

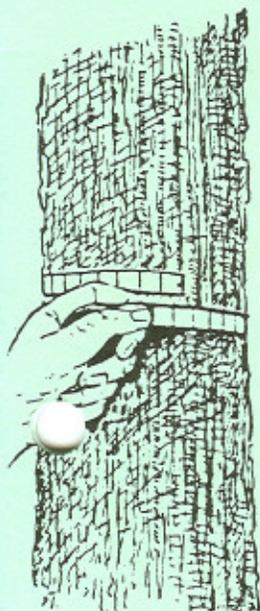
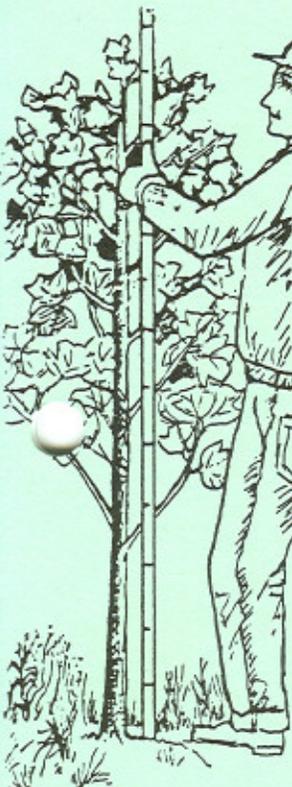
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# LOBLOLLY PINE RELEASE STUDY

REPORT NUMBER

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## LOBLOLLY PINE RELEASE

Report # 11

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### ABSTRACT

This study included two treatments: no release and aerial application of 2 pounds active ingredient of 2,4,5-T per acre during the fourth growing season. Hardwood competition was moderate at the time the release was done. At age 17, released plots averaged 18% more basal area and 23% more volume in standard cords than check plots, and cordwood yields were related to both a free-to-grow index estimated at age 4 ( $r^2 = .766$ ) and hardwood basal area measured at age 17 ( $r^2 = .733$ ).

### INTRODUCTION

This is the eleventh in a series of Occasional Reports concerning release of loblolly pine seedlings from hardwood competition. This particular study was installed on the privately-owned R. L. Wallace tract in Mecklenburg County, in the south central Piedmont of Virginia. The previous stand was mostly hardwood. After logging, the area was chopped and burned in the summer of 1969 and planted in the spring of 1970. Some interplanting was done the following year during the spring of 1971. Aerial spraying was done in June 1973, during the fourth growing season, by applying 2 pounds per acre active ingredient of 2,4,5-T in a total volume of about 5 gallons per acre.

### PLOT INSTALLATION

In March 1974, six permanent 1/10-acre growth plots were installed, three each in both the check and released areas (Figure 1). Volunteer Virginia pine and shortleaf pine seedlings were cut down when the plots were installed.

Measurements were made at age 4, when the plots were installed, and again at ages 9, 13, and 17. At age 4, all loblolly pine seedlings were measured for height to the nearest .1 foot, and classified as to free-to-grow status using a four part classification system (Appendix). At later measurements, diameter at breast height of each loblolly pine was measured to the nearest inch, and a sample of trees in each diameter class was measured for total height to the nearest foot, noting which trees were dominant or codominant.

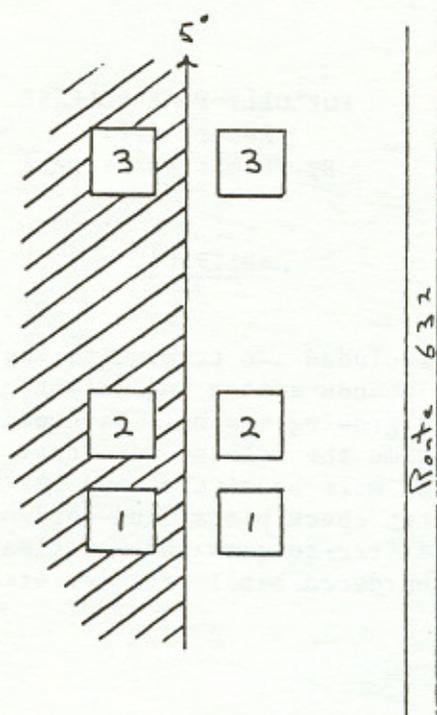


Figure 1. Layout of study area and growth plots.  
Aerial-released area is cross-hatched.

Ownership of the tract changed hands a few years before the age 17 measurement. The new owner was not aware that a release study was present on the property, and ran a maintenance burn through the pine stand, which included our plots, during the winter following the 16th growing season. It was not a hot burn, and no pines were killed (in fact, there did not appear to have been much crown scorch). However, many of the smaller hardwoods were killed and we estimated that perhaps twenty-five percent of the hardwoods in the 1-inch diameter class were killed, but none of the 2-inch and larger hardwoods. The hardwood kill was not uniform over the six plots, so we decided not to measure and tally the hardwoods in the 1-inch class, as we usually do. Instead, we tallied hardwoods starting with the 2-inch class (greater than 1.5 inches DBH), by species, 1-inch diameter class, and crown class. Total heights of all intermediate and codominant hardwoods were measured to the nearest foot.

Table 1. Summary of loblolly data for check and aerial-released plots at ages 4, 9, 13, and 17 years: number of trees per acre, average DBH, basal area per acre, standard cords per acre, and average height of dominant and codominant trees.\*

Age	Plot	Check Plots					Aerially-Sprayed Plots					
		No.	DBH	B.A.	Cds.	Ht.	Plot	No.	DBH	B.A.	Cds.	Ht.
4	1	910	-	-	-	5.0	1	1050	-	-	-	4.9
	2	860	-	-	-	4.4	2	830	-	-	-	4.5
	3	970	-	-	-	5.2	3	620	-	-	-	5.0
Means		913	-	-	-	4.9		833	-	-	-	4.8
-----												
9	1	890	2.67	40.5	-	23.6	1	1010	2.99	55.2	-	21.4
	2	860	2.33	33.5	-	21.9	2	830	3.23	53.1	-	23.4
	3	970	2.92	55.4	-	24.2	3	620	3.42	46.0	-	23.4
Means		907	2.64	43.1	-	23.2		820	3.21	51.4	-	22.7
-----												
13	1	810	4.05	82.5	6.7	34.0	1	1010	4.34	114.6	9.4	33.6
	2	790	3.96	80.3	6.7	32.9	2	830	4.69	112.0	11.8	35.2
	3	880	4.34	105.5	10.2	34.5	3	610	5.07	97.6	11.6	35.1
Means		827	4.12	89.4	7.9	33.8		817	4.70	108.1	10.9	34.6
-----												
17	1	780	4.96	118.7	17.7	43.6	1	1000	5.13	159.6	22.7	42.0
	2	730	5.05	117.2	17.8	43.1	2	770	5.74	153.5	25.3	44.0
	3	780	5.38	138.8	22.1	43.2	3	560	6.18	130.5	22.8	44.7
Means		763	5.13	124.9	19.2	43.3		777	5.68	147.9	23.6	43.6

\* Except at age 4, heights presented are for all trees.

## RESULTS AND DISCUSSION

A summary of loblolly pine data for the four measurements is presented in Table 1. At age 17, released plots averaged 4.4 standard cords per acre more than check plots.<sup>1/</sup> Differences due to release increased with time (Table 2). Table 3 presents stand tables for loblolly pine at age 17. The seedlings that were interplanted the year following the initial planting contributed little or nothing to standard cords at age 17. It was our estimate that practically all of the 4-inch and larger trees were from the original planting. This is a case where interplanting was not needed and should not have been done.

Table 2. Average differences between check and released plots at each measurement, for basal area and standard cords per acre.

<u>Age</u>	<u>Released minus Check</u>	
	<u>Basal Area</u>	<u>Std. Cds</u>
9	8.3	--
13	18.7	3.0
17	23.0	4.4

A summary of average hardwood data at the final measurement at age 17 is presented in Tables 4 and 5, and individual plot data is presented in Table 6. On the average, compared to released plots, check plots had about 2½ times as many hardwoods and also 2½ times as much hardwood basal area. This is considering only trees 1.5 inches DBH and larger (we usually measure hardwood stems down to .5 inches DBH, and the greatest numbers of hardwoods are in the 1- inch diameter class).

A 6-inch yellow-poplar, which was 48 feet tall, was the only codominant hardwood on the three released plots (equivalent to 3 per acre). On the three check plots, there were six codominant hardwoods (20 per acre), five yellow-poplar and a sweetgum. These trees ranged from 40 to 43 feet, and averaged 42 feet in height. Some of these trees will probably continue to grow rapidly enough to maintain a position in the canopy.

<sup>1/</sup> Standard cords at age 18 were subjected to an analysis of variance for randomized blocks. Yields on released plots were not significantly greater than on check plots (probability of a larger  $F=.157$ ).

Table 3. Average number of loblolly pines per acre by diameter class at age 17.

<u>DBH</u>	<u>Check Plots</u>	<u>Released Plots</u>
1	10	3
2	70	37
3	97	93
4	100	107
5	137	117
6	156	156
7	117	137
8	53	83
9	20	27
10	3	17
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Totals	763	777

Table 4. Average numbers of hardwoods per acre by species and diameter class at age 17.

<u>Species</u>	<u>Check Plots</u>					<u>Totals</u>
	<u>2</u>	<u>3</u>	<u>DBH</u>		<u>6</u>	
			<u>4</u>	<u>5</u>		
Yellow-Poplar	33	30	23	20	4	110
Sweetgum	10	3			3	16
Red maple	120	14				134
Black cherry	47	3				50
Red oak	27	13	7			47
White oak	7	3				10
Dogwood	83					83
Sourwood	53	10				63
Miscellaneous	20	7				27
<b>Totals</b>	<b>400</b>	<b>83</b>	<b>30</b>	<b>20</b>	<b>7</b>	<b>540</b>

<u>Species</u>	<u>Released Plots</u>					<u>Totals</u>
	<u>2</u>	<u>3</u>	<u>DBH</u>		<u>6</u>	
			<u>4</u>	<u>5</u>		
Yellow-Poplar	13	7	3		3	26
Sweetgum	50	30				80
Red maple	27	7				34
Black cherry	7	3	7			17
Red oak	13	7	7			27
Dogwood	3					3
Sourwood	10	3				13
Miscellaneous	7	3				10
<b>Totals</b>	<b>130</b>	<b>60</b>	<b>17</b>		<b>3</b>	<b>210</b>

Table 5. Average numbers of hardwoods per acre by diameter class and crown class, and basal area by crown class, at age 17.

DBH	<u>Over-topped</u>	<u>Check Plots</u>			<u>Totals</u>
		<u>Intermediate</u>	<u>Codominant</u>	<u>Dominant</u>	
2	400				400
3	66	17			83
4	7	23			30
5		7	13		20
6			7		7
<hr/>					
Totals	473	47	20		540
B.A.	12.6	3.8	3.1		19.5

DBH	<u>Over-topped</u>	<u>Released Plots</u>			<u>Totals</u>
		<u>Intermediate</u>	<u>Codominant</u>	<u>Dominant</u>	
2	130				130
3	57	3			60
4	3	14			17
5					
6			3		3
<hr/>					
Totals	190	17	3		210
B.A.	5.9	1.4	.6		7.9

Table 6. Numbers of hardwoods by diameter class and crown class, and basal area by crown class, on each 1/10-acre plot.

DBH	Plot - Check #1				Totals	DBH	Plot - Check #2				Totals
	O	I	CD	D			O	I	CD	D	
1						1					
2	47				47	2	44				44
3	9	4			13	3	7				7
4		3			3	4	2				2
5			1		1	5		1	2		3
6			1		1	6			1		1
Totals	56	7	2		65	Totals	53	1	3		57
BA	1.47	.46	.33		2.26	BA	1.48	.14	.47		2.08

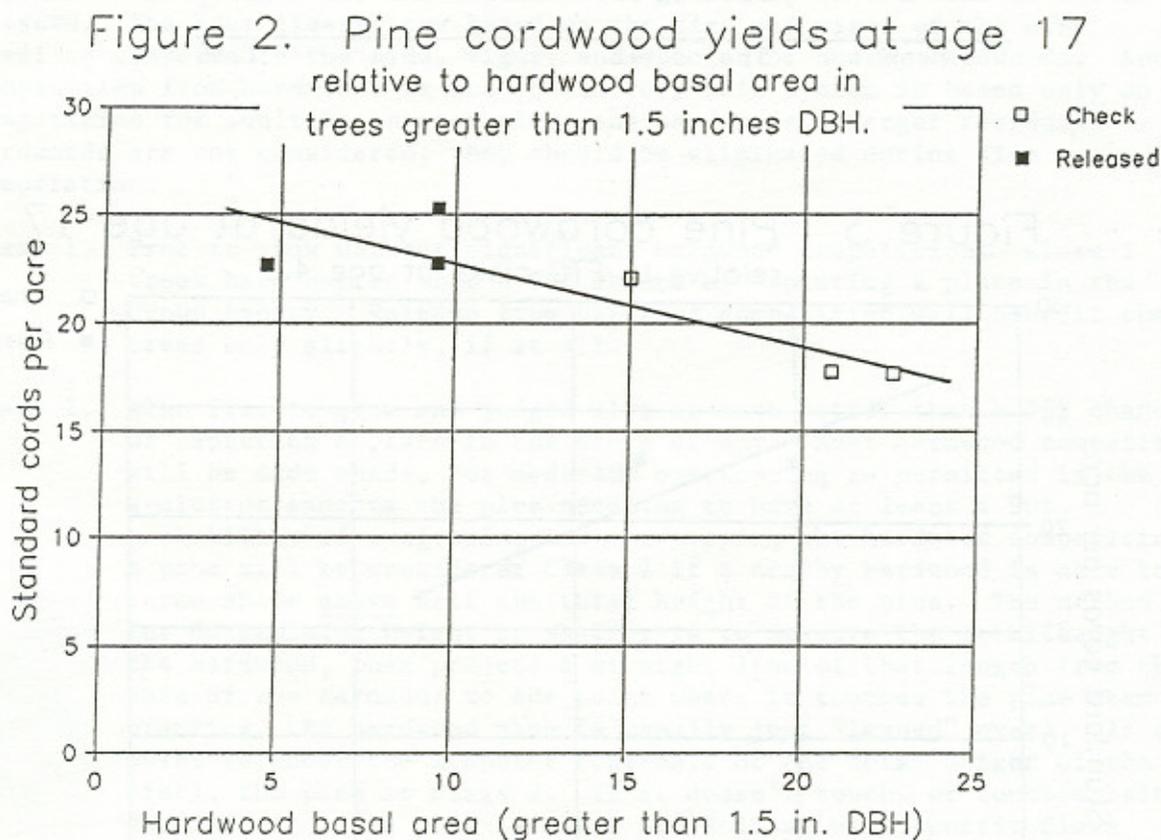
DBH	Plot - Check #3				Totals
	O	I	CD	D	
1					
2	29				29
3	4	1			5
4		4			4
5		1	1		2
Totals	33	6	1		40
BA	.83	.54	.14		1.50

DBH	Plot - Released #1				Totals	DBH	Plot - Released #2				Totals
	O	I	CD	D			O	I	CD	D	
1						1					
2	10				10	2	15				15
3	4	1			5	3	7				7
4						4		1			1
5						5					
6						6			1		1
Totals	14	1			15	Totals	22	1	1		24
BA	.42	.05			.46	BA	.67	.09	.20		.95

DBH	Plot - Released #3				Totals
	O	I	CD	D	
1					
2	14				14
3	6				6
4	1	3			4
Totals	21	3			24
BA	.69	.26			.95

Cordwood yields of loblolly pine at age 17 were related to the amount of hardwood present. Figure 2 shows pine cordwood yields relative to total hardwood basal area at age 17, for the six plots. A simple linear regression fitted to these data accounted for 73 percent of the variation in cordwood yields.<sup>2/</sup> A regression of yields over hardwood basal area in just intermediate and codominant hardwoods accounted for 51 percent of the variation in yields.

Cordwood yields also correlated well with the average free-to-grow index for each plot at age 4; in fact, the correlation was just as good as with hardwood basal area at age 17. Table 7 shows, for each plot, the percent of trees in each free-to-grow class at age 4. In Figure 3, pine cordwood yields for each plot at age 17 are plotted over free-to-grow index at age 4. A simple linear regression fitted to these data accounted for 77 percent of the variation in cordwood yields.<sup>3/</sup>



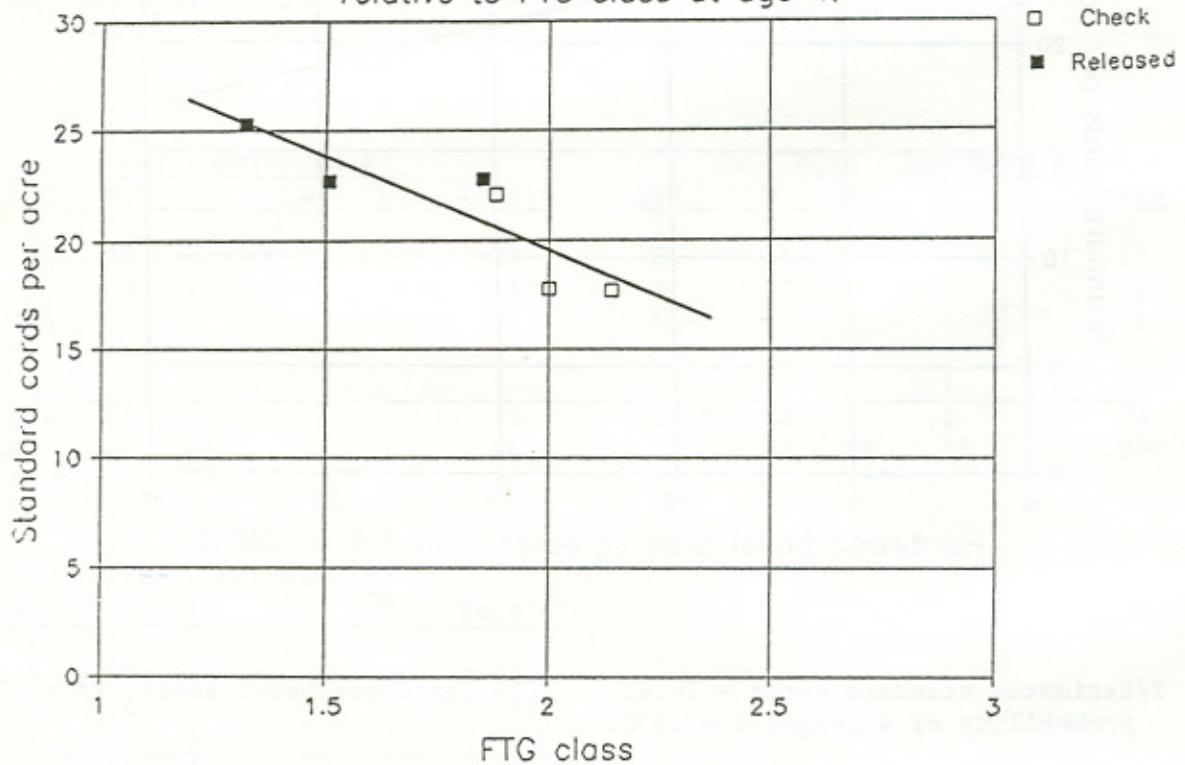
2/Estimated standard cords =  $26.42 - .3676$  (hardwood basal area),  $r^2 = .733$ , probability of a larger F = .030.

3/Estimated standard cords =  $36.72 - 8.5915$  (free-to-grow index at age 4),  $r^2 = .766$ , probability of a larger F = .022.

Table 7. Percent of loblolly seedlings by free-to-grow class, for each plot, at age 4.

<u>Plot</u>		<u>Free-to-Grow Class</u>				<u>Means</u>
		<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	
Check	1	19	51	26	4	2.14
	2	25	57	13	6	2.00
	3	29	58	11	3	1.88
	Means	24	55	17	4	2.01
Released	1	52	44	4	0	1.51
	2	70	28	2	0	1.32
	3	32	53	13	2	1.85
	Means	51	42	6	1	1.56

Figure 3. Pine cordwood yields at age 17 relative to FTG class at age 4.



## APPENDIX

### FREE-TO-GROW-CLASSIFICATION

We began installing release studies in 1967, and it soon became apparent that an improved free-to-grow system for classifying seedlings would be helpful in describing hardwood competition on individual plots. The traditional system of classifying seedlings as simply "free" or "not free-to-grow" was obviously inadequate. Hardwood competition occurs in a continuous spectrum, from the pine seedling completely in the open with no nearby competition, to the seedling that is almost hopelessly buried under hardwoods and receiving little or no direct sunlight.

We developed a four class system in 1971, and used it on all release studies installed since then. The classification system evaluates a pine seedling's potential for: (1) capturing a place in the crown canopy, which depends on height growth, and (2) diameter growth up to the time of crown closure. The four classes are based on the size and vigor of the pine seedling compared to the size, vigor, and species of nearby hardwoods. Root competition from hardwoods is not considered; this system is based only on competition for sunlight between pines and hardwoods. Larger residual hardwoods are not considered; they should be eliminated during site preparation.

- Class 1. Free-to-grow without significant hardwood competition. Class 1 trees have better than a 90% chance of capturing a place in the crown canopy. Release from hardwood competition will benefit these trees only slightly, if at all.
- Class 2. Also free-to-grow and judged also to have better than a 90% chance of capturing a place in the crown canopy. Most hardwood competition will be side shade, but moderate overtopping is permitted if the evaluator expects the pine seedling to have at least a 90% probability of outgrowing and overtopping the hardwood competition. A pine will be considered Class 2 if a nearby hardwood is able to throw shade above half the total height of the pine. The method for determining height of shading is to measure the total height of the hardwood, then project a straight line of that length from the base of the hardwood to the point where it touches the pine stem (in practice, the hardwood stem is usually just "leaned" over). If this point is above the midpoint (one-half of the total height of the pine), the pine is Class 2. If it doesn't touch, or touches below the midpoint, the pine is Class 1. Release will benefit Class 2 pines primarily by increasing diameter growth.
- Class 3. Questionable trees, judged to have a 10% to 90% chance of capturing a place in the crown canopy. Even for pines which eventually make it into the crown canopy, competition will greatly reduce diameter growth. It is assumed that without release, approximately half of these pines will eventually capture a place in the crown canopy.

Class 4. Not free-to-grow. Judged to have less than a 10% chance of capturing a place in the crown canopy because of suppression by overtopping hardwoods. Release will benefit Class 4 trees only at young ages (see notes below).

Notes:

1. The system is symmetrical, centering on a 50% probability with a 10% cut off on the ends (less than 10% of Class 4 trees should "make it", and less than 10% of Class 1 and 2 trees should not make it).
2. In deciding whether a seedling is a Class 2 or 3, or Class 3 or 4, the vigor of the seedling is often as important as the amount of hardwood competition. The previous year's leader growth and the length, density, and color of the needles are indicators of vigor.
3. Class 4 seedlings, in most cases, cannot be successfully released after age 2 or 3, because nearby Class 1 and 2 seedlings will usually be so much taller that they will eventually overtop released Class 4 seedlings. Class 3 seedlings, in most cases, cannot be successfully released after age 3 or 4, for the same reason.
4. Pine seedling growth for the first few years often varies considerably, with some seedlings getting off to a much faster start than others. This growth variation often has little to do with hardwood competition. Consequently, it is not uncommon to see seedlings eventually overtopped, and prevented from reaching the canopy, by adjacent pine seedlings that have grown more rapidly. Release from hardwood competition will not greatly improve the chances for these slow growing seedlings to capture a place in the crown canopy. In applying this classification system to our release plots, we would classify such seedlings as Class 3 or Class 4 "due to pine competition." Thus, a separate tally was kept of those slow growing pine seedlings that would likely be suppressed by pine, rather than hardwood, competition.