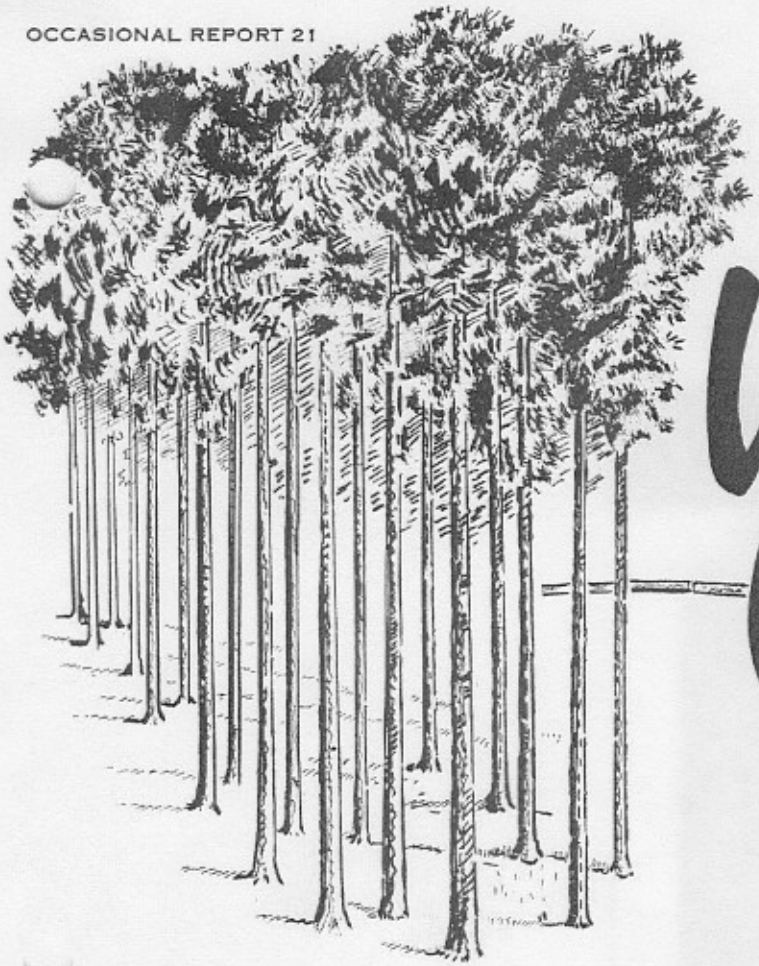
OCCASIONAL REPORT 21

DECEMBER 1965



yield

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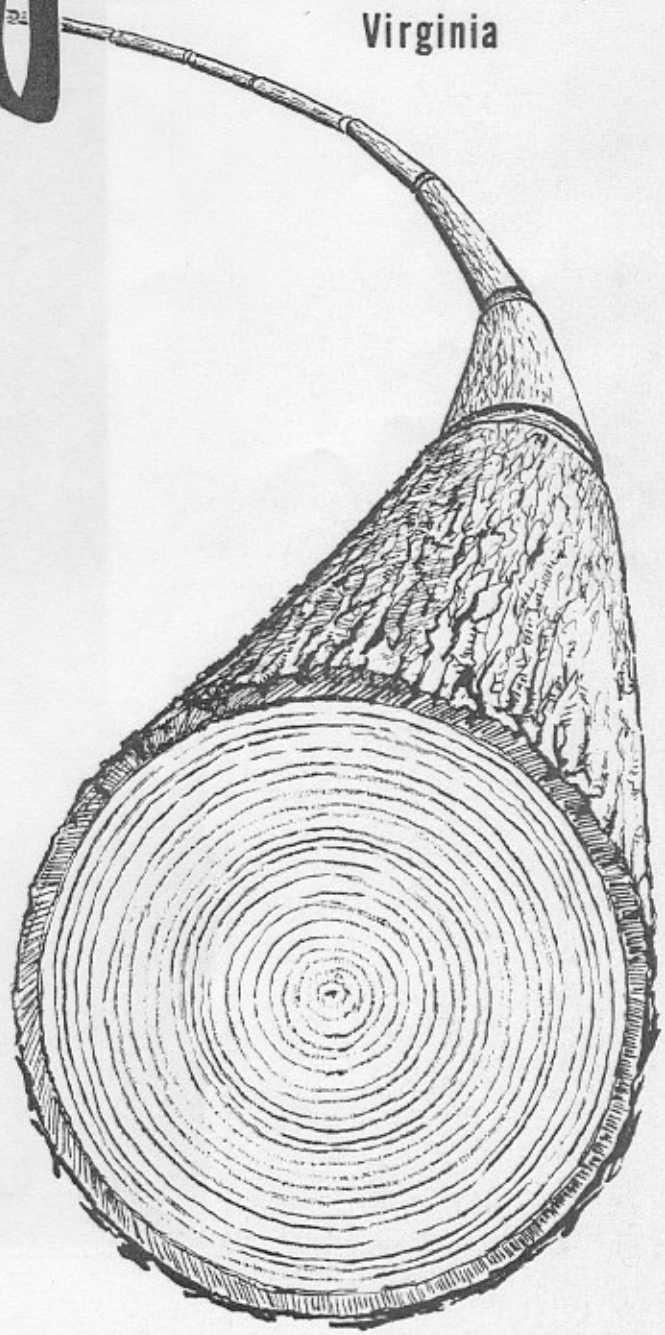

Virginia Division of Forestry
Department of Conservation and Economic Development

Pulpwood Yield of Planted Loblolly Pine in Piedmont and Coastal Plain Virginia

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VIRGINIA DIVISION OF FORESTRY

INTRODUCTION

In 1921, 444 loblolly pine (Pinus taeda) seedlings were distributed by the Virginia Division of Forestry for planting in Virginia. From this rather inauspicious beginning, nursery producton of loblolly pine seedlings has increased to where in 1965 nearly 39,000,000 loblolly pine seedlings were distributed by Virginia Division of Forestry nurseries for planting in the Old Dominion.

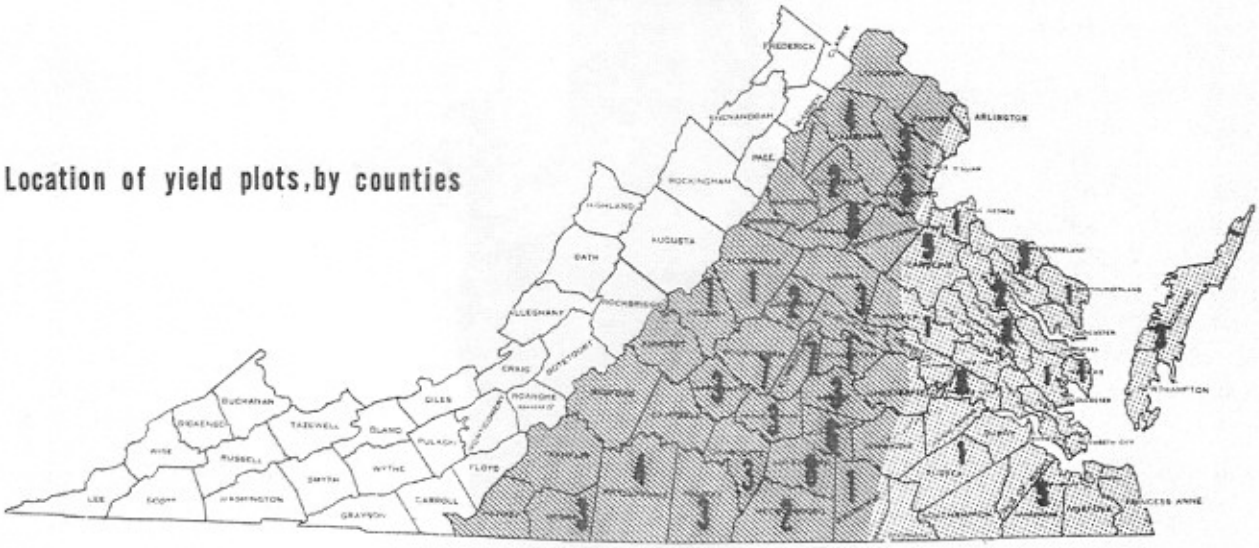
Expected yield is of great importance to most landowners who are considering planting loblolly pine seedlings. The purpose of this report is to provide pulpwood yield information for planted loblolly pine in the piedmont and coastal plain regions of Virginia.

THE STUDY

Sixty-four loblolly pine plantations were sampled in 37 counties of the coastal plain and piedmont of Virginia and 123 circular one-fifth acre yield plots were established and measured. The map and table below show the distribution of plots. All of the loblolly pine plantations selected for inclusion in the study occurred on old fields[1] and represented a wide range of soil types, slopes, and aspects.

1. Land recently in use for agriculture prior to being planted to pine seedlings.

Location of yield plots, by counties



79 Piedmont 44 Coastal Plain

TABLE 1

Plot Distribution by Counties

County	No. of Plots	County	No. of Plots
Accomac	3	King & Queen	3
Albemarle	1	King William	9
Amelia	3	Louisa	3
Appomattox	3	Lunenburg	8
Brunswick	3	Matthews	1
Buckingham	7	Mecklenburg	2
Caroline	5	Nansemond	5
Charles City	6	Nelson	1
Charlotte	3	Northumberland	1
Culpeper	2	Nottoway	6
Cumberland	7	Orange	6
Essex	2	Pittsylvania	4
Fauquier	4	Powhatan	1
Fluvanna	2	Prince Edward	3
Gloucester	1	Prince William	3
Halifax	3	Stafford	3
Hanover	1	Sussex	1
Henry	3	Westmoreland	3
King George	1		
		Total	123

PLOT SELECTION CRITERIA

Certain criteria were established for the selection of plots:

1. The plantation had to be large enough to provide a "buffer" or isolation zone around each one-fifth acre circular plot.

2. Initial planting survival must have been at least 60 percent.

3. Surviving pines on the plots had to be fairly well distributed with no unusually large openings.

4. Plots were not established in plantations which had excessive numbers of volunteer trees (non-planted trees). Planted trees had to comprise at least 90 percent of the total merchantable volume present on the plot.

5. Plots were not established in plantations where there was evidence of damage from fire or grazing.

PLOT MEASUREMENTS

The following data were collected for each one-fifth acre plot included in the study:

1. All living, dead, and "missing" trees were tallied. A tree was considered as "missing" if no evidence of a dead tree could be found and it was thought that a seedling probably had been planted based on the planting spacing used.

2. All living trees, both planted and volunteer, were measured to the nearest one inch DBH (diameter at breast height) class.

3. An adequate sample of total tree heights, measured to the nearest foot, was obtained for each DBH class.

4. Where reliable planting records were not available stand age was determined using an increment borer.

COMPUTATIONS

1. The tally of living, dead, and "missing" trees was used to estimate the number of seedlings planted per acre and the number initially surviving.

2. A graph was prepared of total tree height over diameter at breast height. From this graph curved average heights for each DBH class were used in volume computations.

3. The site index[1] was determined for each plot. As used in this study site index is the average total height in feet that dominant and co-dominant trees will attain in 50 years. One year was added to the age of each plantation in order to obtain age from seed for site index determination.

4. Total volume[2] in standard cords, outside bark, was computed for all trees over 4.5 inches DBH

1. Site index was determined using Coile and Schumacher's *Adjusted Site Index Graph for Young Loblolly Pine.* J. For. 51:432-435.

2. Volumes were computed using Table 5 of *Volume, Yield, and Growth of Loblolly Pine in the Mid-Atlantic Region* by A. L. MacKinney and L. E. Chaiken; Southeastern Forest Experiment Station. Technical Note 33. Issued 1939, revised 1949.

to a 4-inch top outside bark. Only the volume of planted trees was used. (The volume of volunteer trees on each plot was also computed, and all plots having more than 10 per cent of their total volume in volunteer trees were rejected and not included in the yield study.)

5. All plot volumes in standard cords were expanded to a per acre basis.

FREQUENCY DISTRIBUTIONS OF PLOTS

TABLE 2

Number of Plots by Age and Site Index

AGE (Number of Years Since Planting)	SITE INDEX CLASS					
	60-67	68-75	76-83	84-91	92-99	Total
	NUMBER OF PLOTS					
11-14	1	1	6	7	0	15
15-18	1	4	7	3	3	18
19-22	4	9	19	10	3	45
23-26	3	5	11	4	2	25
27-30	3	8	6	3	0	20
	12	27	49	27	8	123

The average age since planting of the 123 plots was 21 years and the average site index was 79.

Table 3 below shows the number of plots by the number of seedlings planted per acre and the number of seedlings per acre initially surviving:

TABLE 3

Number of Seedlings Planted Per Acre	No. of Plots	Number of Seedlings Initially Surviving Per Acre	No. of Plots
375-600	3	295-600	6
601-800	10	601-800	32
801-1,000	33	801-1,000	47
1,001-1,200	40	1,001-1,200	27
1,201-1,400	23	1,201-1,400	7
1,401-1,600	6	1,401-1,600	1
1,601-2,065	8	1,601-1,805	3
Total	123	Total	123

The average number of seedlings planted per acre was 1,104 and the average number surviving was 911.

ANALYSIS OF DATA

Multiple regression techniques were used to analyze the data from the 123 plots in order to develop an equation which would predict yield expressed in standard cords per acre (see statistical note on page 4). Yield was strongly related to planting age and site index, but was not related to either the number of seedlings planted or the number of seedlings initially surviving per acre. The yield table which follows may be used for both the Piedmont and Coastal Plain of Virginia.

TABLE 4

Yield in Standard Cords Per Acre for Planted Loblolly Pine (Merchantable Volume, Outside Bark, for trees over 4.5 inches DBH to a 4-inch top, Outside Bark)

AGE (Number of Years Since Planting)	SITE INDEX IN FEET						
	65	70	75	80	85	90	95
	YIELD IN STANDARD CORDS						
15	15	17	19	22	25	29	33
16	16	19	21	24	28	32	37
17	18	21	24	27	31	36	41
18	20	23	26	30	34	39	45
19	21	25	28	32	37	42	48
20	23	26	30	35	40	45	52
21	25	28	32	37	42	48	56
22	26	30	34	39	45	52	59
23	28	32	36	42	48	54	62
24	29	33	38	44	50	57	65
25	31	35	40	46	52	60	69
26	32	36	42	48	55	63	72
27	33	38	43	50	57	65	74
28	34	39	45	52	59	68	77
29	36	41	47	53	61	70	80
30	37	42	48	55	63	72	83

TABLE 5

Average Annual Growth in Standard Cords Per Acre for Planted Loblolly Pine (Merchantable Volume, Outside Bark, for trees over 4.5 inches DBH to a 4-inch top, Outside Bark)

AGE (Number of Years Since Planting)	SITE INDEX IN FEET						
	65	70	75	80	85	90	95
	AVERAGE ANNUAL GROWTH IN STANDARD CORDS						
15	0.97	1.11	1.27	1.45	1.66	1.90	2.18
20	1.16	1.32	1.51	1.73	1.98	2.27	2.60
25	1.22	1.40	1.60	1.83	2.09	2.40	2.74
30	1.22	1.40	1.60	1.84	2.10	2.40	2.75

USE OF THE YIELD TABLE

These tables may be used for predicting yield of planted loblolly pine in both the Coastal Plain and Piedmont of Virginia.

Yields were not related to the number of seedlings initially surviving on the plots used in this study. However, 95 percent of the plots had 600 or more surviving seedlings per acre (see Table 3). It is suggested that the yield table should be directly applied only to plantations with 600 or more surviving seedlings per acre. Judgment must be exercised in applying the yield table to plantations with less than 600 surviving seedlings per acre.

All plots used in the study had a relatively good distribution of trees with no unusually large openings, and reduced yields should be expected for plantations with poor distribution of trees and large openings.

STATISTICAL NOTE

$$\text{Logarithm of Volume (standard cords per acre)} = 1.2059 - 12.0750 \left(\frac{1}{\text{age}}\right) + 0.01172 \text{ (site index)}$$

The above equation accounted for 90 percent of the sample variation in merchantable pulpwood yields. The standard error is 1 percent of the estimated volume at the mean values of age and site and 3 percent of estimated volumes at the extreme values of age and site. The standard deviation of individual plot volumes ranges from −12 to +14 percent of estimated volumes throughout the range of age and site.

The authors sincerely thank David O. Yandle, Mathematical Statistician, Southeastern Forest Experiment Station, Asheville, North Carolina, for his valuable assistance in analyzing the study data and Duke University, Computing Laboratory, Durham, North Carolina, for making their facilities available.