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ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

# Aerial Stand Volume Table for Plains Cottonwood in Eastern Colorado

**Carleton B. Edminster[1] and James R. Getter[2]**

An aerial stand volume table is developed for plains cottonwood (*Populus deltoides* var. *occidentalis* Rydb.) in eastern Colorado. Gross volume in cubic feet per acre is related to average stand height and crown closure percent.

**Keywords:** Forest measurement, aerial volume table, stand volume estimates, *Populus deltoides* var. *occidentalis.*

The need for efficient inventories of forest resources in eastern Colorado has led to development of the aerial volume table presented in this note. This table is an extension of previously developed relationships for tree volumes and point-sampling factors applicable to plains cottonwood (*Populus deltoides* var. *occidentalis* Rydb.) (Edminster et al. 1977).

The cottonwood forest along the South Platte River bottom in Morgan County was selected as the primary area for this study. This relatively pure forest covers an area approximately 0.75 mile (1.2 km) wide by 45.6 miles (73.4 km) long. Orchards, shelterbelts, and ornamental plantings were excluded from the study.

Personnel of the Colorado State Forest Service measured trees on sample plots and interpreted aerial photographs.

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## Development of Aerial Stand Volume Table

Sample plots were selected using black and white panchromatic vertical aerial photographs of the forest. A grid scaled to 1-acre (0.405-ha) plots was superimposed on the 1:20,000 nominal scale photographs. Using this grid, 29 plots were selected at random for photographic and ground measurement.

The proportion of forest canopy occupied by trees, crown closure percent, and average total height of trees in the plot were determined on the photographs. Crown closure was used in the volume relationship to replace basal area or number of trees per acre because these variables cannot be determined from available photography (Avery 1977). Crown closure percent was determined from ocular estimate by experienced photographic interpreters. Total height of trees or clumps of trees was measured using a parallax bar with stereoscopic photo pairs. Average height for the plot was computed from the heights of individual trees and clumps of trees weighted by their respective contribution to crown closure percent.

Ground measurements included checks of both pilot crown closure percent and average height. The

diameter at breast height measured outside the bark and total height of individual trees or stems within clumps was recorded. Total volume inside the bark in cubic feet for the plot was then determined using the available tree volume equation for the merchantable stem, excluding a 0.5-foot (0.15-m) stump, and major branches to a 2-inch (5.1-cm) diameter (Edminster et al. 1977).

Values presented in table 1 were computed from the regression equation:

$$V = -175.671 + 9.817H + 0.401HC$$
$$R^2 = 0.72 \qquad Sy.x = 196.3$$

where

V = gross stand volume in cubic feet per acre,
H = average total height of the stand in feet,
C = crown closure percent.

The equivalent volume equation in System International metric units is:

$$V_m = -12.292 + 2.254H_m = 0.092H_mC$$

where

$V_m$ = gross stand volume in cubic meters per hectare,
$H_m$ = average total height to the stand in meters.

## Field Checks to Adjust Photo Volumes

Volumes for pure stands given in table 1 do not include allowance for defective trees or unusable portions of trees. Therefore, a portion of interpreted photo plots from an aerial cruise should be sampled in the field to determine what adjustment factors are needed to convert gross volume estimated from aerial photos to net ground volumes. A double sampling procedure would provide a mechanism for estimating these adjustment factors (Cochran 1963).

## Literature Cited


Avery, T. Eugene. 1977. Interpretation of aerial photographs. 3rd ed. 392 p. Burgess Publishing Co., Minneapolis, Minn.

Cochran, William G. 1963. Sampling techniques, 2nd ed. 413 p. John Wiley and Sons, Inc., New York.

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Table 1. Gross stand volumes inside bark (in cubic feet per acre) for plains cottonwood in eastern Colorado

| Average total height (feet) | % crown closure | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 |
| 20 | 61 | 101 | 141 | 181 | 221 | 261 | 301 | 341 | 382 | 422 | 462 | 502 |
| 25 | 120 | 170 | 220 | 270 | 320 | 371 | 421 | 471 | 521 | 571 | 621 | 671 |
| 30 | 179 | 239 | 299 | 359 | 420 | 480 | 540 | 600 | 660 | 720 | 780 | 841 |
| 35 | 238 | 308 | 378 | 449 | 519 | 589 | 659 | 729 | 799 | 870 | 940 | 1,010 |
| 40 | 297 | 377 | 458 | 538 | 618 | 698 | 778 | 859 | 939 | 1,019 | 1,099 | 1,179 |
| 45 | 356 | 447 | 537 | 627 | 717 | 807 | 898 | 988 | 1,078 | 1,168 | 1,259 | 1,349 |
| 50 | 415 | 516 | 616 | 716 | 816 | 917 | 1,017 | 1,117 | 1,217 | 1,318 | 1,418 | 1,518 |
| 55 | 475 | 585 | 695 | 805 | 916 | 1,026 | 1,136 | 1,246 | 1,357 | 1,467 | 1,577 | 1,688 |
| 60 | 534 | 654 | 774 | 895 | 1,015 | 1,135 | 1,255 | 1,376 | 1,496 | 1,616 | 1,737 | 1,857 |
| 65 | 593 | 723 | 853 | 984 | 1,114 | 1,244 | 1,375 | 1,505 | 1,635 | 1,766 | 1,896 | 2,026 |

Computed from: V = -175.671 + 9.817 H + 0.401 HC
Heights listed are midpoints of 5-feet classes.
Crown closures listed are midpoints of 5% classes.
Blocks indicate extent of basic data.