

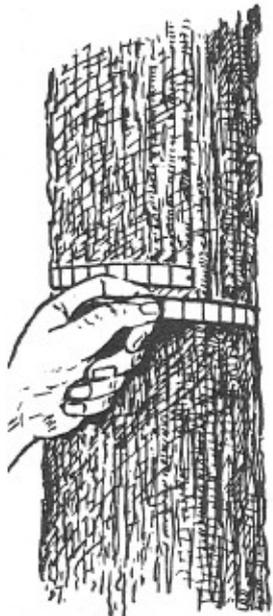
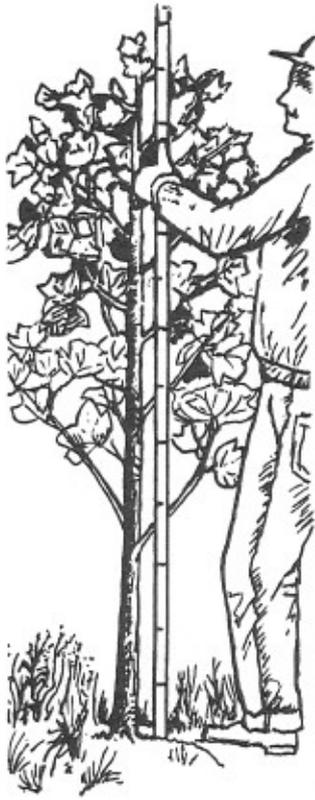
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LOBLOLLY PINE RELEASE STUDY

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LOBLOLLY PINE RELEASE
Report #13
by Thomas A. Dierauf

ABSTRACT

This study included three treatments: No release and basal spraying with 2,4,5-T in fuel oil at dilution rates of 1:40 and 1:20. Basal spraying was done in the winter, one season after planting. Hardwood competition varied considerably, but was severe on most of the plots. At age 17, the 1:40 plots averaged 70 percent more pine basal area and 91 percent greater yield in standard cords than the check plots, and the 1:20 plots averaged 68 percent more basal area and 99 percent greater yield than the check plots. Cordwood yields were related to a free-to-grow index estimated at age 2 ($r^2 = .874$) and hardwood basal area measured at age 17 ($r^2 = .846$).

INTRODUCTION

This is the thirteenth in a series of Occasional Reports concerning release of loblolly pine seedlings from hardwood competition. This study was installed on the privately-owned Nice Brothers tract in New Kent County, in the central Coastal Plain of Virginia. The previous stand was mostly hardwood. Site preparation consisted of prescribed-burning on July 16, 1970, followed by planting in March of 1971.

Basal spraying was done on February 29 and March 1 of 1972, after the seedlings had been through one growing season in the field. Six swaths, each two chains wide, were established (Figure 1). Two swaths were basal sprayed using a 1:40 dilution of 2,4,5-T, in fuel oil, two swaths were basal sprayed using a 1:20 dilution, and two swaths were left unsprayed as controls. The 2,4,5-T contained four pounds of active ingredient per gallon.

GROWTH PLOT INSTALLATION

Plots were installed and first measured at age 2, during the winter following basal spraying. Twelve 1/10-acre plots were installed, two in each of the six swaths, for a total of four plots in each of the three treatments. Volunteer pine seedlings were pulled up when the plots were installed.

Plots were measured four times, during establishment at age 2, and at ages 9, 13, and 17. At age 2, all loblolly pine seedlings were measured for height to the nearest foot, and classified as to free-to-grow status using a four part classification system.^{1/} At later measurements, diameter at breast height of each loblolly pine was measured to the nearest inch, and a sample of

1/ See Occasional Report No. 78 (Release Report No. 11) for a description and discussion of this classification system.

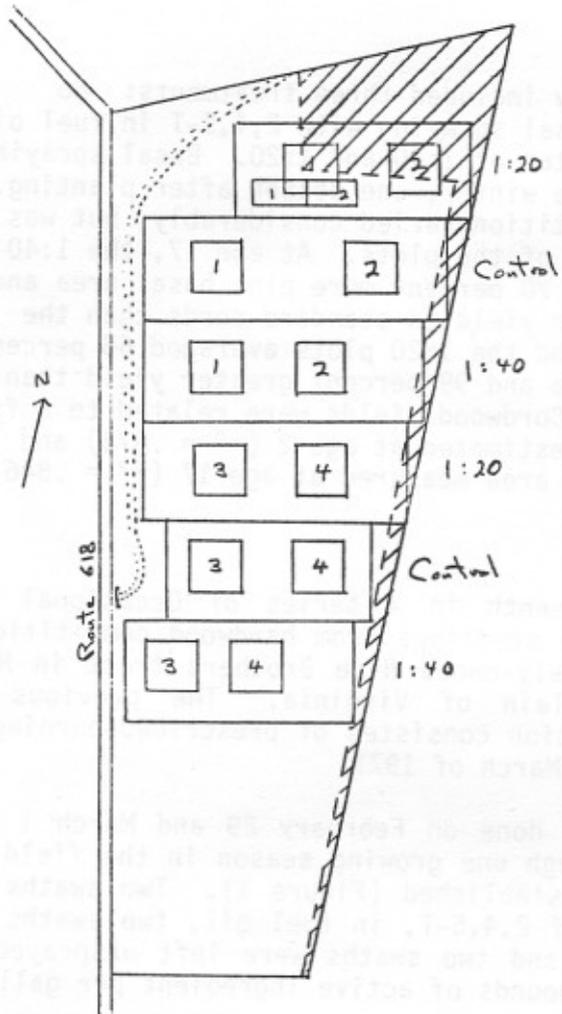


Figure 1. Layout of growth plots. Cross-hatched area was later cleared and plots affected were relocated as indicated.

trees in each diameter class was measured for total height to the nearest foot, noting which trees were dominant or codominant. For the final measurement at age 17, all hardwoods over .5 inch DBH were tallied by species, 1-inch diameter class, and crown class. Total height to the nearest foot was measured on about 40 percent of the intermediate and all of the codominant and dominant hardwoods.

There is an agricultural field on the east side of the tract, and in 1976, four years after the basal spraying was done, the landowner cleared some of the study area to enlarge this field. This cleared area is shown in cross-hatching in Figure 1. This clearing eliminated parts of 1:20 plots 1 and 2 in the northern-most swath. We carefully examined the remaining portion of plots 1 and 2, and established two new plots, 1/20 acre rather than 1/10 acre, which were in our judgment very similar to the original plots in pine stocking and hardwood competition. These new plots had dimensions of $\frac{1}{2}$ by 1 chain, and are also shown in Figure 1. Each of these new plots had 29 loblolly pine seedlings when they were installed at age 9, whereas the original plots had 58 and 54 seedlings. Because there had been no pine mortality between ages 2 and 9 on 1:20 plots 3 and 4, we assumed that the number of seedlings at age 9 on the new plots was probably the number present at age 2. We feel confident that hardwood competition has been similar also, because the 1:20 basal area treatment was very effective in controlling hardwoods.

RESULTS AND DISCUSSION

A summary of loblolly pine data for the four measurements is presented in Table 1. At age 17, 1:40 plots averaged 12.6 standard cords per acre and 1:20 plots averaged 13.6 standard cords per acre more than check plots.^{2/} Differences due to release increased with time (Table 2). Table 3 presents stand tables for loblolly pine at age 17.

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, 1:40 plots had about 90 percent as many hardwoods (greater than .5 inch DBH) and 1:20 plots about 73 percent as many hardwoods as check plots. Differences in hardwood basal area were much greater. At age 17, 1:40 plots had 46 percent as much basal area (in hardwoods greater than .5 inch DBH) and 1:20 plots had 39 percent as much basal area as check plots.

Codominant and dominant hardwoods were much more abundant at age 17 on the check plots than on the released plots. There were an average of 35 per acre on the check plots, none on the 1:40 plots and 7 per acre on the 1:20 plots. There were a total of 11 southern red oaks, 3 black oaks, 1 sweetgum, and 2 yellow-poplar on all 12 plots. These trees ranged in height from 37 to 48 feet and averaged 41 feet. Some of these trees will continue to grow rapidly enough to maintain a position in the canopy, especially on check plots 1, 2, and 3, which we estimated could end up as much as one-third hardwood.

2/ Standard cords at age 17 were subjected to an analysis of variance for randomized blocks. Average yields on released plots were significantly greater than on check plots (probability of a larger F = .016).

Table 1. Summary of loblolly data at ages 2, 9, 13, and 17 years: numbers of trees per acre, average DBH, basal area per acre, standard cords per acre, and average height of dominant and codominant trees*.

Age	Plot	No.	Check Plots				Plot	No.	1:40 Plots				Plot	No.	1:20 Plots					
			DBH	B.A.	Cds.	Ht.			DBH	B.A.	Cds.	Ht.			DBH	B.A.	Cds.	Ht.		
2	1	580					1	510					1	580						
	2	580					2	680					2	580						
	3	640					3	680					3	580						
	4	620					4	850					4	730						
	Means		605					680						618						
9	1	510	3.16	32.0		24.4	1	510	4.46	58.4		27.0	1	580	4.34	63.3		13.4	27.7	
	2	510	3.40	38.4		25.3	2	670	4.57	79.6		26.8	2	580	4.72	71.9		16.4	27.3	
	3	560	2.64	27.4		24.4	3	680	4.09	66.6		27.4	3	580	4.47	66.0		13.1	26.5	
	4	620	4.21	67.0		26.9	4	840	4.51	96.9		27.7	4	730	4.70	90.8		17.2	27.2	
	Means		550	3.35	41.2		25.2		675	4.41	75.4		27.2		618	4.56	73.0		15.0	27.2
13	1	430	4.58	52.6	4.8	34.9	1	510	5.86	103.2	14.6	37.5	1	560	5.57	99.0	13.4	37.5		
	2	440	4.64	57.9	6.2	35.5	2	660	5.77	125.3	16.4	35.6	2	580	5.97	114.2	16.4	39.2		
	3	420	4.14	44.4	3.4	32.8	3	660	5.08	98.6	11.2	37.4	3	580	5.62	104.8	13.1	36.2		
	4	580	5.41	99.0	12.5	36.5	4	840	5.37	137.4	17.0	37.2	4	730	5.63	130.8	17.2	37.2		
	Means		468	4.69	63.5	6.7	34.9		668	5.52	116.1	14.8	36.9		612	5.70	112.2	15.0	37.5	
17	1	410	5.59	74.3	11.9	44.2	1	490	6.80	131.9	24.8	47.0	1	540	6.56	132.1	25.2	45.9		
	2	380	5.92	77.1	12.1	42.4	2	640	6.45	152.6	27.6	44.9	2	580	6.79	149.3	29.6	47.0		
	3	390	5.31	65.4	8.7	42.0	3	650	5.86	129.2	21.8	45.1	3	560	6.52	135.4	25.0	45.7		
	4	540	6.44	127.1	22.5	44.4	4	800	6.19	173.8	31.4	45.8	4	730	6.22	161.1	30.0	45.7		
	Means		430	5.82	86.0	13.8	43.2		645	6.32	146.9	26.4	45.7		602	6.52	144.5	27.4	46.1	

*Except at age 2, heights presented are for all trees.

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

Age	1:40 minus Check		1:20 minus Check	
	Basal Area	Std. Cds.	Basal Area	Std. Cds.
9	34.2	--	31.8	---
13	52.6	8.1	48.7	8.3
17	59.9	12.6	58.5	13.6

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

DBH	Check Plots	1:40 Plots	1:20 Plots
2	5	2	2
3	27	20	7
4	50	60	25
5	75	100	95
6	125	153	143
7	78	193	220
8	68	83	75
9	2	25	30
10		7	5
11		2	
Totals	430	645	602

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

Species	Check Plots								Totals
	1	2	3	4	5	6	7	8	
Red oak	353	285	205	98	25	13		2	981
Willow oak	32	25	18	7					82
White oak	25	2							27
Sweetgum	188	40	40	13	2				283
Dogwood	65	5							70
Yellow-poplar		2							2
Red maple	20								20
Sassafras	68	8							76
Persimmon	15	5							20
Holly	67								67
Hickory	5								5
Miscellaneous	7								7
Totals	845	372	263	118	27	13		2	1,640

Species	1:40 Plots					Totals
	1	2	3	4	5	
Red oak	535	195	40	13		783
Willow oak	53	25	10	2		90
White oak	20	7				27
Sweetgum	168	73	40	13	3	297
Dogwood	105	8				113
Yellow-poplar	2		2			4
Red maple	35					35
Sassafras	73					73
Persimmon	30					30
Holly	12					12
Hickory	5	2				7
Miscellaneous	7					7
Totals	1,045	310	92	28	3	1,478

Species	1:20 Plots							Totals
	1	2	3	4	5	6	7	
Red oak	505	195	15	8	8		5	736
Willow oak	20	17						37
White oak	10	5						15
Sweetgum	145	43	5	5	7			205
Dogwood	53							53
Yellow-poplar					5			5
Red maple	30	5						35
Sassafras	45							45
Persimmon	15							15
Holly	33							33
Hickory	12							12
Miscellaneous	12							12
Totals	880	265	20	13	20		5	1,203

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

<u>Check Plots</u>					
<u>DBH</u>	<u>Over-topped</u>	<u>Intermediate</u>	<u>Codominant</u>	<u>Dominant</u>	<u>Totals</u>
1	845				845
2	372				372
3	40	223			263
4	3	110	5		118
5		12	15		27
6			13		13
7					
8				2	2
Totals	1,260	345	33	2	1,640
B.A.	15.0	22.2	5.0	.7	43.0

<u>1:40 Plots</u>					
<u>DBH</u>	<u>Over-topped</u>	<u>Intermediate</u>	<u>Codominant</u>	<u>Dominant</u>	<u>Totals</u>
1	1,045				1,045
2	310				310
3	75	17			92
4		28			28
5		3			3
Totals	1,430	48			1,478
B.A.	16.1	3.7			19.8

<u>1:20 Plots</u>					
<u>DBH</u>	<u>Over-topped</u>	<u>Intermediate</u>	<u>Codominant</u>	<u>Dominant</u>	<u>Totals</u>
1	880				880
2	265				265
3	18	2			20
4	5	8			13
5		13	7		20
6					
7		5			5
Totals	1,168	28	7		1,203
B.A.	11.9	3.9	1.0		16.8

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

DBH	Check Plot #1				Totals	DBH	Check Plot #2				Totals
	0	I	CD	D			0	I	CD	D	
1	139				139	1	46			46	
2	26				26	2	31			31	
3	2	25			27	3	2	21		23	
4		16	2		18	4		18		18	
5		1	3		4	5		3	3	6	
6			1		1	6			4	4	
7				1	1	7					
8						8					
Totals	167	42	6	1	216	Totals	79	42	7	128	
B.A.	1.42	2.76	.78	.35	5.31	B.A.	1.02	3.01	1.19	5.23	

DBH	Check Plot #3				Totals	DBH	Check Plot #4				Totals
	0	I	CD	D			0	I	CD	D	
1	84				84	1	69			69	
2	62				62	2	30			30	
3		34			34	3	12	9		21	
4		3			3	4	1	7		8	
5		1			1	5					
Totals	146	38			184	Totals	112	16		128	
B.A.	1.81	2.07			3.88	B.A.	1.71	1.05		2.76	

DBH	1:40 Plot #1				Totals	DBH	1:40 Plot #2				Totals
	0	I	CD	D			0	I	CD	D	
1	130				130	1	73			73	
2	32				32	2	31			31	
3	13	5			18	3	6	1		7	
4		6			6	4		3		3	
5		1			1	5					
Totals	175	12			187	Totals	110	4		114	
B.A.	2.04	.90			2.95	B.A.	1.37	.31		1.68	

DBH	1:40 Plot #3				Totals	DBH	1:40 Plot #4				Totals
	0	I	CD	D			0	I	CD	D	
1	146				146	1	69			69	
2	39				39	2	22			22	
3	10	1			11	3	1			1	
4		2			2	4					
Totals	195	3			198	Totals	92			92	
B.A.	2.14	.22			2.36	B.A.	.90			.90	

Table 6 (Continued).

DBH	0	1:20 Plot #1*			Totals	DBH	0	1:20 Plot #2*			Totals
		I	CD	D				I	CD	D	
1	58				58	1	84				84
2	12				12	2	36				36
3	2				2	3					
4		2			2	4					
5		2	2		4	5	2			2	2
6						6					
7		2			2	7					
Totals	72	6	2		80	Totals	120	2			122
B.A.	.68	.98	.27		1.93	B.A.	1.24	.27			1.52

DBH	0	1:20 Plot #3			Totals	DBH	0	1:20 Plot #4			Totals
		I	CD	D				I	CD	D	
1	105				105	1	105				105
2	32				32	2	26				26
3	2	1			3	3	3				3
4	2				2	4	1				1
5		1	1		2	5					
Totals	141	2	1		144	Totals	134	1			135
B.A.	1.54	.18	.14		1.87	B.A.	1.29	.09			1.37

* Figures in 1:20 plots 1 and 2 have been doubled to make them equivalent to 1/10-acre plots.

Cordwood yields of loblolly pine at age 17 were related to the amount of hardwood present. Figure 2 shows pine cordwood yields relative to hardwood basal area at age 17, for the 12 plots. A simple linear regression fitted to these data accounted for 85 percent of the variation in cordwood yields.^{3/} A regression of yields over hardwood basal area in just intermediate, codominant, and dominant hardwoods accounted for 72 percent of the variation in yields.

Cordwood yields also correlated well with the average free-to-grow index for each plot at age 2; in fact, the correlation was slightly better than 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 2. In Figure 3, pine cordwood yields for each plot at age 17 are plotted over free-to-grow index at age 2. A simple linear regression fitted to these data accounted for 87 percent of the variation in cordwood yields.^{4/}

At age 17, dominant and codominant loblolly pines averaged 2.5 feet taller on the 1:40 plots and 2.9 feet taller on the 1:20 plots than on the check plots. At age 2, the differences were .2 and .1 feet comparing check to 1:40 and 1:20 plots respectively. There is nothing to suggest that site index should be better on the released swaths than on the check swaths. As in a number of release studies previously reported, hardwood competition seems to have affected average height of dominant and codominant pines. A plotting of average dominant and codominant height of loblolly pine over hardwood basal area, at age 17, for all 12 plots, shows a significant relationship between pine height and hardwood competition (Figure 4).^{5/} Our Occasional Report 75, Release Report 8, contains a discussion of this relationship and its probable cause.

- 3/ Estimated standard cords = $35.16 - .4786$ (hardwood basal area), $r^2 = .846$, probability of a larger F = .00002.
- 4/ Estimated standard cords = $43.47 - 11.1585$ (free-to-grow index at age 2), $r^2 = .874$, probability of a larger F = .000008.
- 5/ Estimated pine height = $46.98 - .0749$ (hardwood basal area), $r^2 = .489$, probability of a larger F = .011.

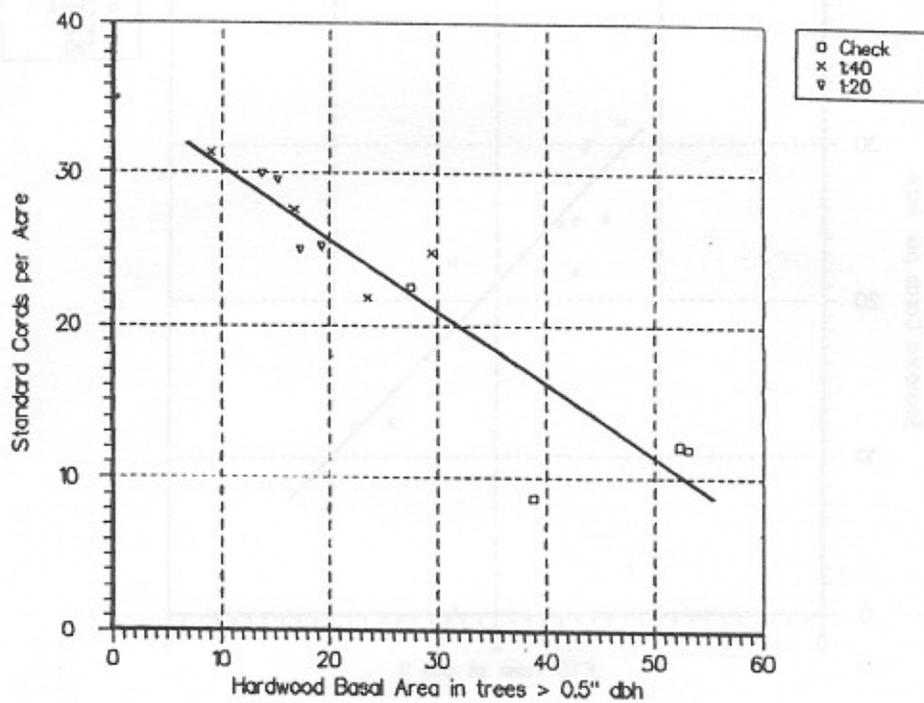


Figure 2. Pine cordwood yields at age 17 related to hardwood basal area.

Table 7. Percent of loblolly seedlings by free-to-grow class, for each plot, at age 2.

Plot		Free-to-grow Status				Means
		1	2	3	4	
Check	1	2	36	36	26	2.86
	2	4	45	35	16	2.63
	3		28	41	31	3.03
	4	20	43	28	10	2.28
	Means		7	38	35	21
1:40	1	52	35	13		1.61
	2	45	52	3		1.58
	3	52	43	4		1.52
	4	76	24			1.24
	Means		56	39	4	
1:20	1	71	25	4		1.33
	2	67	23	8	2	1.46
	3	56	36	8		1.52
	4	60	36	4		1.44
	Means		64	30	6	1

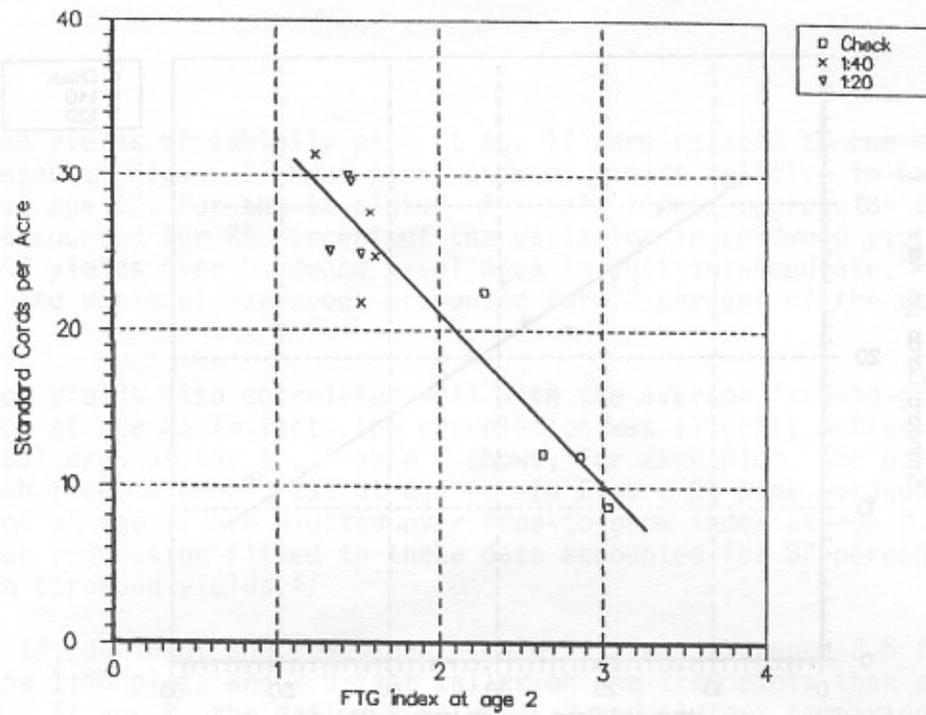


Figure 3. Pine cordwood yields at age 17 related to FTG index.

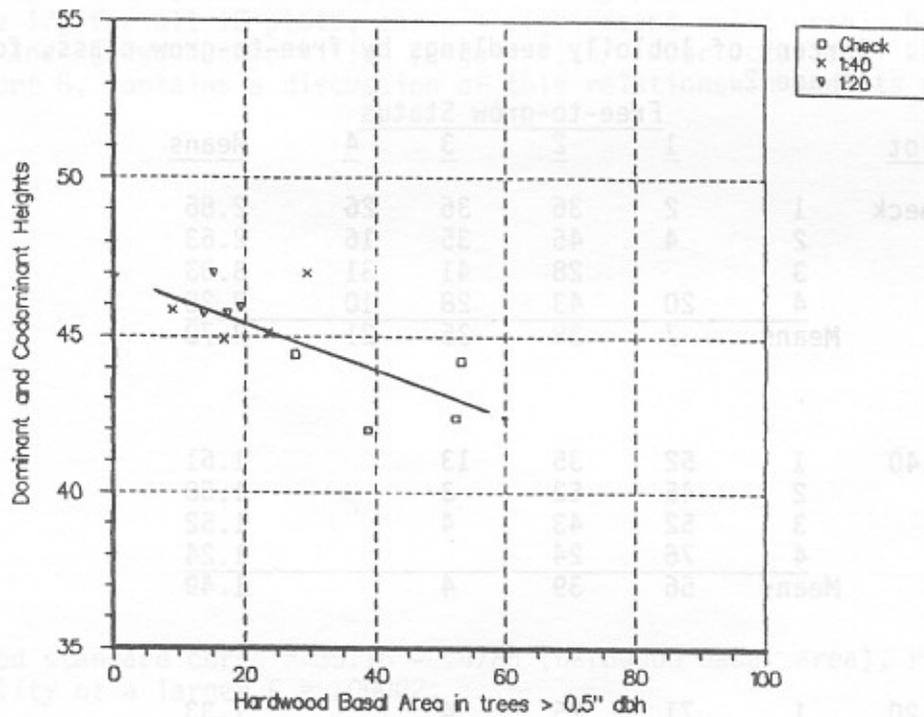


Figure 4. Pine dominant and codominant heights at age 17 related to hardwood basal area.