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Research Report No. 28, Tree Content and Taper Functions for Planted Loblolly and Slash Pine Trees in East Texas, Update: June 1993, Revised: September 1993

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TREE CONTENT AND TAPER FUNCTIONS
FOR
PLANTED LOBLOLLY AND SLASH PINE TREES
IN
EAST TEXAS

UPDATE: 6/93
REVISED: 9/93

BY
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REPORT 28

FROM
THE

EAST TEXAS PINE PLANTATION RESEARCH PROJECT
COLLEGE OF FORESTRY
SFASU
NACOGDOCHES, TX 75962



SEPTEMBER ... 1993

SITUATION

In 1987, tree content and tree taper functions for individual live standing planted loblolly and slash pine trees in East Texas were published¹. These equations were developed based on stem analyses of felled trees located adjacent to East Texas Pine Plantation Research Project (ETPPRP) permanent plots throughout East Texas. The 1987 report was based on 65 loblolly and 34 slash pine trees sampled during 1986. For both species, dbh (D) values ranged from about 2-12 inches and total height (H) values varied from about 10-60 feet.

Analyses of the 65 loblolly and 35 slash pine trees produced equations to estimate:

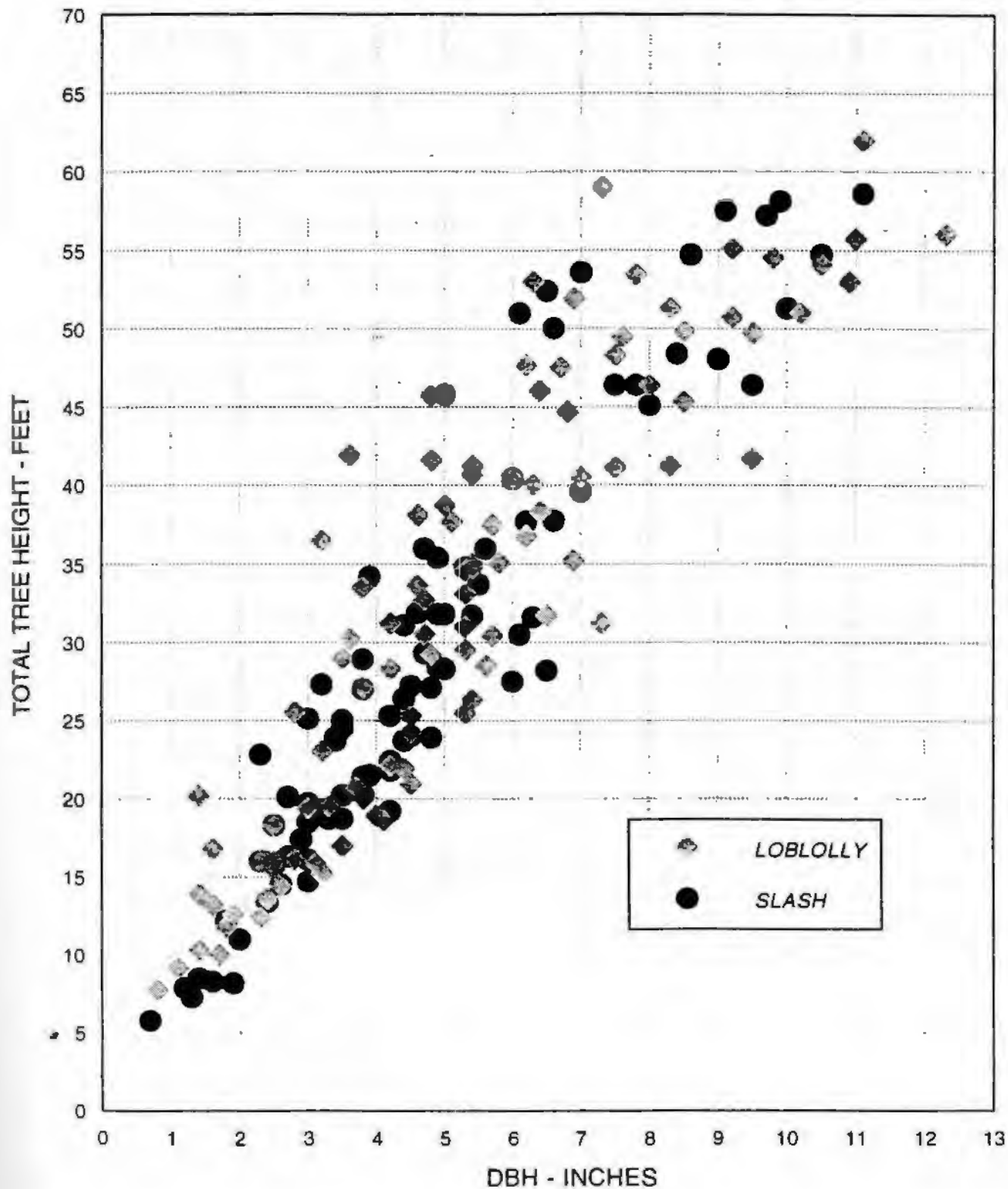
- Complete tree content (stem and branches, excluding stump) with and without bark in cubic feet, green and dry weight in pounds.
- Total stem content (excluding stump) with and without bark in cubic feet, green and dry weight in pounds.
- Partial stem content with and without bark in cubic feet, green and dry weight in pounds from:
 - Stump to an upper stem dob.
 - One upper stem dob to another upper stem dob.
- Distance from ground to an upper stem dob.
- Upper stem dob at a point above ground.

The revision is a result of re-calculating stem volumes and weights after correcting an inconsistency in the determination of the content of the top segment of each felled tree. However, the changes in equation coefficient values are relatively small. The new versions of the tree content and taper functions are presented for these two pine species based on data recorded from additional trees felled adjacent to ETPPRP plots in 1990. After the new sample values were combined with the original sample trees, data from a total of 101 loblolly and 86 slash pine trees were available for analyses. The distribution of the sample trees by dbh and total height is shown on the next page. For both species, the new ranges of dbh and height values are slightly extended compared to the original sample trees. However, within the ranges, a more comprehensive sample has been obtained. As a result, the revised equations presented in this report should estimate planted loblolly and slash pine tree content and taper with improved confidence and dependability.

¹ Lenhart, J. D., T. L. Hackett, C. J. Laman, T. J. Wiswell and J. A. Blackard. 1987. Tree content and taper functions for loblolly and slash pine trees planted on non-old-fields in East Texas. South. J. Appl. For. 11(3):147-151.

DISTRIBUTION OF LOBLOLLY AND SLASH PINE SAMPLE TREES BY DBH AND TOTAL HEIGHT ETPPRP

(LOBLOLLY = 101 TREES AND SLASH = 86 TREES)



PREDICTING COMPLETE TREE CONTENT

The same complete tree content prediction model used in the 1987 study was utilized in this updated work. After non-linear regression analyses were completed, complete tree content (excluding stump) of live individual standing trees can be estimated as:

LOBLOLLY

Cubic feet wood and bark	= 0.008002D ^{2.21862} H ^{0.62612}	(1)
Cubic feet wood only	= 0.002597D ^{2.24396} H ^{0.84232}	(2)
Green weight pounds wood, bark and needles	= 0.44229D ^{2.05568} H ^{0.74148}	(3)
Green weight pounds wood and bark	= 0.22993D ^{2.07017} H ^{0.88283}	(4)
Green weight pounds wood only	= 0.15844D ^{2.13134} H ^{0.92080}	(5)

SLASH

Cubic feet wood and bark	= 0.005324D ^{1.97567} H ^{0.88413}	(6)
Cubic feet wood only	= 0.001712D ^{2.09381} H ^{1.03302}	(7)
Green weight pounds wood, bark and needles	= 0.46707D ^{2.06164} H ^{0.74904}	(8)
Green weight pounds wood and bark	= 0.24270D ^{1.98813} H ^{0.92743}	(9)
Green weight pounds wood only	= 0.14965D ^{2.05560} H ^{0.97659}	(10)

NOTE: Approximate R² was at least 98% for equations (1-10).

PREDICTING STEM CONTENT - TOTAL AND PARTIAL

The same stem content prediction model used in the 1987 study was utilized in this updated work. Stem profile information specifying content to different upper stem diameters outside bark (d - inches) on the tree bole were analyzed with non-linear regression procedures. Stem content (excluding stump and branches) prediction equations are:

LOBLOLLY

Cubic feet wood and bark

$$= 0.0022149D^{1.95195}H^{1.05670} - 0.0020572d^{2.95262}D^{-0.95262}(H-4.5) \quad (11)$$

Cubic feet wood only

$$= 0.0009433D^{1.96921}H^{1.21252} - 0.0017470d^{2.88645}D^{-0.88645}(H-4.5) \quad (12)$$

Green weight pounds wood and bark

$$= 0.067645D^{1.85220}H^{1.27093} - 0.12198d^{2.80297}D^{-0.80297}(H-4.5) \quad (13)$$

Green weight pounds wood only

$$= 0.056686D^{1.89855}H^{1.27156} - 0.11431d^{2.80855}D^{-0.80855}(H-4.5) \quad (14)$$

SLASH

Cubic feet wood and bark

$$= 0.0025858D^{1.77319}H^{1.13294} - 0.0024334d^{3.46624}D^{-1.46624}(H-4.5) \quad (15)$$

Cubic feet wood only

$$= 0.0009719D^{1.85030}H^{1.27030} - 0.0018942d^{3.42954}D^{-1.42954}(H-4.5) \quad (16)$$

PREDICTING STEM CONTENT - TOTAL AND PARTIAL CONT'D

Green weight pounds wood and bark

$$= 0.11325D^{1.79531}H^{1.18087} - 0.13908d^{3.36239}D^{-1.36239}(H-4.5) \quad (17)$$

Green weight pounds wood only

$$= 0.085406D^{1.83783}H^{1.19809} - 0.12342d^{3.38121}D^{-1.38121}(H-4.5) \quad (18)$$

NOTE: Approximate R^2 values for equations (11-18) were at least 98%.

Total stem content estimation: ^{'''} In equations (11-18), set $d = 0$.

Partial stem content estimation: In equations (11-18), set d to appropriate upper stem dob - inches.

PREDICTING TREE TAPER

Using the same procedures described in the 1987 study, updated taper functions were computed for each species as:

LOBLOLLY

From equation (11), an equation was derived to estimate:

$$\text{Upper stem dob} = D((H-h)/(H-4.5))^{1.04973} \quad (19)$$

where h = position on upper stem where dob occurs - feet.

Then equation (19) was rearranged to estimate:

$$h = H - (H-4.5)(\text{dob}/D)^{0.95262} \quad (20)$$

From equations (11) and (12), an equation was derived to estimate:

$$\text{Upper stem dib} = 0.98515D((H-h)/(H-4.5))^{1.01501} \quad (21)$$

where h = position on upper stem where dib occurs - feet.

Then equation (21) was rearranged to estimate:

$$h = H - 1.014852(H-4.5)(\text{dib}/D)^{0.98521} \quad (22)$$

SLASH

From equation (15), an equation was derived to estimate:

$$\text{Upper stem dob} = D((H-h)/(H-4.5))^{0.68202} \quad (23)$$

Then equation (23) was rearranged to estimate:

$$h = H - (H-4.5)(\text{d}/D)^{1.46624} \quad (24)$$

PREDICTING TREE TAPER CONT'D

From equations (15) and 16), an equation was derived to estimate:

$$\text{Upper stem dib} = 0.90129D((H-h)/(H-4.5))^{0.66950} \quad (25)$$

Then equation (25) was rearranged to estimate:

$$h = H - 1.16794(H-4.5)(\text{dib}/D)^{1.49365} \quad (26)$$

APPLICATION

These 26 equations can be utilized in various combinations and sets to merchandise individual live standing planted loblolly or slash pines in East Texas into one or more products. Tree products can be quantified in either cubic feet or green pounds. Tree content can be in several combinations of wood, bark and/or needles.

The ability to merchandise or partition a live standing tree stem into several products is a useful forest mensurational/economic/management tool. For example, please consider a planted loblolly pine tree in East Texas with $D = 10''$ and $H = 60'$:

- Expected part of loblolly pine stem to be utilized as a 9-foot plywood peeler bolt(s):
 - The dob at 9' above stump is 9.2", which exceeds minimum small end dob for a peeler.
[Equation (19)]
 - The dob at 18' above stump is 7.5", which is less than minimum peeler small end dob.
[Equation (19)]
 - The content of the stem from the stump to the 9.1" dob is 6.08 cu ft wood & bark.
[Equation (11)]
 - Perhaps a plylog stumpage price can be applied to the content of this lower part of stem.

- Expected part of loblolly pine stem to be utilized as small sawlog or chip-n-saw:
 - Length of stem from top of peeler log to a 6" dob is 16.9'.
[Equation (20) - 9']
 - The content of this part of stem is 6.40 cu ft wood & bark.
[Equation (11) - 6.08 cu ft]
 - Perhaps a chip-n-saw stumpage price can be applied to this middle part of stem.

- Expected part of loblolly pine stem to be utilized as pulpwood:
 - Length of stem from top of chip-n-saw log to terminal bud tip is 34.1'.
[60' - 9' - 16.9']
 - The content of this part of stem is 2.53 cubic feet wood and bark.
[Equation (11) - 6.08 cu ft - 6.40 cu ft]
 - Perhaps a pulpwood stumpage price can be applied to this top part of stem.

If successfully conducted, the result should be an accurate representation of the content and taper of this loblolly pine tree relative to "best" utilization plus a calculation of the "highest" stumpage value. The stumpage values may be incorporated into forest inventory, appraisal and planning procedures.