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Research Report No. 16, Stand Structure and Yield of Loblolly Pine Plantations in East Texas, Update: 1987

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

STAND STRUCTURE AND YIELD OF LOBLOLLY PINE PLANTATIONS IN EAST TEXAS, UPDATE: 1987

by
J. David Lenhart

REPORT NUMBER 16

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

December, 1987

This is the sixteenth 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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Support from the participating companies...
Champion International Corporation,
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is gratefully appreciated.

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

J. David Lenhart
Project Director
December 7, 1987

STAND STRUCTURE AND YIELD OF LOBLOLLY PINE PLANTATIONS IN EAST TEXAS, UPDATE: 1987

by

J. David Lenhart
Professor, School of Forestry, SFASU

ABSTRACT. An updated diameter distribution yield prediction system is presented for loblolly pine (*Pinus taeda* L.) plantations on non-old-fields in East Texas. The new revised system was developed using data from initial measurement (1982-84) and first remeasurement (1985-87) of the East Texas Pine Plantation Research Project permanent plots.

INTRODUCTION

With the completion of the first remeasurement cycle of the East Texas Pine Plantation Research Project (ETPPRP), it was possible to combine remeasured data with initial data and compute updated versions of several components of the loblolly pine diameter distribution yield prediction system presented in ETPPRP Report No. 11 (Lenhart 1986).

This report presents an updated procedure to estimate the stand structure and yield for loblolly pine plantations in East Texas.

Some of the material in this report has been submitted to the Southern Journal of Applied Forestry for consideration for possible publication.

PERMANENT PLOT MEASUREMENTS

A total of 173 ETPPRP permanent plots are located in loblolly pine plantations in 24 counties throughout East Texas. Each plot consists of two subplots--one for model development and the other for model evaluation. Initial measurement of planted pines within each plot occurred during installation 1982-84, and first remeasurement of the planted pines was completed 1985-87. Data from both points in time were available for analysis.

Observed stand parameters available for stand structure analysis were:

1. Number of completed growing seasons (A).
2. Average height of the ten tallest trees (H).
3. Surviving number of trees per acre (T).
4. Surviving number of trees per acre by one-inch diameter classes (n).
5. Minimum diameter (DMIN).
6. Arithmetic mean diameter (DMEAN).
7. Quadratic mean diameter (DQMEAN).
8. Maximum diameter (DMAX).

In addition, site index (base age = 25 years) (S) values were calculated using equations developed by Lenhart et al. (1986).

An exploratory analysis of fitting the Weibull distribution to the data indicated that for successful fitting, at least three of the observed diameter classes had to be occupied with trees. If only one or two diameter classes had trees (usually plots less than 3 or 4 years old), the fitting routine would fail to find a solution. As a result, the number of loblolly pine observations was reduced from 346 to 234.

On the average, the observations represent plantations that are young (9 years) and on productive sites (SI=75 feet), where the surviving number of trees per acre (465-474) indicates about 90-100 square feet of growing space per tree, Table 1.

Table 1. Descriptive statistics of loblolly pine plantation observations by subplot type.

Stand Parameter	Type of Subplot	
	Development	Evaluation
Age (yrs)		
Mean	8.8	8.8
Range	3-19	3-19
Height (ft)		
Mean	29.6	29.4
Range	8-74	10-71
Site Index$_{25}$ (ft)		
Mean	75.2	75.4
Range	29-129	31-127
Surviving Trees per Acre		
Mean	464.6	474.0
Range	104-957	153-936
Min. Diameter (in.)		
Mean	1.08	1.08
Range	0-4.5	0-3.9
Arith. Mean Diameter (in.)		
Mean	3.92	3.89
Range	0.35-8.90	0.55-8.07
Quad. Mean Diameter (in.)		
Mean	4.08	4.04
Range	0.55-9.02	0.80-8.28
Max. Diameter (in.)		
Mean	6.37	6.27
Range	2.1-12.5	2.0-12.9
Tot. Stem Wood & Bark ft^3		
Mean	719.0	714.0
Range	1-3730	1-3809

PREDICTING STAND STRUCTURE AND YIELD

Several Weibull probability distribution parameter recovery procedures, which use stand level diameter values, have been developed (Burk and Burkhart 1984, Matney et al. 1987). The recovery procedure by Burk and Burkhart was used for these data. Location, shape and scale parameters for the Weibull distribution are obtained from estimates of minimum diameter, arithmetic mean diameter and quadratic mean diameter based on stand level values, such as age, height and trees per acre.

For loblolly pine plantations in East Texas, the revised and updated diameter distribution yield prediction method is:

1. Determine plantation age (number of growing seasons completed), number of surviving trees per acre at that age and average total height of the ten tallest trees in the plantation. If height is unknown, but site index is known, then estimate height as (Lenhart et al.1986):

$$H=S((1-EXP(-0.08005275A))/0.864843)^{1.628569} \qquad (1)$$

2. Predict stand level diameter values as:

$$DMIN = -0.0983 + 0.0593H - 0.0012T \qquad (2)$$

$$R^2 = 73\% \qquad SEE = 0.4969$$

If DMIN < 0, DMIN = 0.

$$DQMEAN = EXP(2.6753 - 28.5809/H - 0.0005T) \quad (3)$$

$R^2 = 96\%$ SEE = 0.1150

$$DMEAN = -0.1214 + 0.9920DQMEAN \quad (4)$$

$r^2 = 99.9\%$ SEE = 0.0596

3. Recover the Weibull parameters and compute the number of trees per acre by diameter class as:

   a. Weibull location parameter (a) is equal to DMIN.

   b. Weibull shape parameter (c) is computed by inserting DQMEAN, DMEAN and (a) in the equation:

$$DQMEAN^2 - a^2 - 2a(DMEAN-a) - (DMEAN-a)^2 \Gamma(1+2/c)/(\Gamma(1+1/c))^2 = 0 \quad (5)$$

   where: Γ = the complete gamma function.

   and solving for (c) using iterative procedures.

   c. Weibull scale parameter (b) is calculated using:

$$b = (DMEAN-a)/\Gamma(1+1/c) \quad (6)$$

The proportion (P) of T occurring between lower diameter bound (d_l) and upper diameter bound (d_u) in each diameter class is found as:

$$d_l < P < d_u = EXP(-((d_l-a)/b)^c - EXP(-((d_u-a)/b)^c) \quad (7)$$

For P of each diameter class, multiply by T to estimate the expected number of trees per acre in the diameter class.

4. Predict the total height (h) of each tree with diameter class mid-point (d) as (Dixon 1987):

$$h = EXP(\ln(H) + 0.009993 + (\ln(d) - \ln(DMAX))(0.018957 + 0.080091\ln(A) + 0.114679\ln(H/A) + 0.014514\ln(T))) \quad (8)$$

This equation updates earlier work by Blackard (1985).

5. Estimate the content of an individual tree representing the mid-point of each diameter class. Equations for predicting the cubic feet, green weight and dry weight in pounds for planted loblolly and slash pines in East Texas have been developed by Lenhart et al. (1987).

6. Multiply the individual tree content for each diameter class by the expected number of trees per acre for that diameter class to obtain yield per acre. By summing across all diameter classes, the total yield per acre is calculated. By selectively summing across specified diameter classes, per acre yields can be determined for different products (pulp, lumber, plywood, etc.).

EVALUATION

The evaluation subplots, which are separated from development subplots by a 60-foot wide buffer zone, provided an opportunity to analyze the accuracy of the diameter distribution yield prediction system. After the diameter distribution yield prediction system was utilized to calculate the predicted cubic feet of wood and bark per acre in the total stem for each evaluation subplot, the estimated yields were compared to the observed actual yields. On the average, the system underpredicted volumes by 5.3%. Plottings of percent differences against stand level values indicated no adverse trends.

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PREDICTED
STAND STRUCTURE
PLUS
VOLUME AND WEIGHT PER ACRE BY DBH CLASS
FOR
LOBLOLLY PINE PLANTATIONS
ON
NON-OLD-FIELDS
IN
EAST TEXAS

****
* AGE = 4 YEARS SINCE ESTABLISHMENT *
* SITE INDEX = 70 FEET (INDEX AGE = 25 YRS) *
* T/A = 400 SURVIVING AT AGE 4 *
****

THREE PREDICTED PLANTATION CHARACTERISTICS ARE...
1) AVERAGE HEIGHT OF TEN TALLEST TREES = 11 FEET.
2) ARITHMETIC MEAN DBH = .8 INCHES.
3) QUADRATIC MEAN DBH = .9 INCHES.

PER ACRE VALUES

STRUCTURE			VOLUME & WEIGHT - TOTAL STEM				
			WOOD & BARK		WOOD ONLY		
NUMBER OF TREES	BASAL AREA (SQFT)	AVG IND. TREE HT (FT)	VOLUME (CUFT)	GREEN WEIGHT (LBS)	VOLUME (CUFT)	DRY WEIGHT (LBS)	DBH (IN)
371	2	8	7	327	4	140	1
28	1	10	3	120	2	52	2
1	0	11	0	10	0	4	3
0	0	0	0	0	0	0	4
0	0	0	0	0	0	0	5
0	0	0	0	0	0	0	6
0	0	0	0	0	0	0	7
0	0	0	0	0	0	0	8
0	0	0	0	0	0	0	9
0	0	0	0	0	0	0	10
0	0	0	0	0	0	0	11
0	0	0	0	0	0	0	12
0	0	0	0	0	0	0	13
0	0	0	0	0	0	0	14
0	0	0	0	0	0	0	15
400	3		10	457	6	196	

... BASED ON RESEARCH CONDUCTED IN THE
EAST TEXAS PINE PLANTATION RESEARCH PROJECT

SCHOOL OF FORESTRY
STEPHEN F. AUSTIN STATE UNIVERSITY
... BETWEEN 1982 - 1987.

PREDICTED
STAND STRUCTURE
PLUS
VOLUME AND WEIGHT PER ACRE BY DBH CLASS
FOR
LOBLOLLY PINE PLANTATIONS
ON
NON-OLD-FIELDS
IN
EAST TEXAS

****
* AGE = 8 YEARS SINCE ESTABLISHMENT *
* SITE INDEX = 70 FEET (INDEX AGE = 25 YRS) *
* T/A = 400 SURVIVING AT AGE 8 *
****

THREE PREDICTED PLANTATION CHARACTERISTICS ARE...
1) AVERAGE HEIGHT OF TEN TALLEST TREES = 26 FEET.
2) ARITHMETIC MEAN DBH = 3.8 INCHES.
3) QUADRATIC MEAN DBH = 4.0 INCHES.

PER ACRE VALUES

STRUCTURE			VOLUME & WEIGHT - TOTAL STEM				
		AVG IND.	WOOD & BARK		WOOD ONLY		
DBH (IN)	NUMBER OF TREES	BASAL AREA (SQFT)	TREE HT (FT)	VOLUME (CUFT)	GREEN WEIGHT (LBS)	VOLUME (CUFT)	DRY WEIGHT (LBS)	DBH (IN)
1	3	0	12	0	4	0	2	1
2	45	1	16	7	354	5	152	2
3	115	6	19	47	2408	33	1038	3
4	132	12	21	106	5383	76	2326	4
5	78	11	23	107	5427	78	2350	5
6	23	5	25	49	2505	36	1087	6
7	4	1	26	12	611	9	266	7
8	0	0	0	0	0	0	0	8
9	0	0	0	0	0	0	0	9
10	0	0	0	0	0	0	0	10
11	0	0	0	0	0	0	0	11
12	0	0	0	0	0	0	0	12
13	0	0	0	0	0	0	0	13
14	0	0	0	0	0	0	0	14
15	0	0	0	0	0	0	0	15
TOTAL	400	36		328	16692	237	7221	

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VOLUME AND WEIGHT PER ACRE BY DBH CLASS
FOR
LOBLOLLY PINE PLANTATIONS
ON
NON-OLD-FIELDS
IN
EAST TEXAS

****
* AGE = 10 YEARS SINCE ESTABLISHMENT *
* SITE INDEX = 70 FEET (INDEX AGE = 25 YRS) *
* T/A = 400 SURVIVING AT AGE 10 *
****

THREE PREDICTED PLANTATION CHARACTERISTICS ARE...
1) AVERAGE HEIGHT OF TEN TALLEST TREES = 34 FEET.
2) ARITHMETIC MEAN DBH = 5.0 INCHES.
3) QUADRATIC MEAN DBH = 5.1 INCHES.

PER ACRE VALUES

STRUCTURE			VOLUME & WEIGHT - TOTAL STEM				
			WOOD & BARK		WOOD ONLY		
NUMBER OF TREES	BASAL AREA (SQFT)	AVG IND. TREE HT (FT)	VOLUME (CUFT)	GREEN WEIGHT (LBS)	VOLUME (CUFT)	DRY WEIGHT (LBS)	DBH (IN)
0	0	0	0	0	0	0	1
8	0	18	1	73	1	31	2
45	2	21	21	1072	15	462	3
96	8	24	89	4651	65	2009	4
116	16	27	189	9927	141	4296	5
86	17	29	216	11346	163	4918	6
38	10	31	139	7287	106	3164	7
9	3	33	46	2401	35	1044	8
1	0	34	7	345	5	150	9
0	0	0	0	0	0	0	10
0	0	0	0	0	0	0	11
0	0	0	0	0	0	0	12
0	0	0	0	0	0	0	13
0	0	0	0	0	0	0	14
0	0	0	0	0	0	0	15
400	56		708	37102	531	16074	

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FOR
LOBLOLLY PINE PLANTATIONS
ON
NON-OLD-FIELDS
IN
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****
* AGE = 12 YEARS SINCE ESTABLISHMENT *
* SITE INDEX = 70 FEET (INDEX AGE = 25 YRS) *
* T/A = 400 SURVIVING AT AGE 12 *
****

THREE PREDICTED PLANTATION CHARACTERISTICS ARE...
1) AVERAGE HEIGHT OF TEN TALLEST TREES = 40 FEET.
2) ARITHMETIC MEAN DBH = 5.6 INCHES.
3) QUADRATIC MEAN DBH = 5.8 INCHES.

PER ACRE VALUES

STRUCTURE			VOLUME & WEIGHT - TOTAL STEM				
			WOOD & BARK		WOOD ONLY		
DBH (IN)	NUMBER OF TREES	BASAL AREA (SQFT)	AVG IND. TREE HT (FT)	VOLUME (CUFT)	GREEN WEIGHT (LBS)	VOLUME (CUFT)	DRY WEIGHT (LBS)	DBH (IN)
1	0	0	0	0	0	0	0	1
2	2	0	20	0	21	0	9	2
3	22	1	24	12	623	8	268	3
4	63	5	27	66	3553	49	1534	4
5	101	14	30	184	9902	139	4283	5
6	104	20	32	290	15579	223	6751	6
7	70	19	34	282	15124	219	6563	7
8	30	10	37	172	9277	135	4030	8
9	8	4	39	61	3300	48	1435	9
10	1	1	40	10	519	8	226	10
11	0	0	0	0	0	0	0	11
12	0	0	0	0	0	0	0	12
13	0	0	0	0	0	0	0	13
14	0	0	0	0	0	0	0	14
15	0	0	0	0	0	0	0	15
TOTAL	400	74		1077	57898	829	25099	

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****
* AGE = 14 YEARS SINCE ESTABLISHMENT *
* SITE INDEX = 70 FEET (INDEX AGE = 25 YRS) *
* T/A = 400 SURVIVING AT AGE 14 *
****

THREE PREDICTED PLANTATION CHARACTERISTICS ARE...
1) AVERAGE HEIGHT OF TEN TALLEST TREES = 47 FEET.
2) ARITHMETIC MEAN DBH = 6.3 INCHES.
3) QUADRATIC MEAN DBH = 6.5 INCHES.

PER ACRE VALUES

STRUCTURE			VOLUME & WEIGHT - TOTAL STEM				
			WOOD & BARK		WOOD ONLY		
NUMBER OF TREES	BASAL AREA (SQFT)	AVG IND. TREE HT (FT)	VOLUME (CUFT)	GREEN WEIGHT (LBS)	VOLUME (CUFT)	DRY WEIGHT (LBS)	DBH (IN)
0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	2
9	0	26	5	282	4	122	3
38	3	30	45	2456	34	1060	4
77	10	33	155	8537	119	3691	5
100	20	36	316	17440	247	7553	6
90	24	39	419	23212	332	10067	7
56	20	41	357	19771	286	8586	8
23	10	43	194	10760	157	4678	9
6	3	45	65	3624	53	1577	10
1	1	47	14	763	11	333	11
0	0	0	0	0	0	0	12
0	0	0	0	0	0	0	13
0	0	0	0	0	0	0	14
0	0	0	0	0	0	0	15
400	91		1570	86845	1243	37667	

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VOLUME AND WEIGHT PER ACRE BY DBH CLASS
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LOBLOLLY PINE PLANTATIONS
ON
NON-OLD-FIELDS
IN
EAST TEXAS

****
* AGE = 16 YEARS SINCE ESTABLISHMENT *
* SITE INDEX = 70 FEET (INDEX AGE = 25 YRS) *
* T/A = 400 SURVIVING AT AGE 16 *
****

THREE PREDICTED PLANTATION CHARACTERISTICS ARE...
1) AVERAGE HEIGHT OF TEN TALLEST TREES = 52 FEET.
2) ARITHMETIC MEAN DBH = 6.7 INCHES.
3) QUADRATIC MEAN DBH = 6.9 INCHES.

PER ACRE VALUES

DBH (IN)	STRUCTURE: NUMBER OF TREES	STRUCTURE: BASAL AREA (SQFT)	STRUCTURE: AVG IND. TREE HT (FT)	VOLUME & WEIGHT - TOTAL STEM: WOOD & BARK: VOLUME (CUFT)	WOOD & BARK: GREEN WEIGHT (LBS)	WOOD ONLY: VOLUME (CUFT)	WOOD ONLY: DRY WEIGHT (LBS)	DBH (IN)
1	0	0	0	0	0	0	0	1
2	0	0	0	0	0	0	0	2
3	4	0	29	3	145	2	62	3
4	27	2	33	35	1973	27	851	4
5	63	9	36	139	7815	109	3378	5
6	92	18	40	326	18382	258	7958	6
7	94	25	43	486	27500	390	11922	7
8	69	24	45	486	27471	394	11925	8
9	35	15	48	333	18872	273	8201	9
10	12	7	50	146	8304	121	3612	10
11	3	2	53	47	2674	39	1164	11
12	0	0	0	0	0	0	0	12
13	0	0	0	0	0	0	0	13
14	0	0	0	0	0	0	0	14
15	0	0	0	0	0	0	0	15
TOTAL	400	102		2001	113136	1613	49073	

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****
* AGE = 18 YEARS SINCE ESTABLISHMENT *
* SITE INDEX = 70 FEET (INDEX AGE = 25 YRS) *
* T/A = 400 SURVIVING AT AGE 18 *
****

THREE PREDICTED PLANTATION CHARACTERISTICS ARE...
1) AVERAGE HEIGHT OF TEN TALLEST TREES = 57 FEET.
2) ARITHMETIC MEAN DBH = 7.0 INCHES.
3) QUADRATIC MEAN DBH = 7.2 INCHES.

PER ACRE VALUES

DBH (IN)	STRUCTURE: NUMBER OF TREES	STRUCTURE: BASAL AREA (SQFT)	STRUCTURE: AVG IND. TREE HT (FT)	VOLUME & WEIGHT - TOTAL STEM: WOOD & BARK: VOLUME (CUFT)	WOOD & BARK: GREEN WEIGHT (LBS)	WOOD ONLY: VOLUME (CUFT)	WOOD ONLY: DRY WEIGHT (LBS)	DBH (IN)
1	0	0	0	0	0	0	0	1
2	0	0	0	0	0	0	0	2
3	2	0	30	1	75	1	32	3
4	19	2	34	26	1443	20	622	4
5	52	7	38	122	6917	96	2989	5
6	83	16	42	309	17661	247	7644	6
7	94	25	45	510	29162	413	12640	7
8	77	27	48	581	33319	476	14460	8
9	46	20	50	456	26146	377	11360	9
10	20	11	53	259	14922	216	6489	10
11	6	4	55	98	5611	82	2442	11
12	1	1	58	20	1178	17	513	12
13	0	0	0	0	0	0	0	13
14	0	0	0	0	0	0	0	14
15	0	0	0	0	0	0	0	15
	400	113		2382	136434	1945	59191	

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PREDICTED
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VOLUME AND WEIGHT PER ACRE BY DBH CLASS
FOR
LOBLOLLY PINE PLANTATIONS
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****
* AGE = 22 YEARS SINCE ESTABLISHMENT *
* SITE INDEX = 70 FEET (INDEX AGE = 25 YRS) *
* T/A = 400 SURVIVING AT AGE 22 *
****

THREE PREDICTED PLANTATION CHARACTERISTICS ARE...
1) AVERAGE HEIGHT OF TEN TALLEST TREES = 65 FEET.
2) ARITHMETIC MEAN DBH = 7.5 INCHES.
3) QUADRATIC MEAN DBH = 7.7 INCHES.

PER ACRE VALUES

STRUCTURE			VOLUME & WEIGHT - TOTAL STEM				
			WOOD & BARK		WOOD ONLY		
DBH (IN)	NUMBER OF TREES	BASAL AREA (SQFT)	AVG IND. TREE HT (FT)	VOLUME (CUFT)	GREEN WEIGHT (LBS)	VOLUME (CUFT)	DRY WEIGHT (LBS)	DBH (IN)
1	0	0	0	0	0	0	0	1
2	0	0	0	0	0	0	0	2
3	0	0	0	0	0	0	0	3
4	10	1	37	15	847	11	365	4
5	38	5	42	99	5752	79	2484	5
6	71	14	45	285	16515	230	7146	6
7	90	24	49	534	31165	438	13503	7
8	84	29	52	690	40304	572	17485	8
9	59	26	55	648	37924	543	16471	9
10	31	17	58	443	25982	374	11295	10
11	12	8	61	218	12826	186	5581	11
12	3	2	63	67	3933	57	1713	12
13	1	1	66	27	1617	24	704	13
14	0	0	0	0	0	0	0	14
15	0	0	0	0	0	0	0	15
TOTAL	400	127		3026	176865	2514	76747	

NOTE... BASED ON RESEARCH CONDUCTED IN THE
EAST TEXAS PINE PLANTATION RESEARCH PROJECT

SCHOOL OF FORESTRY
STEPHEN F. AUSTIN STATE UNIVERSITY
... BETWEEN 1982 - 1987.

PREDICTED
STAND STRUCTURE
PLUS
VOLUME AND WEIGHT PER ACRE BY DBH CLASS
FOR
LOBLOLLY PINE PLANTATIONS
ON
NON-OLD-FIELDS
IN
EAST TEXAS

****
* AGE = 24 YEARS SINCE ESTABLISHMENT *
* SITE INDEX = 70 FEET (INDEX AGE = 25 YRS) *
* T/A = 400 SURVIVING AT AGE 24 *
****

THREE PREDICTED PLANTATION CHARACTERISTICS ARE...
1) AVERAGE HEIGHT OF TEN TALLEST TREES = 69 FEET.
2) ARITHMETIC MEAN DBH = 7.7 INCHES.
3) QUADRATIC MEAN DBH = 7.9 INCHES.

---------- PER ACRE VALUES ----------

STRUCTURE			VOLUME & WEIGHT - TOTAL STEM				
		AVG	WOOD & BARK		WOOD ONLY		
DBH (IN)	NUMBER OF TREES	BASAL AREA (SQFT)	IND. TREE HT (FT)	VOLUME (CUFT)	GREEN WEIGHT (LBS)	VOLUME (CUFT)	DRY WEIGHT (LBS)	DBH (IN)
1	0	0	0	0	0	0	0	1
2	0	0	0	0	0	0	0	2
3	0	0	0	0	0	0	0	3
4	6	1	39	9	544	7	234	4
5	33	4	44	90	5304	73	2291	5
6	66	13	48	283	16685	231	7218	6
7	87	23	52	550	32527	455	14090	7
8	85	30	55	741	43845	620	19017	8
9	64	28	58	743	44057	628	19130	9
10	36	20	61	542	32203	462	13996	10
11	16	11	64	306	18195	263	7915	11
12	5	4	67	119	7097	103	3090	12
13	1	1	70	29	1744	25	760	13
14	0	0	0	0	0	0	0	14
15	0	0	0	0	0	0	0	15
TOTAL	400	135		3412	202201	2867	87741	

NOTE... BASED ON RESEARCH CONDUCTED IN THE
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