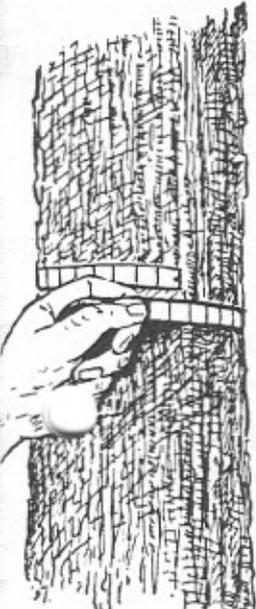


Occasional Report 76 February 1989

# LOBLOLLY PINE RELEASE STUDY

## REPORT NUMBER

# 9



Virginia  
Department of Forestry



LOBLOLLY PINE RELEASE  
Report Number 9

by:  
Thomas A. Dierauf

Abstract. This study included two treatments: no release and hand-chopping during the fifth growing season. Hardwood competition was unusually severe at the time the release was done. At age 21, hand-chopped plots averaged 109 percent more basal area and 153 percent more volume in standard cords than the check plots, and cordwood yields were related to hardwood basal area ( $r^2 = .902$ ).

INTRODUCTION

This is the ninth in a series of Occasional Reports concerning release of loblolly seedlings from hardwood competition. This study was installed in the central Piedmont of Virginia on the Appomattox-Buckingham State Forest, in Stand 12 of the Willis 4 Management Unit. The previous stand was primarily mixed hardwoods, with some scattered pine. There was no site preparation other than frilling of residual hardwood trees following clearcutting. Loblolly pine seedlings were planted in the spring of 1965.

The release study was installed during the summer of 1969, which was the fifth growing season. All hardwoods were cut close to the ground on about two-thirds of the tract, leaving the rest as a check area (Figure 1). Hardwood competition was unusually severe.

GROWTH PLOT INSTALLATION

In April 1975, after ten growing seasons, 16 permanent one-tenth acre growth plots were installed. Eight plots were installed, in both the check and hand-chopped areas. All volunteer pines (mostly Virginia pine, with some shortleaf) were cut down at this time.

Measurements were made at age 10, when the plots were installed, and again at ages 14, 18, and 21. Diameter at breast height of each loblolly pine was measured to the nearest inch. For a sample of trees in each diameter class, total height was measured to the nearest foot, noting which trees were dominant or codominant. At age 21, all hardwoods over .5 inches DBH were tallied by species, 1-inch diameter class, and crown class. Heights of all dominant and codominant hardwoods were also measured.

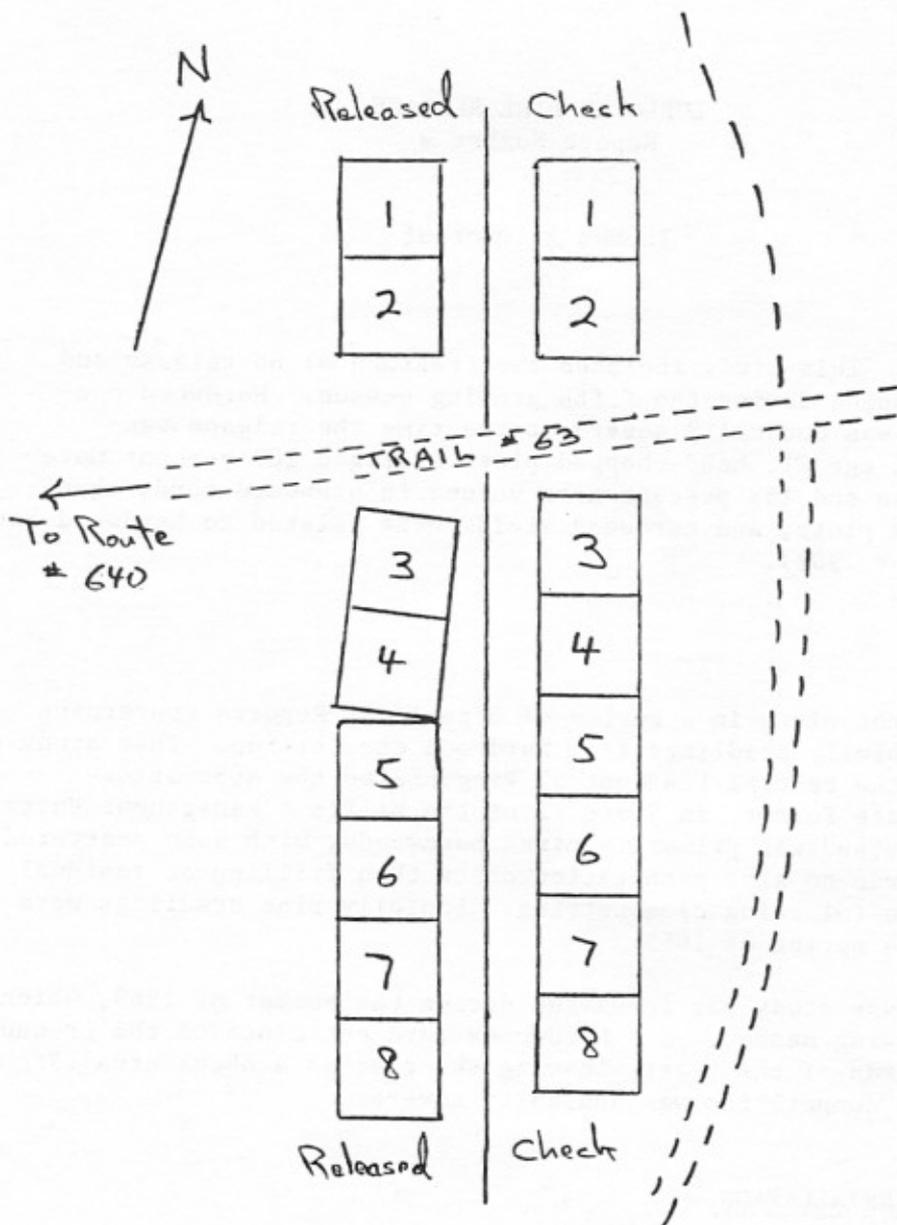


Figure 1. Layout of study area and growth plots.

## RESULTS AND DISCUSSION

A summary of loblolly pine data for the four measurements is presented in Table 1. At age 21, hand-chopped plots averaged 16.4 standard cords per acre more than check plots.<sup>1/</sup> Differences due to release increased with time (Table 2). Table 3 presents average stand tables for check and hand-chopped plots at age 21.

A summary of hardwood data at age 21 is presented in Tables 4 and 5. Total numbers of hardwoods were greater on the hand-chopped plots, but there were fewer large hardwoods and less basal area than on the check plots: 52 percent more hardwoods, but 41 percent less basal area. It is common for numbers of hardwoods to increase following hand-chopping, because two or more sprouts often originate where a single hardwood is cut. Table 6 presents hardwood data at age 21 for each 1/10-acre plot, giving numbers by diameter and crown class and basal area by crown class.

At age 21, there were a total of 106 dominant and codominant hardwoods on the eight check plots: 66 chestnut oak, 21 scarlet oak, 4 white oak, 8 yellow-poplar, and 7 red maple (106 trees on 8 plots represent 132 per acre). On the eight hand-chopped plots, there were a total of only 6 dominant and codominant hardwoods: 2 chestnut oak and 4 yellow-poplar (6 trees on 8 plots represent 8 per acre). Table 7 compares the average heights of dominant and codominant loblolly pines and hardwoods at age 21. The hardwoods average about four feet shorter. Check plots 1, 2, and 3 are now and will continue to be dominated by hardwoods, but even on the other five check plots, some hardwoods will probably continue to grow fast enough to maintain a position in the canopy. On the hand-chopped plots, however, the canopy is already dominated by loblolly pine, with the exception of plots 1 and 2, where a few yellow-poplar and chestnut oak stump sprouts may maintain a place in the canopy.

The relationship between cordwood yields of loblolly pine and hardwood basal area at age 21 is strong. Figure 2 shows the relationship between pine cordwood yields and basal area in dominant, codominant, and intermediate hardwoods at age 21, for the 16 plots. A simple linear regression fitted to these 16 plots accounted for 90 percent of the variation in cordwood yields.<sup>2/</sup> A regression of yields over total hardwood basal area (all trees greater than .5 inches DBH) accounted for 84 percent of the variation in yields.

- 1/ Standard cords at age 21 were subjected to an analysis of variance. Yields on hand-chopped plots were significantly greater than on check plots (probability of a larger F = .0002).
- 2/ Estimated standard cords =  $28.695 - .5678$  (hardwood basal area in I, CD, and D trees),  $r^2 = .902$ , probability of a larger F = .00000002. Fitting the natural logarithm of standard cords to hardwood basal area in intermediate, codominant and dominant trees resulted in an  $r^2$  of .961.

Table 1. A summary of loblolly pine data for check and hand-chopped plots at ages 10, 14, 18, and 21 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	Check						Hand-chopped					
	Plot	No.	DBH	B.A.	Cds.	Ht.	Plot	No.	DBH	B.A.	Cds.	Ht.
10	1	390	1.45	6.1	-	26.0	1	650	2.73	30.3	-	24.7
	2	440	1.38	6.2	-	*	2	710	2.40	27.4	-	24.2
	3	490	1.59	9.0	-	21.4	3	860	3.45	61.2	-	25.3
	4	750	2.34	26.4	-	24.1	4	760	3.71	62.6	-	26.9
	5	1000	2.42	40.0	-	25.2	5	820	3.37	57.6	-	27.0
	6	850	2.15	26.7	-	25.8	6	780	2.54	33.2	-	23.7
	7	810	2.88	43.4	-	25.1	7	820	2.71	39.1	-	23.3
	8	850	2.38	32.3	-	23.3	8	860	3.13	51.7	-	26.0
Means		698	2.07	23.8	-	24.4	Means	782	3.00	45.4	-	25.1
14	1	240	2.38	9.3	.5	39.0	1	640	3.81	58.2	4.3	36.2
	2	240	2.42	9.2	.1	*	2	680	3.51	55.8	4.0	33.9
	3	350	2.43	13.7	.1	31.5	3	800	4.64	103.1	10.5	35.2
	4	700	3.14	44.1	1.5	32.6	4	720	4.99	104.2	12.3	37.8
	5	890	3.25	62.4	4.1	34.9	5	800	4.56	103.1	11.4	35.9
	6	800	2.98	47.1	2.1	34.5	6	720	4.04	72.5	5.6	35.1
	7	750	3.96	73.1	5.7	35.7	7	790	3.99	79.0	6.7	34.7
	8	800	3.26	54.6	2.4	33.2	8	850	4.26	93.9	8.3	35.7
Means		596	2.98	39.2	2.1	34.5	Means	750	4.22	83.7	7.9	35.6
18	1	120	4.08	12.6	1.3	46.0	1	580	4.93	86.9	13.0	44.7
	2	200	3.30	13.7	.8	40.5	2	610	4.59	82.5	12.0	42.6
	3	300	3.07	18.9	1.3	40.0	3	750	5.49	134.2	21.8	45.9
	4	660	3.79	61.2	6.1	41.4	4	710	5.73	137.3	24.6	47.6
	5	740	4.18	85.5	10.7	42.9	5	750	5.52	138.5	23.9	45.8
	6	680	4.00	68.3	7.5	42.1	6	670	5.13	108.4	17.1	45.9
	7	700	4.90	101.6	14.7	44.2	7	710	5.14	116.2	18.0	43.7
	8	700	4.21	78.8	9.3	41.4	8	800	5.28	133.6	21.1	46.1
Means		512	3.94	55.1	6.5	42.3	Means	698	5.23	117.2	18.9	45.3
21	1	110	5.00	16.2	2.4	52.0	1	560	5.52	103.2	19.1	48.1
	2	170	4.18	18.4	2.3	45.0	2	550	5.49	101.4	18.3	48.4
	3	240	3.83	22.8	2.5	42.5	3	750	5.88	153.8	29.5	48.6
	4	560	4.61	72.5	9.9	45.7	4	700	6.17	155.9	32.3	50.8
	5	660	4.82	98.2	16.8	48.0	5	720	6.10	160.6	34.1	51.6
	6	620	4.74	85.6	13.7	47.2	6	630	5.78	127.8	24.7	51.1
	7	640	5.64	119.9	22.6	50.7	7	670	5.91	141.2	27.7	51.1
	8	620	4.95	93.1	15.5	46.9	8	780	5.73	155.2	30.9	50.9
Means		452	4.72	65.8	10.7	47.2	Means	670	5.82	137.4	27.1	50.

\* No trees were judged dominant or codominant.

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

<u>Hand-chopped minus check</u>		
<u>Age</u>	<u>Basal Area</u>	<u>Std. Cds.</u>
10	21.6	-
14	44.5	5.8
18	62.1	12.4
21	71.6	16.4

Table 3. Average number of loblolly pine per acre by diameter class at age 21.

<u>DBH</u>	<u>Check Plots</u>	<u>Hand-chopped Plots</u>
1	6	1
2	36	24
3	78	53
4	65	90
5	106	104
6	74	154
7	59	121
8	22	75
9	4	32
10	2	11
11		4
12		1
<b>Totals</b>	<b>452</b>	<b>670</b>

Table 4. Average numbers of hardwoods per acre by species and diameter class at age 21.

Species	Check Plots									Total
	DBH									
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	
Chestnut oak	113	95	73	42	38	12	5	6		384
Red oaks*	175	91	49	21	10	5	2			353
White oak	99	55	46	14		4				218
Red maple	390	143	36	19	4					592
Yellow-poplar	42	16	1		5	3	4		1	72
Blackgum	234	9								243
Hickory	57	10	1							68
Dogwood	45	14								59
Misc.**	5									5
Totals	1160	433	206	96	57	24	11	6	1	1994

	Hand-chopped Plots						Totals
	DBH						
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	
Chestnut oak	229	100	31	6	3		369
Red oaks*	290	93	18	6			407
White oak	251	110	23	5			389
Red maple	1086	148	6				1240
Yellow-poplar	135	38	5	5	1	1	185
Blackgum	204		2				206
Hickory	73	2					75
Dogwood	130	5					135
Misc.**	26	2					28
Totals	2424	498	85	22	4	1	3034

\* Mostly scarlet oak.

\*\* Witch-hazel, hawthorn, black cherry, and beech.

Table 5. Average numbers of hardwoods per acre by diameter class and crown class, and basal area by crown class, at age 21.

DBH	<u>Check Plots</u>				<u>Totals</u>
	<u>Over-topped</u>	<u>Intermediate</u>	<u>Codominant</u>	<u>Dominant</u>	
1	1,160				1,160
2	433				433
3	110	94	2		206
4	4	57	35		96
5		4	49	4	57
6			16	8	24
7			5	6	11
8				6	6
9				1	1
<u>Totals</u>	1,707	155	107	25	1,994
<u>B.A.</u>	21.5	10.1	14.3	6.3	52.2

<u>Hand-chopped Plots</u>					
1	2,424				2,424
2	498				498
3	61	24			85
4	2	17	3		22
5			4		4
6				1	1
<u>Totals</u>	2,985	41	7	1	3,034
<u>B.A.</u>	27.2	2.7	.8	.2	30.9

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

Plot - Check #1						Plot - Check #2					
DBH	0	I	CD	D	Totals	DBH	0	I	CD	D	Totals
1	159				159	1	134				134
2	64				64	2	48				48
3	16	15			31	3	18	16			34
4		11	6		17	4		9	5		14
5			6		6	5			10	2	12
6			4	1	5	6			1	4	5
7						7					
8				1	1	8				1	1
9				1	1	9					
Totals	239	26	16	3	284	Totals	200	25	16	7	248
BA	3.05	1.70	2.13	.99	7.86	BA	2.66	1.57	2.00	1.41	7.64

Plot - Check #3						Plot - Check #4					
DBH	0	I	CD	D	Totals	DBH	0	I	CD	D	Totals
1	98				98	1	156				156
2	46				46	2	42				42
3	9	11	1		21	3	8	3			11
4	1	9	3		13	4		5			5
5		1	10	1	12	5			2		2
6			2	1	3	6			3		3
7				2	2	7			2	1	3
8				2	2	8					
Totals	154	21	16	6	197	Totals	206	8	7	1	222
BA	2.07	1.46	2.07	1.56	7.16	BA	2.16	.58	1.40	.27	4.41

Plot - Check #5						Plot - Check #6					
DBH	0	I	CD	D	Totals	DBH	0	I	CD	D	Totals
1	109				109	1	109				109
2	42				42	2	39				39
3	16	9	1		26	3	9	13			22
4		4	5		9	4	1	3	6		10
5			2		2	5			3		3
6			1		1	6					
7				1	1	7					
Totals	167	13	9	1	190	Totals	158	16	9		183
BA	2.30	.79	.95	.27	4.31	BA	1.97	.90	.93		3.81

Plot - Check #7						Plot - Check #8					
DBH	0	I	CD	D	Totals	DBH	0	I	CD	D	Totals
1	81				81	1	82				82
2	36				36	2	29				29
3	7	2			9	3	5	6			11
4	1	2	2		5	4		3	1		4
5			4		4	5		2	2		4
6			1		1	6			1		1
7			1		1	7			1	1	2
8						8				1	1
Totals	125	4	8		137	Totals	116	11	5	2	134
BA	1.66	.27	1.18		3.11	BA	1.32	.83	.82	.62	3.59

Plot - Hand chop #1						Plot - Hand chop #2					
DBH	O	I	CD	D	Totals	DBH	O	I	CD	D	Totals
1	240				240	1	220				220
2	56				56	2	70				70
3	7	9			16	3	8	7			15
4	1	1			2	4		6	2		8
5			2		2	5			1		1
6						6				1	1
<b>Totals</b>	<b>304</b>	<b>10</b>	<b>2</b>		<b>316</b>	<b>Totals</b>	<b>298</b>	<b>13</b>	<b>3</b>	<b>1</b>	<b>315</b>
<b>BA</b>	<b>2.96</b>	<b>.53</b>	<b>.27</b>		<b>3.76</b>	<b>BA</b>	<b>3.12</b>	<b>.87</b>	<b>.31</b>	<b>.20</b>	<b>4.49</b>

Plot - Hand chop #3						Plot - Hand chop #4					
DBH	O	I	CD	D	Totals	DBH	O	I	CD	D	Totals
1	316				316	1	270				270
2	35				35	2	51				51
3	5				5	3	2				2
4		2			2	4	1				1
<b>Totals</b>	<b>154</b>	<b>2</b>			<b>358</b>	<b>Totals</b>	<b>324</b>				<b>324</b>
<b>BA</b>	<b>2.73</b>	<b>.18</b>			<b>2.91</b>	<b>BA</b>	<b>2.77</b>				<b>2.77</b>

Plot - Hand chop #5						Plot - Hand chop #6					
DBH	O	I	CD	D	Totals	DBH	O	I	CD	D	Totals
1	234				234	1	235				235
2	45				45	2	57				57
3	6				6	3	7				7
4		1			1	4		3			3
<b>Totals</b>	<b>285</b>	<b>1</b>			<b>286</b>	<b>Totals</b>	<b>299</b>	<b>3</b>			<b>302</b>
<b>BA</b>	<b>2.55</b>	<b>.09</b>			<b>2.64</b>	<b>BA</b>	<b>2.87</b>	<b>.26</b>			<b>3.13</b>

Plot - Hand-chop #7						Plot - Hand chop #8					
DBH	O	I	CD	D	Totals	DBH	O	I	CD	D	Totals
1	219				219	1	205				205
2	49				49	2	35				35
3	6	2			8	3	8	1			9
4		1			1	4					
<b>Totals</b>	<b>274</b>	<b>3</b>			<b>277</b>	<b>Totals</b>	<b>248</b>	<b>1</b>			<b>249</b>
<b>BA</b>	<b>2.56</b>	<b>.18</b>			<b>2.74</b>	<b>BA</b>	<b>2.27</b>	<b>.05</b>			<b>2.32</b>

Figure 2. Pine cordwood yields at age 21 relative to hardwood basal area in intermediates, codominants, and dominants.

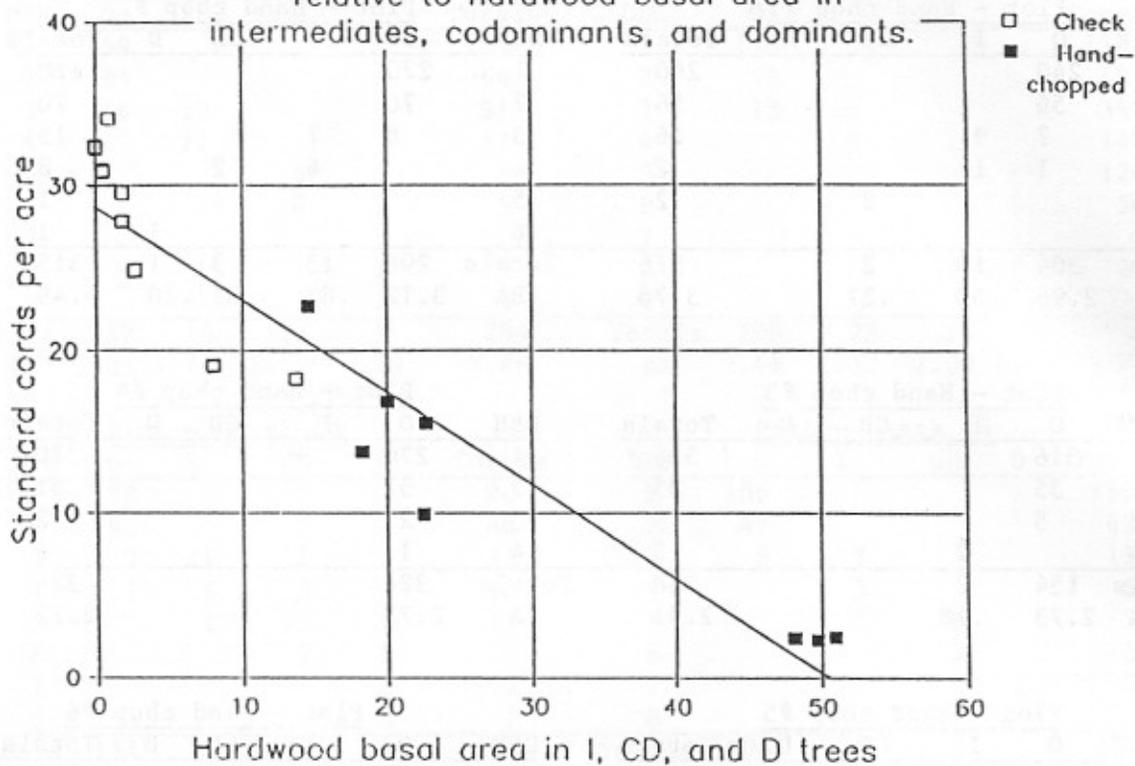


Figure 3. Dominant and codominant loblolly height at age 21 relative to hardwood basal area in intermediates, codominants, and dominants.

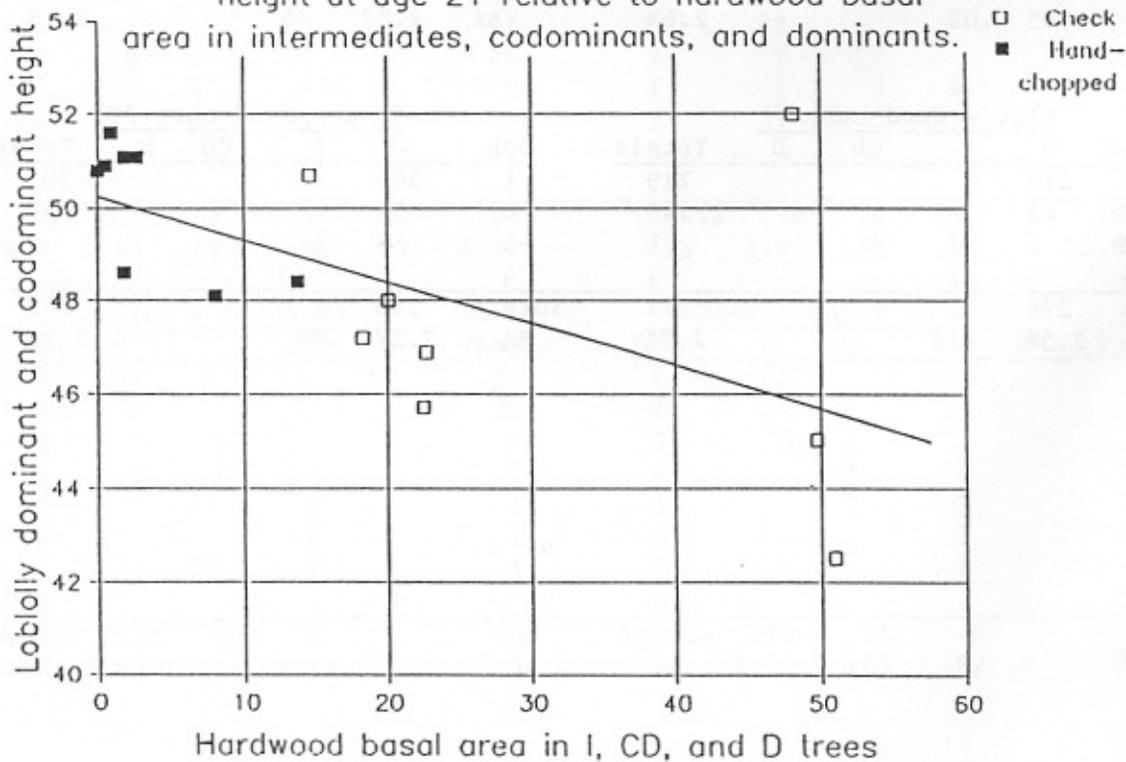


Table 7. Average height in feet of dominant and codominant trees at age 21.

<u>Treatment</u>	<u>Loblolly</u>		<u>Hardwood</u>	
	<u>Mean</u>	<u>Range</u>	<u>Mean</u>	<u>Range</u>
Check	47.2	41 to 58	43.1	35 to 54
Hand-chopped	50.1	43 to 60	46.0	42 to 51

Dominant and codominant loblolly pines have been taller on hand-chopped plots at all 4 measurements: the average differences being .7, 1.1, 3.0 and 2.9 feet at the 10, 14, 18, and 21-year measurements, respectively. Looking carefully at topographic position, soil type and topsoil depth, and hardwood species composition, there is no indication that site index is higher on the released plots. Hardwood competition seems to have affected average height of dominant and codominant pines. A plotting of average dominant and codominant height of loblolly pine at age 21 over hardwood basal area in intermediate, codominant, and dominant trees--for all 16 plots--shows a significant relationship between pine height and hardwood competition (Figure 3).<sup>3/</sup> We have observed a significant relationship between codominant and dominant pine height and hardwood basal area on a number of release studies.<sup>4/</sup> This study is an excellent example of how loblolly pine trees can "develop" from intermediate to codominant or dominant trees as stands grow older. On check plot 2, we did not consider any of the loblolly pines present to be codominant or dominant at ages 10 and 14 (Table 1), but at the 18 and 21-year measurements, two loblolly pines were judged to be codominant or dominant. Hardwood competition has been extremely severe on check plots 1, 2, and 3. At the 21-year measurement, we judged only two loblolly pines on plots 1 and 2, and four pines on plot 3 to be codominant or dominant. Where hardwood competition has been severe, heights of some ultimately codominant or dominant pines may underestimate site quality.

3/ Estimated pine height =  $50.251 - .0920$  (hardwood basal area),  $r^2 = .368$ , probability of a larger F = .013. A regression of pine height over total hardwood basal area (trees greater than .5 inches) was also significant:  $r^2 = .259$ , probability of a larger F = .044.

4/ See Occasional Report No. 75, Release Report No. 8, for a discussion of this relationship and its probable cause.