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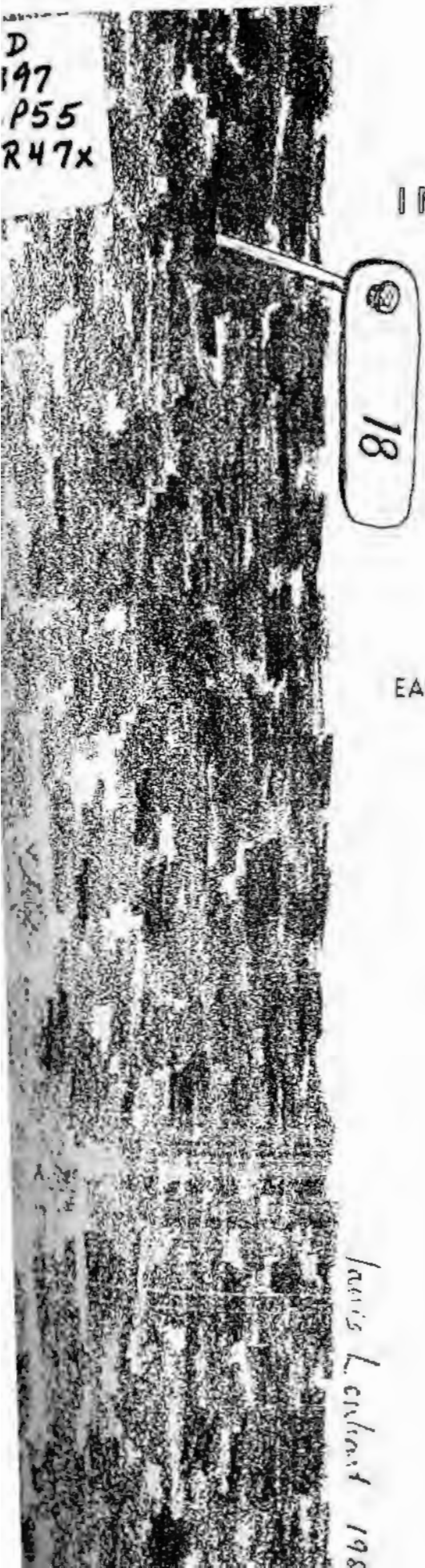
Research Report No. 4, Predicting Individual Tree Height

Jock A. Blackard



PREDICTING INDIVIDUAL TREE HEIGHT

by

Jock A. Blackard

REPORT NUMBER 4

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, 1985

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

Subject and content of each ETPPRP report will be 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.

* * * * * * * * *

Support from the participating companies...

Champion International Corporation,

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is gratefully appreciated.

* * * * * * * * *

This report is based on a thesis being written by Mr. Blackard to fulfill partial requirements for a MSF degree. Mr. Blackard expects to receive his degree in May, 1986.

J. David Lenhart

Project Director

December 19, 1985

PREDICTING INDIVIDUAL TREE HEIGHT

by

Jock A. Blackard[1]

ABSTRACT. Equations to estimate individual total tree height of loblolly pine (*Pinus taeda* L.) and slash pine (*Pinus elliottii* Engelm.) trees planted on non-old-fields in East Texas are presented.

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INTRODUCTION

One of the components in the diameter distribution yield prediction method is estimating the total height of individual trees. Height information plus dbh can determine the amount of wood in an individual tree. When the individual tree values are multiplied by the number of trees per acre in each respective dbh class, an estimate of the amount of wood per acre by dbh class is obtained. An estimate of the total amount of wood per acre may be found by summing across all dbh classes.

In this report, equations are presented to estimate the total height of individual planted loblolly and slash pines in non-old-fields in East Texas. The thesis by the author will include expanded and detailed descriptions of the procedures to obtain these two equations.

PLANTATION MEASUREMENTS

Data for this study were obtained during installation of 256 permanent monumented plots in unthinned loblolly and slash pine plantations located on non-old-fields throughout East Texas. Of the 256 plots, 178 are in loblolly pine plantations, and 78 are in slash pine plantations. The growth and yield plots were installed during 1982-84 by the School of Forestry in plantations owned by the participating companies (Lenhart *et al.* 1985).

Each plot consists of two subplots -- one to remain unthinned and the other to receive thinnings. The height growth equations were developed using data from the subplots to-remain-unthinned. Within a subplot, each planted pine was tagged and numbered. Total height and dbh (among other values) were determined for each planted pine. These two tree values plus plantation characteristics -- age, average top ten tree heights and number of trees per acre -- were available for analyses.

Sample size for regression analysis was 10,625 observations for loblolly pine and 4,993 observations for slash pine.

PREDICTING INDIVIDUAL LOBLOLLY PINE TREE HEIGHTS

After plotting and studying the 10,625 loblolly pine observations, it appeared that a variation of the equation form developed by Lenhart and Clutter (1971) represented the observed trends. For this data set, the natural logarithm of height was linearly related to the natural logarithm of dbh.

Multiple linear regression analysis of the height growth difference model produced an equation for planted loblolly pine as

$$\ln(h) = \ln(TTH) + 0.007161 - 0.12505\ln(A)(\ln(DMAX)-\ln(D)) - 0.13367\ln(TTH/A)(\ln(DMAX-\ln(D)) + 0.004739\ln(STA)(\ln(DMAX)-\ln(D)),$$

with $R^2 = 67.8\%$ and RMS = 0.01302,

where h = Total height (feet) for a tree with dbh D (inches),

TTH = Average height (feet) of the ten tallest trees,

A = Number of growing seasons completed since plantation establishment (years),

DMAX = Maximum dbh (inches) occurring in plantation and

STA = Surviving number of trees per acre.

Using the loblolly pine equation, Table 1 shows predicted heights by several combinations of site index (SI), surviving trees per acre, plantation age and dbh. Average height of the ten tallest trees is computed using the site index equation developed in the ETPPRP (Lenhart *et al.* in press, Blackard 1985). For a given combination of SI, STA and A, the minimum and maximum diameters are determined using unpublished research from the ETPPRP.

Based on values from Table 1 for site index = 60 feet and surviving trees per acre = 400, Figures 1, 2 and 3 display height growth trends over diameter classes for different plantation age classes.

In Figure 3, as plantation age approaches index age (25 years), the height of the tree of maximum diameter approaches the site index value of 60 feet. By using the difference model approach (Lenhart and Clutter 1971), this result is assured.

TABLE 1. PREDICTED TOTAL HEIGHT IN FEET OF INDIVIDUAL TREES BY SITE INDEX, STAND DENSITY, AGE AND DIAMETER CLASSES, FOR NON-OLD-FIELD LOBLOLLY PINE PLANTATIONS IN EAST TEXAS.

SITE INDEX CLASS 40 FEET

TREES PER ACRE CLASS	AGE (YRS)	1-INCH DIAMETER CLASS															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
200	4	6.2															
	6	8.8	10.7														
	8	10.7	13.3	15.1													
	10	11.1	14.1	16.2	17.9	19.4											
	12	12.0	15.5	17.0	20.0	21.8	23.3										
	14	12.6	16.5	18.3	21.6	23.6	25.3	26.9									
	16		17.2	20.2	22.7	24.9	26.8	28.5	30.1								
	18		18.5	21.9	24.7	27.1	29.2	31.1	32.9								
	20		19.7	23.2	25.1	27.6	29.8	31.8	33.7	35.4							
	22		19.7	23.4	26.5	29.2	31.6	33.7	35.7	37.6							
	24		19.9	23.3	26.5	29.2	31.6	33.8	35.8	37.7	39.5						
	25		19.9	23.8	27.0	29.7	32.2	34.5	36.6	38.5	40.3						
400	4	6.2															
	6	8.9	10.7														
	8	10.7	13.3	15.1													
	10	11.1	14.1	16.2	17.9	19.4											
	12	12.0	15.5	17.1	20.1	21.8	23.3										
	14	12.7	16.6	18.4	21.7	23.6	25.3	26.9									
	16	13.1	17.3	20.3	22.8	24.9	26.8	28.5	30.1								
	18		18.6	21.0	24.7	27.1	29.2	31.2	32.9								
	20		18.8	22.5	25.2	27.7	29.9	31.9	33.7	35.4							
	22		19.8	23.5	26.6	29.2	31.6	33.8	35.7	37.6							
	24		19.6	23.4	26.5	29.2	31.6	33.8	35.8	37.7	39.5						
	25		20.0	23.9	27.0	29.8	32.3	34.5	36.6	38.5	40.3						

TABLE 1. PREDICTED TOTAL LOBLOLLY HEIGHTS IN FEET...CONTINUED

SITE INDEX CLASS 40 FEET

TREES PER ACRE CLASS	AGE (YRS)	1-INCH DIAMETER CLASS 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
600	4	6.2															
	6	8.9	10.7														
	8	10.7	13.3	15.1													
	10	11.1	14.1	15.3	17.9	19.4											
	12	12.1	15.5	17.1	20.1	21.8	23.3										
	14	12.7	16.6	18.4	21.7	23.6	25.3	26.9									
	16	13.1	17.3	20.3	22.8	24.9	26.8	28.5	30.1								
	18		18.7	20.8	24.8	27.2	29.3	31.2	32.9								
	20		19.9	23.4	25.2	27.7	29.9	31.9	33.7	35.4							
	22		19.8	23.5	26.6	29.3	31.6	33.8	35.8	37.6							
	24		19.7	23.5	26.6	29.3	31.7	33.8	35.9	37.7	39.5						
	25		20.1	23.4	27.1	29.8	32.3	34.5	36.6	38.5	40.3						
800	4	6.2															
	6	8.9	10.7														
	8	10.7	13.3	15.1													
	10	11.2	14.2	15.3	18.0	19.4											
	12	12.1	15.5	17.1	20.1	21.8	23.3										
	14	12.8	16.6	18.4	21.7	23.6	25.3	26.9									
	16	13.9	18.3	21.5	24.1	26.3	28.3	30.1									
	18	14.1	18.7	20.1	24.5	27.2	29.3	31.2	32.9								
	20		18.9	23.4	25.2	27.7	29.9	31.9	33.7	35.4							
	22		19.5	23.5	26.6	29.3	31.6	33.8	35.8	37.6							
	24		20.7	24.6	27.8	30.7	33.2	35.4	37.5	39.5							
	25		20.1	23.9	27.1	29.9	32.3	34.6	36.6	38.5	40.3						

TABLE 1. PREDICTED TOTAL LOBLOLLY HEIGHTS IN FEET...CONTINUED

SITE INDEX CLASS 60 FEET

TREES PER ACRE CLASS	AGE (YRS)	1-INCH DIAMETER CLASS															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
200	4	7.8	9.3														
	6	10.2	12.7	14.5	16.0												
	8	11.6	15.1	17.5	19.5	21.2	22.7										
	10		17.5	20.6	23.2	25.4	27.3	29.0									
	12		19.3	23.0	26.0	28.6	30.9	33.0	34.9								
	14		20.7	24.7	28.1	31.0	33.7	36.0	38.3	40.3							
	16			25.8	29.6	32.8	35.7	38.3	40.7	43.0	45.1						
	18			26.6	30.7	34.1	37.1	39.9	42.5	44.9	47.2	49.4					
	20			27.5	32.7	36.4	39.7	42.8	45.6	48.2	50.7	53.1					
	22			28.3	33.1	36.9	40.3	43.4	46.3	49.0	51.6	54.0	56.4				
	24				34.5	38.5	42.1	45.4	48.5	51.4	54.1	56.7	59.2				
	25				35.2	39.2	42.9	46.3	49.5	52.5	55.3	57.9	60.5				
400	4	7.8	9.3														
	6	10.2	12.6	14.5	16.0												
	8	11.7	15.1	17.6	19.5	21.2	22.7										
	10	13.3	17.6	20.7	23.2	25.4	27.3	29.0									
	12		18.5	23.0	24.8	27.2	29.4	31.4	33.2	34.9							
	14		20.3	24.8	28.2	31.1	33.7	36.1	38.3	40.3							
	16		21.7	25.1	29.7	32.9	35.7	38.3	40.8	43.0	45.1						
	18			25.9	30.8	34.2	37.2	40.0	42.5	44.9	47.2	49.4					
	20			26.6	32.8	36.5	39.8	42.8	45.6	48.3	50.7	53.1					
	22			27.3	33.2	36.9	40.3	43.5	46.3	49.1	51.6	54.0	56.4				
	24			28.1	34.6	38.6	42.2	45.5	48.6	51.4	54.2	56.7	59.2				
	25			28.6	35.3	39.4	43.0	46.4	49.6	52.5	55.3	58.0	60.5				

TABLE 1. PREDICTED TOTAL LOBLOLLY HEIGHTS IN FEET...CONTINUED

SITE INDEX CLASS 60 FEET

TREES PER ACRE CLASS	AGE (YRS)	1-INCH DIAMETER CLASS															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
600	4	7.8	9.3														
	6	10.2	12.3	14.1	16.0												
	8	11.8	15.1	17.5	19.5	21.2	22.7										
	10	13.4	17.5	20.7	23.2	25.4	27.3	29.0									
	12		19.5	23.1	26.1	28.7	31.0	33.0	34.9								
	14		20.8	24.9	28.2	31.1	33.7	36.1	38.3	40.3							
	16		21.8	26.1	29.8	32.9	35.8	38.4	40.8	43.0	45.1						
	18			27.0	30.9	34.2	37.2	40.0	42.6	45.0	47.2	49.4					
	20			28.7	32.9	36.6	39.9	42.9	45.7	48.3	50.8	53.1					
	22			29.9	33.3	37.0	40.4	43.5	46.4	49.1	51.6	54.1	56.4				
	24			30.2	34.7	38.7	42.3	45.6	48.6	51.5	54.2	56.8	59.2				
	25			30.7	35.4	39.4	43.1	46.5	49.6	52.5	55.3	58.0	60.5				
800	4	7.8	9.3														
	6	11.2	14.0	16.0													
	8	11.8	15.2	17.5	19.5	21.2	22.7										
	10	13.4	17.7	20.7	23.3	25.4	27.3	29.0									
	12	14.6	19.5	23.1	26.1	28.7	31.0	33.0	34.9								
	14		20.4	24.9	28.3	31.2	33.8	36.1	38.3	40.3							
	16		21.6	26.2	29.8	33.0	35.8	38.4	40.8	43.0	45.1						
	18		22.4	27.0	30.9	34.3	37.3	40.0	42.6	45.0	47.2	49.4					
	20			27.5	32.9	36.6	39.9	42.9	45.7	48.3	50.8	53.1					
	22			30.2	34.7	38.5	42.2	45.4	48.4	51.2	53.8	56.4					
	24			31.2	34.6	38.7	42.3	45.6	48.6	51.5	54.2	56.8	59.2				
	25			30.9	35.4	39.5	43.1	46.5	49.6	52.6	55.3	58.0	60.5				

TABLE 1. PREDICTED TOTAL LOBLOLLY HEIGHTS IN FEET...CONTINUED

SITE INDEX CLASS 80 FEET

TREES PER ACRE CLASS	AGE (YRS)	1-INCH DIAMETER CLASS 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
200	4	9.0	11.0	1 .4													
	5	11.8	1 .2	17.7	19.6	21.3											
	8		1 .1	2 .7	24.0	26.3	28.3	30.2									
	10		1 .9	2 .6	27.0	29.9	32.4	34.6	36.7	38.7							
	12			2 .6	30.4	33.7	36.7	39.5	42.0	44.4	46.6						
	14			2 .7	33.0	36.7	40.1	43.2	46.1	48.8	51.3	53.7					
	16				34.8	38.9	42.6	46.0	49.2	52.1	54.9	57.6	60.1				
	18				36.2	40.5	44.4	48.0	51.4	54.6	57.6	60.4	63.2	65.8			
	20				38.5	43.2	47.5	51.4	55.1	58.5	61.8	64.9	67.9	70.8			
	22				40.5	45.5	50.1	54.3	58.3	62.0	65.5	68.8	72.0	75.1			
	24					45.7	50.4	54.7	58.7	62.4	66.0	69.5	72.7	75.9	78.9		
	25					46.6	51.3	55.7	59.8	63.7	67.4	70.9	74.3	77.5	80.6		
400	4	9.0	11.0	12.4													
	6	11.9	1 .3	1 .7	19.6	21.3											
	8	13.7	1 .1	2 .4	24.0	26.3	28.4	30.2									
	10		2 .0	2 .9	27.1	29.9	32.4	34.7	36.8	38.7							
	12			2 .7	30.5	33.8	36.8	39.5	42.0	44.4	46.6						
	14			2 .3	33.1	36.8	40.2	43.3	46.1	48.8	51.3	53.7					
	16			3 .3	35.0	39.0	42.7	46.1	49.2	52.2	55.0	57.6	60.1				
	18				36.3	40.6	44.5	48.1	51.5	54.6	57.6	60.5	63.2	65.8			
	20				38.6	43.3	47.6	51.5	55.2	58.6	61.9	65.0	67.9	70.8			
	22				39.1	43.9	48.3	52.4	56.1	59.7	63.1	66.3	69.3	72.3	75.1		
	24				40.8	45.9	50.5	54.8	58.8	62.5	66.1	69.5	72.8	75.9	78.9		
	25				41.5	46.8	51.5	55.9	60.0	63.8	67.5	71.0	74.3	77.5	80.6		

TABLE 1. PRE ICTED TOTAL LOBLOLLY HEIGHTS IN FEET...CONTINUED

SITE INDEX CLASS 50 FEET

TREES PER ACRE CLASS	AGE (YRS)	1-INCH DIAMETER CLASS 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
600	4	10.2	12.4														
	6	11.9	15.3	17.7	19.6	21.3											
	8	13.7	16.2	21.4	24.1	26.3	28.4	30.2									
	10		20.1	24.0	27.2	29.9	32.4	34.7	36.8	38.7							
	12		22.2	27.8	30.6	33.9	36.3	39.5	42.0	44.4	46.6						
	14			29.9	33.1	36.9	40.2	43.3	46.1	48.8	51.3	53.7					
	16			32.4	35.0	39.1	42.8	46.1	49.3	52.2	55.0	57.6	60.1				
	18			31.5	36.4	40.7	44.6	48.2	51.5	54.7	57.7	60.5	63.2	65.8			
	20				38.7	43.4	47.6	51.6	55.2	58.6	61.9	65.0	67.9	70.8			
	22				40.8	45.8	50.3	54.5	58.4	62.1	65.6	68.9	72.1	75.1			
	24				40.9	46.0	50.6	54.9	58.8	62.6	66.1	69.5	72.8	75.9	78.9		
	25				41.6	46.6	51.6	55.9	60.0	63.9	67.5	71.0	74.3	77.5	80.6		
800	4	9.0	11.1	13.4													
	6	11.9	15.3	17.7	19.6	21.3											
	8	13.8	16.2	21.4	24.1	26.4	28.4	30.2									
	10		20.1	24.0	27.2	30.0	32.4	34.7	36.8	38.7							
	12		22.3	27.8	30.6	33.9	36.9	39.6	42.1	44.4	46.6						
	14			29.9	33.2	36.9	40.3	43.3	46.2	48.8	51.3	53.7					
	16			32.5	35.1	39.1	42.8	46.2	49.3	52.2	55.0	57.6	60.1				
	18			31.3	37.9	42.4	46.5	50.2	53.7	57.0	60.0	63.0	65.8				
	20				38.8	43.5	47.7	51.6	55.2	58.7	61.9	65.0	67.9	70.8			
	22				40.8	45.8	50.4	54.5	58.4	62.1	65.6	68.9	72.1	75.1			
	24				41.0	46.0	50.7	54.9	58.9	62.6	66.2	69.6	72.8	75.9	78.9		
	25				41.7	46.9	51.6	56.0	60.1	63.9	67.5	71.0	74.3	77.5	80.6		

FIGURE 1. PREDICTED LOBLOLLY PINE HEIGHTS BY DIAMETER CLASSES FOR FOUR AGE CLASSES WITH SI = 60 AND TREES PER ACRE = 400.

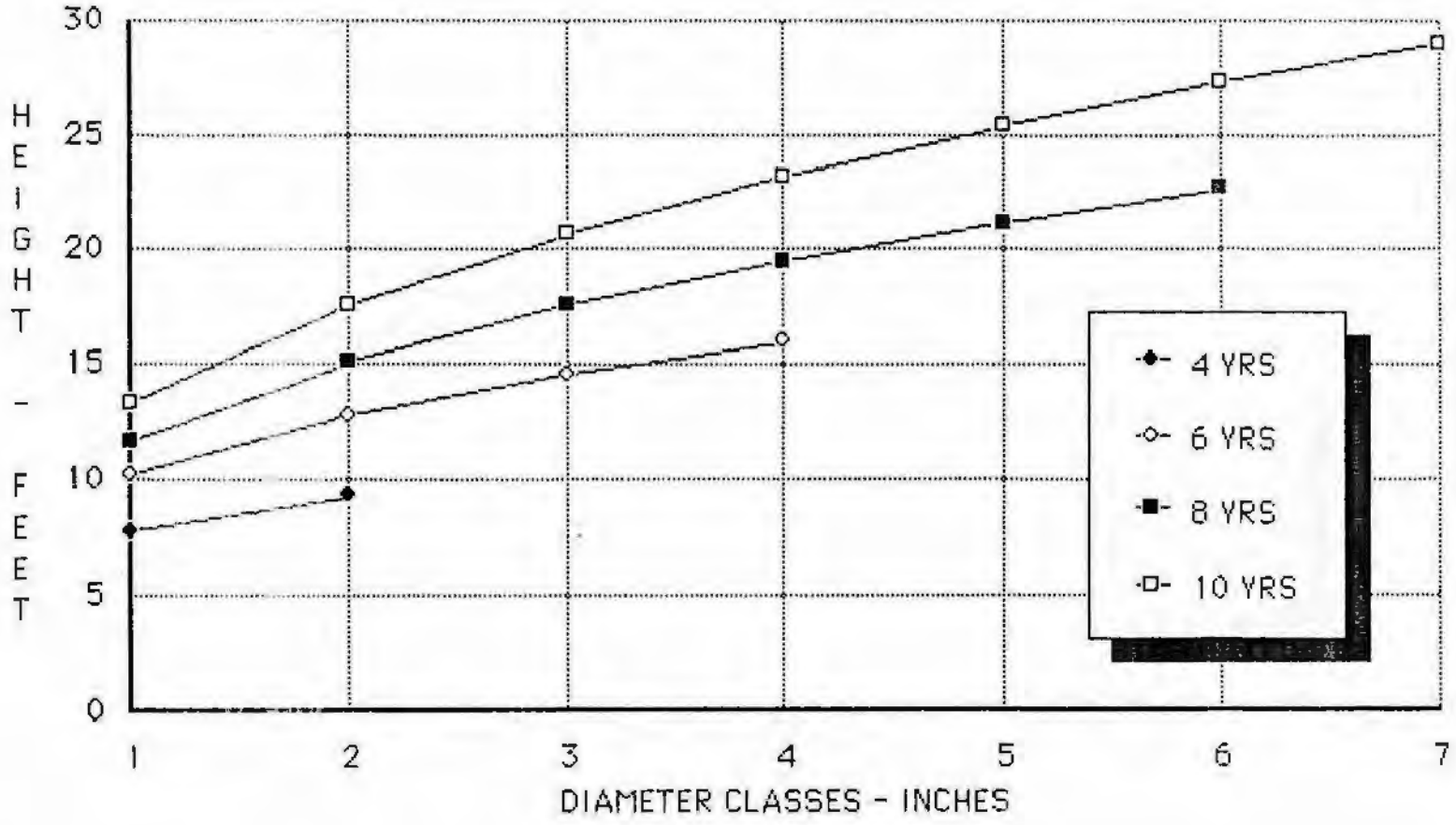


FIGURE 2. PREDICTED LOBLOLLY PINE HEIGHTS BY DIAMETER CLASSES FOR THREE AGE CLASSES WITH SI = 60 AND TREES PER ACRE = 400.

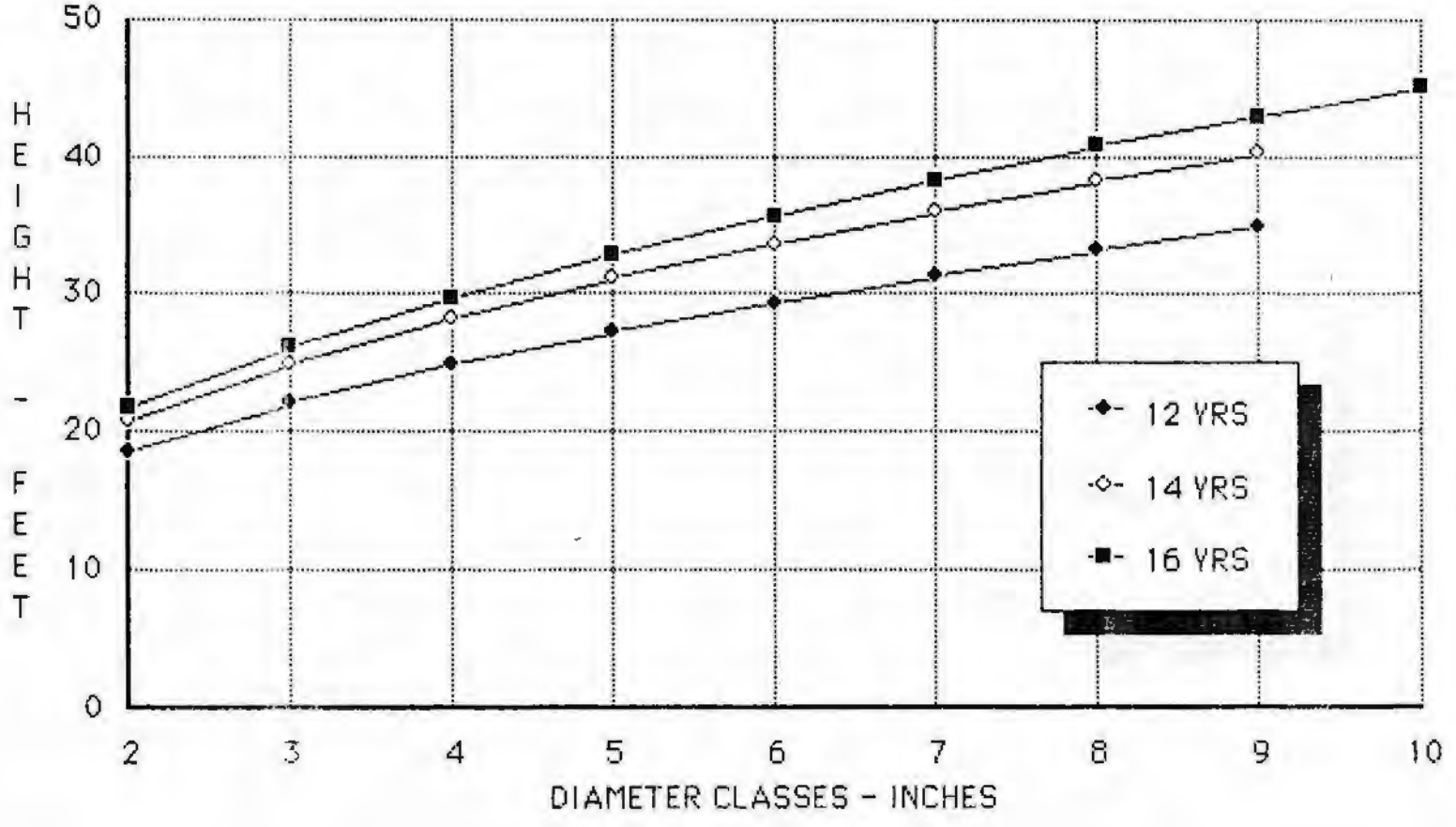
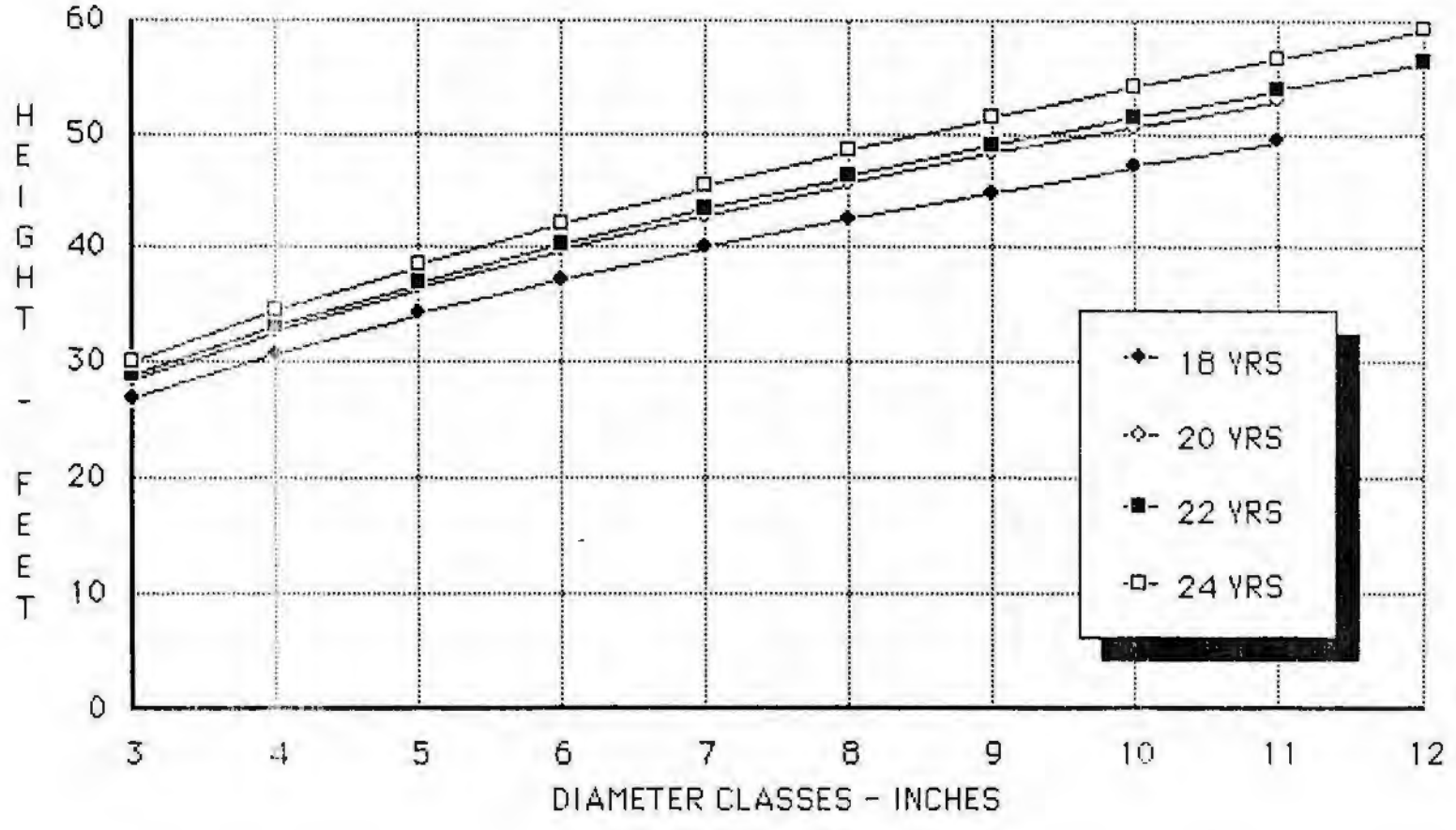


FIGURE 3. PREDICTED LOBLOLLY PINE HEIGHTS BY DIAMETER CLASSES FOR FOUR AGE CLASSES WITH SI = 60 AND TREES PER ACRE = 400.



PREDICTING INDIVIDUAL SLASH PINE TREE HEIGHTS

A review of plottings of the 4,993 slash pine observations indicated that the natural logarithm of height for this species was also linearly related to the natural logarithm of dbh.

Multiple regression analysis of the height growth difference model resulted in an equation for slash pine as

$$\ln(h) = \ln(TTH) + 0.004596 - 0.16604\ln(A)(\ln(DMAX)-\ln(D)) - 0.15172\ln(TTH/A)(\ln(DMAX)-\ln(D)),$$

with $R^2 = 69.2\%$ and RMS = 0.01506.

Based on values from Table 2 for site index = 60 feet and surviving trees per acre = 400, Figures 4, 5 and 6 show height growth trends over diameter classes for different plantation age classes.

TABLE 2. PREDICTED TOTAL HEIGHT IN FEET OF INDIVIDUAL TREES BY SITE INDEX, STAND DENSITY, AGE AND DIAMETER CLASSES, FOR NON-OLD-FIELD SLASH PINE PLANTATIONS IN EAST TEXAS.

SITE INDEX CLASS 40 FEET

TREES PER ACRE CLASS	AGE (YRS)	1-INCH DIAMETER CLASS															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
200	4	7.3															
	6	8.9	11.8														
	8	8.7	11.8	14.2	16.2												
	10	9.3	13.0	15.8	18.2	20.3											
	12	9.5	13.6	16.8	19.5	21.9	24.0										
	14	9.6	14.0	17.4	20.3	22.9	25.2	27.4									
	16		14.1	17.7	20.7	23.5	26.0	28.3	30.5								
	18		15.0	18.9	22.3	25.3	28.1	30.7	33.1								
	20		14.8	18.7	22.1	25.2	28.0	30.7	33.2	35.5							
	22		15.4	19.6	23.2	26.5	29.6	32.4	35.1	37.6							
	24		15.0	19.1	22.7	26.0	29.0	31.8	34.5	37.0	39.4						
	25		15.2	19.4	23.1	26.5	29.5	32.4	35.2	37.7	40.2						
400	4	7.3															
	6	8.9	11.8														
	8	8.7	11.8	14.2	16.2												
	10	9.3	13.0	15.8	18.2	20.3											
	12	9.5	13.6	16.8	19.5	21.9	24.0										
	14	9.6	14.0	17.4	20.3	22.9	25.2	27.4									
	16		14.1	17.7	20.7	23.5	26.0	28.3	30.5								
	18		15.0	18.9	22.3	25.3	28.1	30.7	33.1								
	20		14.8	18.7	22.1	25.2	28.0	30.7	33.2	35.5							
	22		15.4	19.6	23.2	26.5	29.6	32.4	35.1	37.6							
	24		15.0	19.1	22.7	26.0	29.0	31.8	34.5	37.0	39.4						
	25		15.2	19.4	23.1	26.5	29.5	32.4	35.2	37.7	40.2						

TABLE 2. PREDICTED TOTAL SLASH HEIGHTS IN FEET...CONTINUED

SITE INDEX CLASS 40 FEET

TREES PER ACRE CLASS	AGE (YRS)	1-INCH DIAMETER CLASS															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
600	4	7.3															
	6	8.9	11.8														
	8	8.7	11.6	14.2	16.2												
	10	9.3	13.0	15.8	18.2	20.3											
	12	9.5	13.6	16.8	19.5	21.9	24.0										
	14	9.6	14.0	17.4	20.3	22.9	25.2	27.4									
	16	9.6	14.1	17.7	20.7	23.5	26.0	28.3	30.5								
	18		15.0	18.9	22.3	25.3	28.1	30.7	33.1								
	20		14.8	18.7	22.1	25.2	28.0	30.7	33.2	35.5							
	22		15.4	19.6	23.2	26.5	29.6	32.4	35.1	37.6							
	24		15.0	19.1	22.7	26.0	29.0	31.8	34.5	37.0	39.4						
	25		15.3	19.4	23.1	26.5	29.5	32.4	35.2	37.7	40.2						
800	4	7.3															
	6	8.9	11.8														
	8	8.7	11.6	14.2	16.2												
	10	9.3	13.0	15.8	18.2	20.3											
	12	9.5	13.6	16.8	19.5	21.9	24.0										
	14	9.6	14.0	17.4	20.3	22.9	25.2	27.4									
	16	9.6	14.1	17.7	20.7	23.5	26.0	28.3	30.5								
	18	10.1	15.0	18.9	22.3	25.3	28.1	30.7	33.1								
	20		14.8	18.7	22.1	25.2	28.0	30.7	33.2	35.5							
	22		15.4	19.6	23.2	26.5	29.6	32.4	35.1	37.6							
	24		16.0	20.4	24.2	27.7	30.9	33.9	36.7	39.4							
	25		15.8	19.4	23.1	26.5	29.5	32.4	35.2	37.7	40.2						

TABLE 2. PREDICTED TOTAL SLASH HEIGHTS IN FEET...CONTINUED

SITE INDEX CLASS 60 FEET

TREES PER ACRE CLASS	AGE (YRS)	1-INCH DIAMETER CLASS 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
200	4	8.4	10.9														
	6	9.3	12.8	15.5	17.6												
	8	9.7	13.8	17.0	19.7	22.1	24.2										
	10		14.2	17.7	20.8	23.5	25.9	28.2	30.4								
	12		15.1	19.1	22.6	25.7	28.5	31.2	33.7	36.0							
	14		15.7	20.0	23.7	27.1	30.3	33.2	36.0	38.6	41.1						
	16			21.7	25.9	29.8	33.3	36.6	39.8	42.8	45.7						
	18			21.9	26.2	30.2	33.9	37.3	40.6	43.8	46.8	49.7					
	20			23.1	27.7	32.0	36.0	39.8	43.4	46.8	50.1	53.2					
	22			23.4	27.5	31.8	35.8	39.6	43.2	46.7	50.0	53.2	56.4				
	24				28.5	33.1	37.3	41.3	45.2	48.8	52.4	55.8	59.1				
	25				29.0	33.7	38.0	42.1	46.0	49.8	53.4	56.9	60.3				
400	4	8.4	10.9														
	6	9.3	12.8	15.5	17.6												
	8	9.7	13.8	17.0	19.7	22.1	24.2										
	10	9.7	14.2	17.7	20.8	23.5	25.9	28.2	30.4								
	12		15.1	19.1	22.6	25.7	28.5	31.2	33.7	36.0							
	14		15.7	20.0	23.7	27.1	30.3	33.2	36.0	38.6	41.1						
	16			21.7	25.9	29.8	33.3	36.6	39.8	42.8	45.7						
	18			21.9	26.2	30.2	33.9	37.3	40.6	43.8	46.8	49.7					
	20			23.1	27.7	32.0	36.0	39.8	43.4	46.8	50.1	53.2					
	22			23.4	27.5	31.8	35.8	39.6	43.2	46.7	50.0	53.2	56.4				
	24			23.6	28.5	33.1	37.3	41.3	45.2	48.8	52.4	55.8	59.1				
	25			23.9	29.0	33.7	38.0	42.1	46.0	49.8	53.4	56.9	60.3				

TABLE 2. PREDICTED TOTAL SLASH HEIGHTS IN FEET...CONTINUED

SITE INDEX CLASS 60 FEET

TREES PER ACRE CLASS	AGE (YRS)	1-INCH DIAMETER CLASS 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
600	4	8.4	10.9														
	6	9.3	12.8	15.5	17.6												
	8	9.7	13.8	17.0	19.7	22.1	24.2										
	10	9.7	14.2	17.7	20.8	23.5	25.9	28.2	30.4								
	12		15.1	18.1	22.6	25.7	28.5	31.2	33.7	36.0							
	14		15.7	20.0	23.7	27.1	30.3	33.2	36.0	38.6	41.1						
	16		16.9	21.7	25.9	29.8	33.3	36.6	39.8	42.8	45.7						
	18			21.9	26.2	30.2	33.9	37.3	40.6	43.8	46.8	49.7					
	20			23.1	27.7	32.0	36.0	39.3	43.4	46.8	50.1	53.2					
	22			23.8	27.5	31.8	35.8	39.6	43.2	46.7	50.0	53.2	56.4				
	24			23.6	28.5	33.1	37.3	41.3	45.2	48.8	52.4	55.8	59.1				
	25			23.9	29.0	33.7	38.0	42.1	46.0	49.8	53.4	56.9	60.3				
800	4	8.4	10.9														
	6	9.3	12.8	15.5	17.6												
	8	9.7	13.8	17.0	19.7	22.1	24.2										
	10	10.5	15.3	19.1	22.4	25.3	27.9	30.4									
	12		16.2	20.4	24.1	27.5	30.5	33.4	36.0								
	14		16.7	21.3	25.3	28.9	32.2	35.4	38.3	41.1							
	16		16.9	21.7	25.9	29.8	33.3	36.6	39.8	42.8	45.7						
	18		16.9	21.9	26.2	30.2	33.9	37.3	40.6	43.8	46.8	49.7					
	20			23.1	27.7	32.0	36.0	39.3	43.4	46.8	50.1	53.2					
	22			23.8	27.5	31.8	35.8	39.6	43.2	46.7	50.0	53.2	56.4				
	24			23.6	28.5	33.1	37.3	41.3	45.2	48.8	52.4	55.8	59.1				
	25			23.9	29.0	33.7	38.0	42.1	46.0	49.8	53.4	56.9	60.3				

TABLE 2. PREDICTED TOTAL SLASH HEIGHTS IN FEET...CONTINUED

SITE INDEX CLASS 80 FEET

TREES PER ACRE CLASS	AGE (YRS)	1-INCH DIAMETER CLASS															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
200	4	9.1	12.2	14.5													
	6	9.6	13.5	16.6	19.2	21.4	23.5										
	8		15.0	17.7	22.0	24.9	27.5	30.0	32.3								
	10		16.6	21.1	25.0	28.6	31.8	34.9	37.8	40.5							
	12			22.7	27.2	31.2	35.0	38.5	41.8	45.0	48.0						
	14			23.8	28.6	33.0	37.1	41.0	44.6	48.2	51.5	54.8					
	16				29.4	34.1	38.5	42.6	46.5	50.3	54.0	57.5	60.9				
	18				29.9	34.7	39.3	43.6	47.7	51.7	55.5	59.2	62.8	66.2			
	20				31.5	36.8	41.7	46.4	50.8	55.1	59.3	63.3	67.2	71.0			
	22				33.0	38.6	43.8	48.8	53.5	58.1	62.6	66.9	71.1	75.1			
	24					38.1	43.3	48.3	53.0	57.6	62.1	66.4	70.6	74.8	78.8		
	25					38.7	44.1	49.1	54.0	58.8	63.3	67.8	72.1	76.3	80.4		
400	4	9.1	12.8	14.5													
	6	9.6	13.5	16.6	19.2	21.4	23.5										
	8		15.0	17.7	22.0	24.9	27.5	30.0	32.3								
	10		16.6	21.1	25.0	28.6	31.8	34.9	37.8	40.5							
	12			22.7	27.2	31.2	35.0	38.5	41.8	45.0	48.0						
	14			23.8	28.6	33.0	37.1	41.0	44.6	48.2	51.5	54.8					
	16			24.3	29.4	34.1	38.5	42.6	46.5	50.3	54.0	57.5	60.9				
	18				29.9	34.7	39.3	43.6	47.7	51.7	55.5	59.2	62.8	66.2			
	20				31.5	36.8	41.7	46.4	50.8	55.1	59.3	63.3	67.2	71.0			
	22				31.3	36.6	41.6	46.3	50.8	55.2	59.4	63.5	67.5	71.3	75.1		
	24				32.5	38.1	43.3	48.3	53.0	57.6	62.1	66.4	70.6	74.8	78.8		
	25				33.0	38.7	44.1	49.1	54.0	58.8	63.3	67.8	72.1	76.3	80.4		

TABLE 2. PREDICTED TOTAL SLASH HEIGHTS IN FEET...CONTINUED

SITE INDEX CLASS 80 FEET

TREES PER ACRE CLASS	AGE (YRS)	1-INCH DIAMETER CLASS															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
600	4	9.1	13.0	14.5													
	6	9.6	13.5	15.6	19.2	21.4	23.5										
	8	10.2	15.0	16.7	22.0	24.9	27.5	30.0	32.3								
	10		15.6	21.1	25.0	28.6	31.8	34.9	37.8	40.5							
	12		17.7	23.7	27.2	31.2	35.0	38.5	41.8	45.0	48.0						
	14			23.6	28.6	33.0	37.1	41.0	44.6	48.2	51.5	54.8					
	16			24.3	29.4	34.1	38.5	42.6	46.5	50.3	54.0	57.5	60.9				
	18			24.5	29.9	34.7	39.3	43.6	47.7	51.7	55.5	59.2	62.8	66.2			
	20				31.5	36.8	41.7	46.4	50.8	55.1	59.3	63.3	67.2	71.0			
	22				33.0	38.6	43.8	48.8	53.5	58.1	62.6	66.9	71.1	75.1			
	24				32.5	38.1	43.3	48.3	53.0	57.6	62.1	66.4	70.6	74.8	78.8		
	25				33.0	38.7	44.1	49.1	54.0	58.8	63.3	67.8	72.1	76.3	80.4		
800	4	9.1	12.2	14.5													
	6	9.6	13.5	15.6	19.2	21.4	23.5										
	8	10.2	15.0	16.7	22.0	24.9	27.5	30.0	32.3								
	10		15.6	21.1	25.0	28.6	31.8	34.9	37.8	40.5							
	12		17.7	23.7	27.2	31.2	35.0	38.5	41.8	45.0	48.0						
	14			23.6	28.6	33.0	37.1	41.0	44.6	48.2	51.5	54.8					
	16			24.3	29.4	34.1	38.5	42.6	46.5	50.3	54.0	57.5	60.9				
	18			25.0	31.5	36.6	41.5	46.0	50.4	54.5	58.6	62.5	66.2				
	20				31.5	36.8	41.7	46.4	50.8	55.1	59.3	63.3	67.2	71.0			
	22				33.0	38.6	43.8	48.8	53.5	58.1	62.6	66.9	71.1	75.1			
	24				32.5	38.1	43.3	48.3	53.0	57.6	62.1	66.4	70.6	74.8	78.8		
	25				33.0	38.7	44.1	49.1	54.0	58.8	63.3	67.8	72.1	76.3	80.4		

FIGURE 4. PREDICTED SLASH PINE HEIGHTS BY DIAMETER CLASSES FOR FOUR AGE CLASSES WITH SI = 60 AND TREES PER ACRE = 400.

FIGURE 5. PREDICTED SLASH PINE HEIGHTS BY DIAMETER CLASSES FOR TWO AGE CLASSES WITH SI = 60 AND TREES PER ACRE = 400.

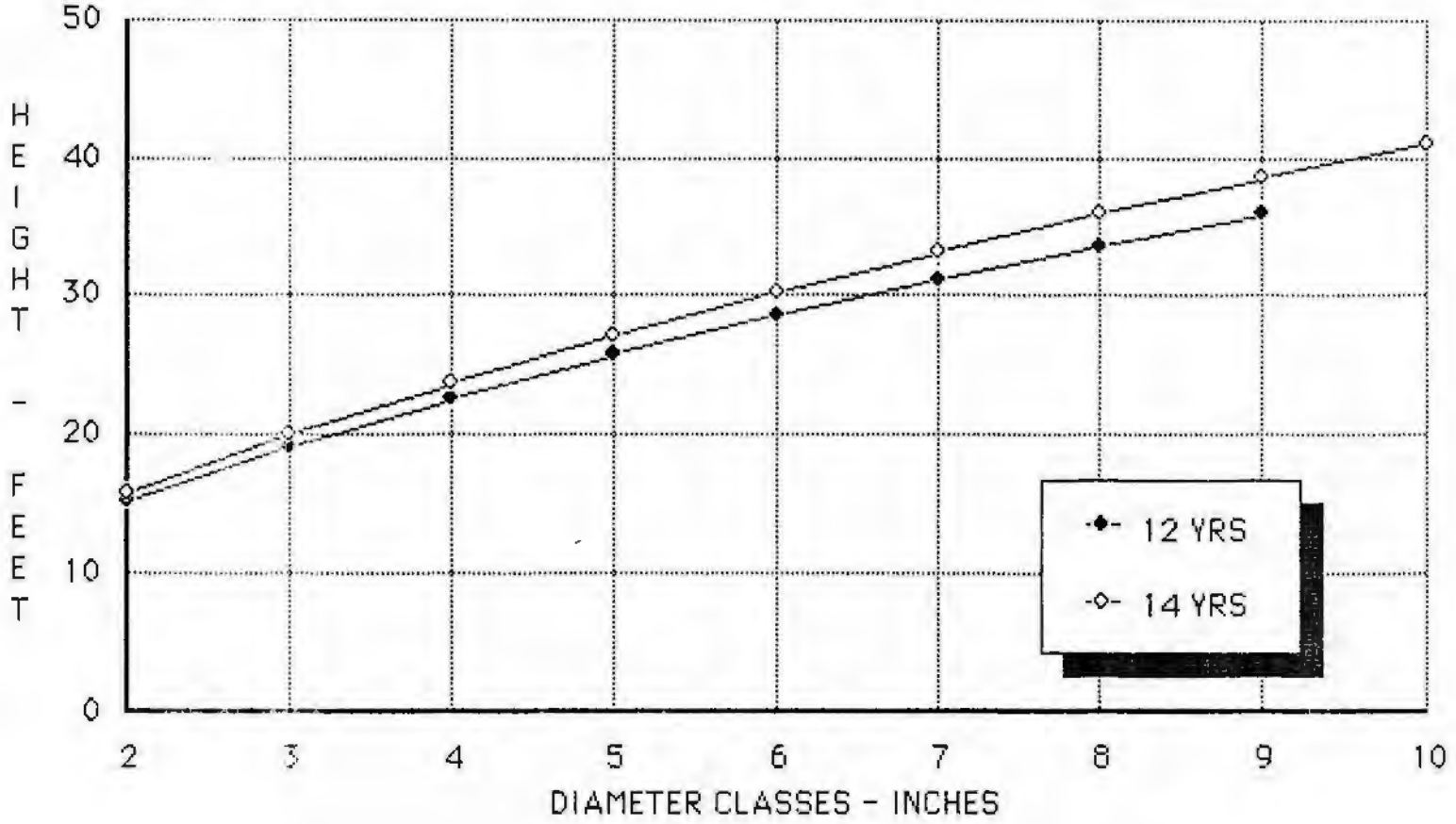
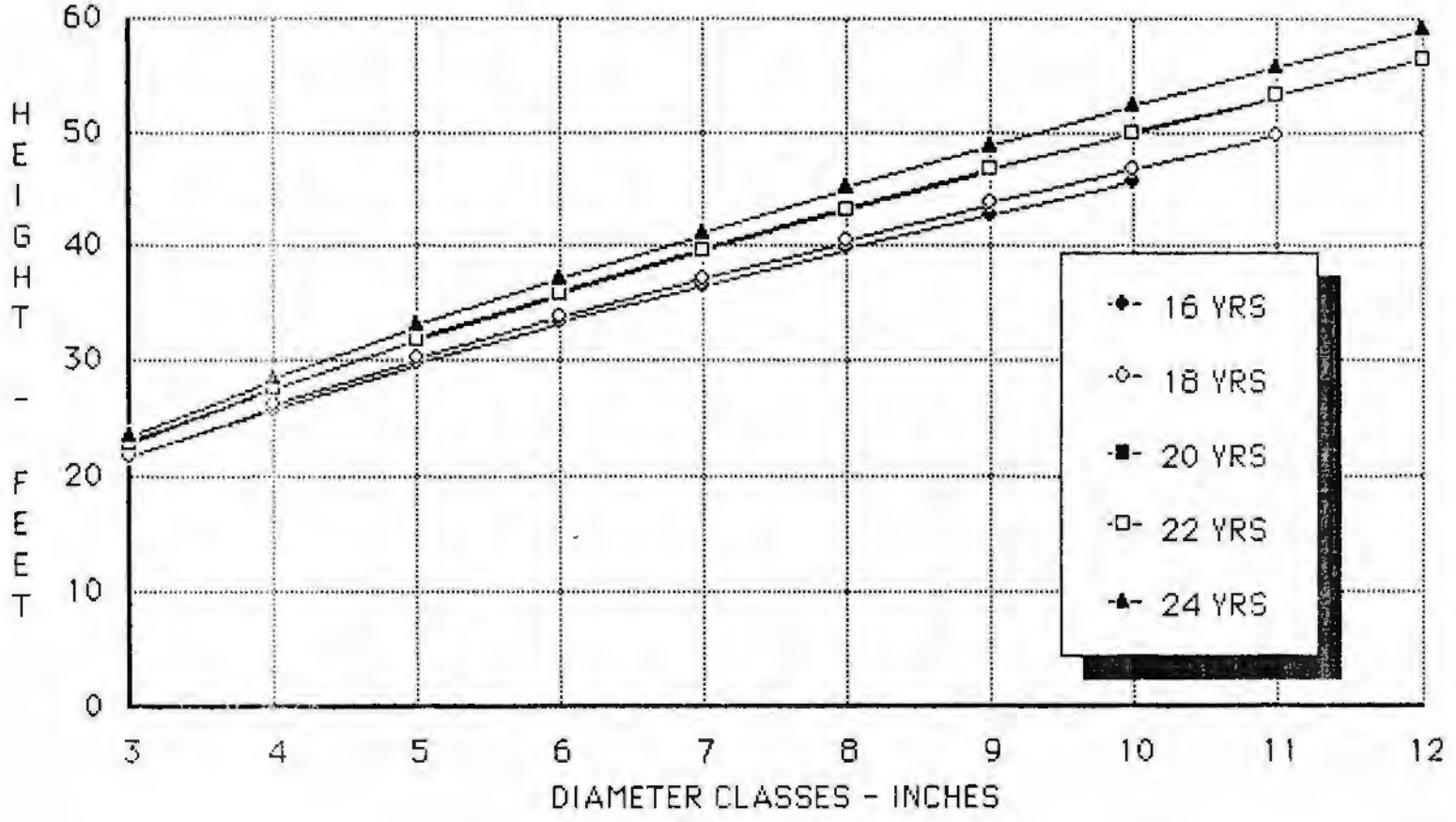


FIGURE 6. PREDICTED SLASH PINE HEIGHTS BY DIAMETER CLASSES FOR FIVE AGE CLASSES WITH SI = 60 AND TREES PER ACRE = 400.



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