, and n is the number of trees in the sample. Equations (3) and (4) account for at least 98 percent of the variation in observed cubic-foot volume. Predicted values for a combination of diameters and heights are given in tables 1 and 2.

Table 1.--Cubic-foot volume (outside bark) to a 3-inch top diameter[1]

| D.b.h. (inches) | Total height (feet) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 |
| | Cubic feet | | | | | | | |
| 4 | 1.4 | 1.6 | 1.8 | 2.0 | 2.2 | | | |
| 5 | 2.4 | 2.7 | 3.0 | 3.3 | 3.7 | 4.0 | | |
| 6 | | 4.1 | 4.5 | 5.0 | 5.4 | 5.9 | 6.3 | |
| 7 | | | 6.3 | 6.9 | 7.5 | 8.1 | 8.7 | |
| 8 | | | 8.3 | 9.1 | 9.9 | 10.7 | 11.5 | 12.3 |
| 9 | | | | 11.6 | 12.6 | 13.6 | 14.6 | 15.6 |
| 10 | | | | | 15.6 | 16.9 | 18.1 | 19.3 |

[1]Block indicates extent of observed data.

Table 2.--Cubic-foot volume (outside bark) of total stem[1]

| D.b.h. (inches) | Total height (feet) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 |
| | Cubic feet | | | | | | | |
| 4 | 1.8 | 2.0 | 2.2 | 2.4 | 2.6 | | | |
| 5 | 2.8 | 3.2 | 3.5 | 3.8 | 4.1 | 4.4 | | |
| 6 | | 4.5 | 5.0 | 5.4 | 5.9 | 6.4 | 6.8 | |
| 7 | | | 6.8 | 7.4 | 8.0 | 8.6 | 9.3 | |
| 8 | | | 8.9 | 9.7 | 10.5 | 11.3 | 12.1 | 12.9 |
| 9 | | | | 12.2 | 13.3 | 14.3 | 15.3 | 16.3 |
| 10 | | | | | 16.4 | 17.6 | 18.9 | 20.2 |

[1]Block indicates extent of observed data.

## Green Weights

Green weights of the merchantable stem, total stem, and total tree were calculated for each sample tree. Total tree weights refer to all woody portions above stump height. Stumps were approximately 4 inches high. Linear regression procedures were used to develop the equation for the merchantable stem. Constrained regressions were used to obtain prediction equations for green weights of the total stem and total tree.

Green weights of the merchantable stem
(3-inch top outside bark) = $-32.35109 + 0.15544(D^2H)$ (6)

Green weight of the total stem = $0.15397(D^2H)$ (7)

Green weight of the total tree = $0.17231(D^2H)$ (8)

Variation explained by equations (7) and (8) were computed from formula (5). In each case, the equations explained at least 99 percent of the variation in observed green weight. Predicted green weights for merchantable stem, total stem, and total tree are given in tables 3, 4, and 5.

## Dry Weights

Dry weights of the merchantable stem, total stem, and total tree were determined from the ovendry weights of the sample disks. Samples from stem bolts, tops, and branches were ovendried to a constant weight

Table 3.--Green weight (including bark) to a 3-inch top diameter (outside bark)[1]

| D.b.h. (inches) | Total height (feet) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 |
| | Pounds | | | | | | | |
| 4 | 80 | 92 | 104 | 117 | 129 | | | |
| 5 | 143 | 162 | 181 | 201 | 220 | 239 | | |
| 6 | | 247 | 275 | 303 | 331 | 359 | 387 | |
| 7 | | | 387 | 425 | 463 | 501 | 539 | |
| 8 | | | 515 | 565 | 614 | 664 | 714 | 764 |
| 9 | | | | 723 | 786 | 849 | 912 | 975 |
| 10 | | | | | 978 | 1,056 | 1,133 | 1,211 |

[1]Block indicates extent of observed data.

Table 4.--Green weight (including bark) of total stem[1]

| D.b.h. (inches) | Total height (feet) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 |
| | Pounds | | | | | | | |
| 4 | 111 | 123 | 135 | 148 | 160 | | | |
| 5 | 173 | 192 | 212 | 231 | 250 | 269 | | |
| 6 | | 277 | 305 | 333 | 360 | 388 | 416 | |
| 7 | | | 415 | 453 | 490 | 528 | 566 | |
| 8 | | | 542 | 591 | 641 | 690 | 739 | 788 |
| 9 | | | | 748 | 811 | 873 | 935 | 998 |
| 10 | | | | | 1,001 | 1,078 | 1,155 | 1,232 |

[1]Block indicates extent of observed data.

Table 5.--Green weight (including bark) of total tree[1]

| D.b.h. (inches) | Total height (feet) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 |
| | Pounds | | | | | | | |
| 4 | 124 | 138 | 152 | 165 | 179 | | | |
| 5 | 194 | 215 | 237 | 258 | 280 | 302 | | |
| 6 | | 310 | 341 | 372 | 403 | 434 | 465 | |
| 7 | | | 464 | 507 | 549 | 591 | 633 | |
| 8 | | | 607 | 662 | 717 | 772 | 827 | 882 |
| 9 | | | | 836 | 907 | 977 | 1,047 | 1,117 |
| 10 | | | | | 1,120 | 1,206 | 1,292 | 1,378 |

[1]Block indicates extent of observed data. Weights do not include leaves.

at 105° C.[2] Percentage of dry matter for each sample was calculated from the formula

$$\frac{\text{Ovendry weight of wood disks}}{\text{Green weight of wood disks}} \qquad (9)$$

The average percentage of dry matter of each merchantable stem was determined by weighting the percentage of dry matter of each bolt by bolt volume. Disk values for the branches were not weighted. Linear regression was used to determine prediction equations for the dry weight of merchantable stems. Constrained regressions were used to derive the equations for dry weights of total stems and total trees.

Dry weight of the merchantable stem (3-inch top outside bark) = $-17.67910 + 0.06684(D^2H)$ (10)

Dry weight of the total stem = $0.06521(D^2H)$ (11)

Dry weight of the total tree = $0.07431(D^2H)$ (12)

Equations (10), (11), and (12) accounted for at least 99 percent of the variation in observed dry weights. Predicted dry weights for the merchantable stem, total stem, and total tree are given in tables 6, 7, and 8.

Although the data were collected from a single plantation, they represent the only information available on per-tree volume and weight for sycamore at this time. One should consider the limited data source, however, when using the equations or tables to evaluate or predict early growth and yield of sycamore plantations.

[2]Brown, H. P., Panshin, A. J., and Forsaith, C. C. Textbook of wood technology. 652 pp. New York: McGraw-Hill Book Co., Inc. 1949.

Table 6.--Dry weight (including bark) to a 3-inch top diameter (outside bark)[1]

| D.b.h. (inches) | Total height (feet) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 |
| | Pounds | | | | | | | |
| 4 | 30 | 36 | 41 | 46 | 52 | | | |
| 5 | 58 | 66 | 74 | 83 | 91 | 99 | | |
| 6 | | 103 | 115 | 127 | 139 | 151 | 163 | |
| 7 | | | 162 | 179 | 195 | 212 | 228 | |
| 8 | | | 218 | 239 | 260 | 282 | 303 | 325 |
| 9 | | | | 307 | 334 | 361 | 388 | 415 |
| 10 | | | | | 417 | 450 | 484 | 517 |

[1]Block indicates extent of observed data.

Table 7.--Dry weight (including bark) of total stem[1]

| D.b.h. (inches) | Total height (feet) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 |
| | Pounds | | | | | | | |
| 4 | 47 | 52 | 57 | 63 | 68 | | | |
| 5 | 73 | 82 | 90 | 98 | 106 | 114 | | |
| 6 | | 117 | 129 | 141 | 153 | 164 | 176 | |
| 7 | | | 176 | 192 | 208 | 224 | 240 | |
| 8 | | | 230 | 250 | 271 | 292 | 313 | 334 |
| 9 | | | | 317 | 343 | 370 | 396 | 423 |
| 10 | | | | | 424 | 456 | 489 | 522 |

[1]Block indicates extent of observed data.

Table 8.--Dry weight (including bark) of total tree[1]

| D.b.h. (inches) | Total height (feet) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 |
| | Pounds | | | | | | | |
| 4 | 54 | 59 | 65 | 71 | 77 | | | |
| 5 | 84 | 93 | 102 | 111 | 121 | 130 | | |
| 6 | | 134 | 147 | 161 | 174 | 187 | 201 | |
| 7 | | | 200 | 218 | 237 | 255 | 273 | |
| 8 | | | 262 | 285 | 309 | 333 | 357 | 380 |
| 9 | | | | 361 | 391 | 421 | 451 | 482 |
| 10 | | | | | 483 | 520 | 557 | 594 |

[1]Block indicates extent of observed data. Weights do not include leaves.

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1973. Volume and weight tables for plantation-grown sycamore. Southeast. For. Exp. Stn., USDA For. Serv. Res. Pap. SE-107, 8 pp.

Cubic-foot volumes, green weights, and dry weights per tree are tabulated for plantation-grown sycamore. The regression equations used to predict these parameters are also given.

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