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Research Report No. 10, Estimating the Dry Weight of Individual Slash Pine Trees Planted in East Texas

J. David Lenhart
Arthur Temple College of Forestry and Agriculture, Stephen F. Austin State University

ESTIMATING THE DRY WEIGHT OF INDIVIDUAL SLASH PINE TREES PLANTED IN EAST TEXAS

by

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REPORT NUMBER 10

TO

PARTICIPATING COMPANIES

IN THE

EAST TEXAS PINE PLANTATION RESEARCH PROJECT

A STUDY OF

LOBLOLLY AND SLASH PINE PLANTATIONS

IN

EAST TEXAS

CENTER FOR APPLIED STUDIES

SCHOOL OF FORESTRY

STEPHEN F. AUSTIN STATE UNIVERSITY

NACOGDOCHES, TEXAS 75962

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This is the tenth in a continuing series of reports describing results from the East Texas Pine Plantation Research Project.

Subject and content of each ETPPRP report is regional in scope and of particular interest to loblolly and slash pine plantation owners in East Texas.

Any suggestions, ideas or comments will always be welcomed.

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This report is based on work by J. David Lenhart.

J. David Lenhart
Project Director
October 16, 1986

ESTIMATING THE DRY WEIGHT OF INDIVIDUAL SLASH PINE TREES PLANTED IN EAST TEXAS

by

J. David Lenhart
Professor, School of Forestry, SFASU

ABSTRACT. Equations are presented to estimate the dry weight in pounds of the wood in the stem and branches of individual slash pine trees planted on site-prepared land in East Texas.

INTRODUCTION

The estimation of the content of individual trees is a principal component in the measurement process to determine per acre yields. In particular, the content of individual trees is a value needed in the last stages of the diameter distribution yield prediction method. Also, tree content information is useful in timber cruising.

In this report, we present equations to estimate the dry weight in pounds of individual planted slash pines on non-old-fields in East Texas as:

1. Complete Tree Dry Weight only: CTDWW.
2. Total Stem Dry Weight Wood only: TSDWW.
3. Partial Stem Dry Weight Wood only: PSDWW.

By appropriate subtraction, the dry weight of wood in the branches can be determined. In addition, differences between total stem and partial stem values can be obtained for various multiple-product computations.

TREE MEASUREMENTS

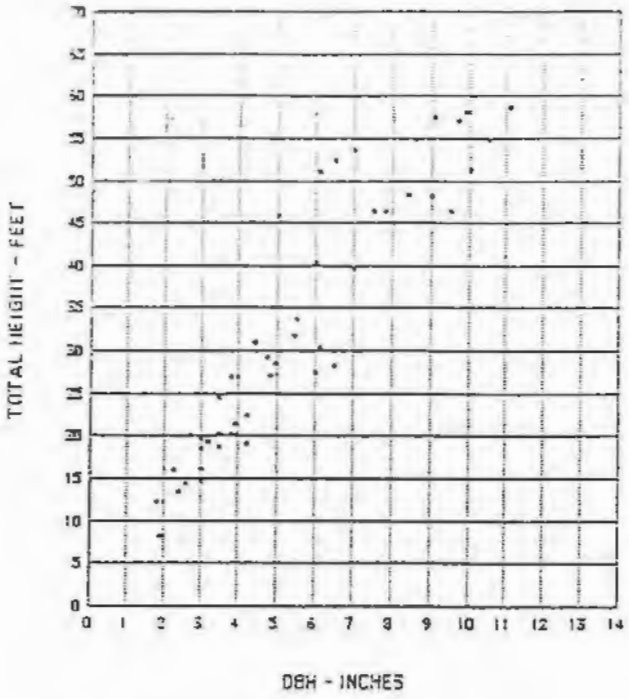
A total of 52 slash pine sample trees located in the buffer zones of 26 of our 61 ETPPRP permanent plots in slash pine plantations were felled during January - March, 1986. Two trees were sampled per plantation. The distribution of the 52 sample trees by county and by dbh and height classes is shown in Figure 1.

Prior to felling a tree, the dbh and crown class were determined. After felling, the branches were removed and weighed. A typical branch was weighed with and without needles. Eight branch segments (12" long) were cut and weighed with and without bark. The peeled segments were taken to the laboratory and oven-dried until moisture loss ceased.

At 3-foot cut points along the stem, dob was recorded. Then the stem was bucked into 3-foot long bolts. Each bolt was weighed. At the bottom of each bolt, a 1- to 2-inch disk was cut. Each disk was weighed with and without bark. In addition, dib for each disk was noted. The top stem segment was also weighed and considered part of the stem. The peeled disks were taken to the laboratory and oven-dried until moisture loss ceased.

The necessary field and laboratory data was now available to compute observed tree dry weight of wood as:

1. Partial stem to the top of each successive bolt.
2. Total stem.
3. Branches.



NUMBER OF SLASH PINE SAMPLE TREES
BY DBH AND HEIGHT. n = 52 trees.

Figure 1.

SLASH

n = 52 trees

Number of sample trees by county in Texas.

COMPLETE TREE DRY WEIGHT ESTIMATION

Plottings of CTDWW over dbh (D) and total tree height (H) indicated a model originally suggested by Schumacher and Hall (1933) as

$$\text{Tree content} = b_0 D^{b1} H^{b2} \qquad (1)$$

represented the relationships seen in the plottings.

Non-linear regression analysis of the data set produced the following prediction equations as

$$\text{CTDWW} = 0.045237 D^{2.179459} H^{1.027380}, \qquad (2)$$

with $R^2 = 99\%^*$.

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* All R^2 values in this report were calculated using non-linear regression results as:

$$R^2 = ((n-1)(\text{std dev dep var})^2 - \text{Residual SS})/((n-1)(\text{std dev dep var})^2)(100)$$

PARTIAL AND TOTAL STEM DRY WEIGHT ESTIMATION

In a dissertation by McTague (1985), a new tree content estimation model was presented, that has several desireable properties as

1. Treats total stem content as a special case of partial stem content.
2. Predicts partial stem content between stump and any upper stem diameter limit.
3. Convertible to a well-behaved taper function.
4. Suitable for estimating green or dry weight of the total or partial stem.

Subsequently, Pienaar and others (1985) developed a variation of the original McTague model as

Content wood only in the stem = $b_0 D^{b1} H^{b2}$

$$- b_3(d^{b4}/D^{b4} - 2)(h - 4.5), \qquad (3)$$

Where d = upper stem diameter o. b.

Equation (3) was used in non-linear regression analysis with a data set comprised of 540 cases of dry weight of wood. The resulting equation is

$$PSDWW = 0.026738D^{1.898673}H^{1.277228} - 0.060061d^{3.601110}D^{-1.601110}(H - 4.5) \quad (4)$$

with $R^2 = 97\%$.

If the value for the variable d (upper stem diameter o. b.) in Eq. 4 is set to zero (or the top of the stem), Eq. 4 collapses to

$$TSDW = 0.026738D^{1.898673}H^{1.277228}. \quad (5)$$

Table 1 shows predicted dry weight values for various combinations of D, H and d based on Eq. 4.

TABLE 1. ESTIMATED DRY WEIGHT OF WOOD ONLY IN THE STEM TO SPECIFIED UPPER DIAMETER LIMITS FOR INDIVIDUAL SLASH PINE TREES ON NON-OLD-FIELD PLANTATIONS IN EAST TEXAS.

DBH (IN)	UPPER STEM DIAMETER LIMIT (IN)	TOTAL TREE HEIGHT (FEET)						
		20	30	40	50	60	70	80
2	0	5						
4	0	17	29					
	2	16	27					
6	0		62	89	119			
	2		61	88	117			
	4		49	71	96			
8	0			154	205	259		
	2			153	204	257		
	4			143	191	241		
	6			106	143	183		
10	0				313	395	481	
	2				312	394	480	
	4				303	383	467	
	6				270	342	419	
12	0					559	680	807
	2					558	679	806
	4					550	670	794
	6					519	634	753
	8					447	549	655
14	0					749	912	1081
	2					746	911	1080
	4					742	903	1071
	6					716	875	1039
	8					662	809	963

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