

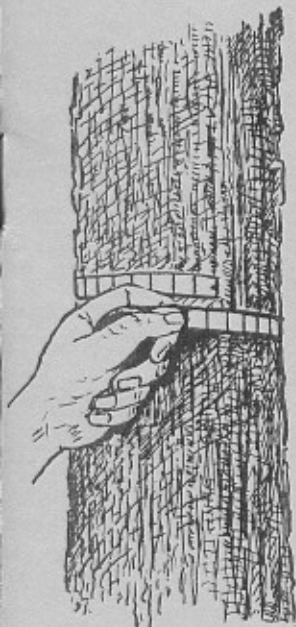
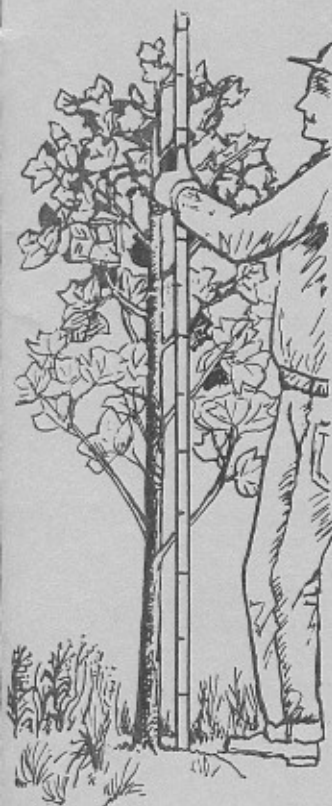
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LOBLOLLY PINE RELEASE STUDY

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LOBLOLLY PINE RELEASE
Report #5

by
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Abstract. This study included two treatments: no release and mist-blowing with a backpack mist-blower during the fourth growing season. Hardwood competition was severe at the time the release was done. At age 21, mist-blown plots averaged 78 percent more basal area and 91 percent more volume in standard cords than check plots.

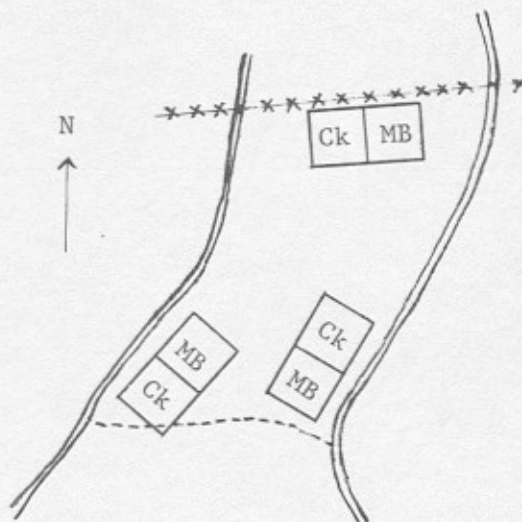
INTRODUCTION

This is the fifth in a series of Occasional Reports concerning release of loblolly pine seedlings from hardwood competition. This particular study was installed on the privately-owned Walter Coles tract in Albemarle County, in the west central piedmont of Virginia. The previous stand of mixed hardwoods, predominately oak, was cut during August of 1963 and prescribed burned during October, 1963. The fire was very hot, even though the fuel had only two months to cure. Loblolly seedlings were planted in the spring of 1964. In July of 1967, three pairs of one-half acre plots were selected (Figure 1), so that members of each pair were as similar as possible with respect to pine stocking and hardwood competition. The tract was small and quite variable. The southeast and north plot pairs matched reasonably well, but there was a big difference in numbers of pine seedlings in the southwest pair. Hardwood competition was matched quite well.

A coin was flipped to decide which plot of each pair would be released, and a backpack mist-blower was used to apply two pounds active ingredient of 2,4,5-T per acre. The mist-blowing was done on July 19, 1967, during the fourth growing season, and residual hardwoods that survived the prescribed burn were girdled at the same time. The remainder of the tract, outside the one-half acre plots, was mist-blown later the same summer.

FIGURE 1.

Layout of study and plot locations. Map shows one-half acre plots - one-tenth acre permanent growth plots were centered within these. "Ck." indicates check plots and "MB" indicates mist-blown.



Hardwood competition was severe at time of treatment. Many sprout clumps were too tall for good coverage with the backpack mist-blower, and the release would probably have been more effective if it had been done during the second or third growing season. Although the degree of hardwood kill was probably about average for a backpack mist-blower operation, the degree of release was only marginal. Most hardwood sprout clumps were killed back, but most of them resprouted and resumed growth.

PLOT INSTALLATION

Permanent growth plots were installed in November, 1967, at the end of the fourth growing season. A square, one-tenth acre plot was installed in the center of each one-half acre plot. Volunteer Virginia pine and shortleaf pine seedlings were pulled up or cut down when the plots were installed.

Growth plots were measured five times, at establishment (age 4) and at ages 9, 13, 17 and 21. At age 4, total height to the nearest .1 foot of all loblolly pine seedlings was measured. 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.

Hardwoods were tallied at ages 4, 9, and 21. At ages 4 and 9, all hardwoods that were breast high or taller were tallied by one-inch diameter class. Spray damage was ignored in the age 4 hardwood tally in order to estimate hardwood stocking before mortality and dieback resulting from the mist-blowing. At age 21 all hardwoods over .5 inch DBH were tallied by one-inch diameter class. Total heights to the nearest foot of about half of the dominant and codominant hardwoods were also measured at age 21.

RESULTS AND DISCUSSION

A summary of loblolly pine data for the five measurements is presented in Table 1. At age 21, mist-blown plots averaged 13.4 standard cords more than the check plots, almost double the yield. Differences due to release increased with time. Basal area differences between mist-blown and check plots were 23.4, 39.7, 48.2, and 54.2 square feet at age 9, 13, 17, and 21 respectively; and yield differences were 6.6, 10.0, and 13.4 standard cords at age 13, 17, and 21. Table 2 presents stand tables for loblolly pine at age 21.

The greater average yield of mist-blown plots over check plots is larger than it would have been had there been equal numbers of loblolly seedlings present when the plots were installed (Table 1). All mist-blown plots had more pine seedlings at age 4 than the corresponding check plots, and no pines were killed by the mist-blowing. These differences in initial numbers of seedlings were strongly related to yields. Figure 2 shows pine yields at age 21 relative to numbers of pine seedlings present at age 4. The simple linear regression lines in Figure 2 were fitted separately to the check plots and the mist-blown plots, and have almost identical slopes. When covariance analysis was

TABLE 1. Summary of loblolly data at each of five measurements: number of trees per acre, average DBH, basal area per acre, standard cords^{1/} per acre, and average height of dominant and codominant trees

Age	Plot	No.	Check Plots		Cds.	Ht.	Plot	Mist-blown Plots		Cds.	Ht.	
			DBH	B.A.				No.	DBH			B.A.
4	SE	690	-	-	-	9.0	SE	750	-	-	-	8.9
	SW	370	-	-	-	7.0	SW	630	-	-	-	7.7
	N	460	-	-	-	8.2	N	470	-	-	-	8.2
	Means	507	-	-	-	8.1	Means	617	-	-	-	8.3
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9	SE	680	3.10	42.8	-	29.8	SE	690	4.12	70.2	-	28.8
	SW	340	2.19	11.7	-	22.7	SW	620	3.42	43.0	-	27.1
	N	410	2.98	27.5	-	28.1	N	460	3.62	39.0	-	27.5
	Means	477	2.76	27.3	-	26.9	Means	590	3.72	50.7	-	27.8
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13	SE	550	4.69	71.4	8.9	41.8	SE	660	5.33	114.3	18.1	43.2
	SW	270	3.70	24.4	2.3	35.2	SW	610	4.67	78.2	8.6	39.1
	N	400	3.98	45.9	6.0	40.1	N	420	5.17	68.1	10.3	43.1
	Means	407	4.12	47.2	5.7	39.0	Means	563	5.06	86.9	12.3	41.8
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17	SE	490	5.57	88.5	14.2	44.5	SE	590	6.29	137.6	26.2	46.7
	SW	190	5.00	28.8	3.6	37.7	SW	570	5.28	93.2	13.9	43.2
	N	300	5.33	54.9	8.5	42.8	N	390	6.05	86.0	16.2	47.3
	Means	327	5.30	57.4	8.8	41.7	Means	517	5.87	105.6	18.8	45.7
<hr/>												
21	SE	460	6.20	102.9	23.0	54.7	SE	570	6.86	156.7	38.2	57.6
	SW	190	5.74	38.8	6.6	46.0	SW	570	5.81	113.0	22.5	51.7
	N	260	6.54	67.8	14.4	50.8	N	390	6.54	102.4	23.5	55.8
	Means	303	6.16	69.8	14.7	50.5	Means	510	6.40	124.0	28.1	55.0

^{1/} Except at age 4, heights presented are for all trees.

Two treatments were used: mist-blown plots and check plots. The mist-blown plots were treated with a mist-blowing machine at age 4. The check plots were not treated. The number of loblolly seedlings per acre at age 4 was recorded for each plot. The number of pine cordwood yields per acre at age 21 was also recorded for each plot. The data are shown in Figure 2.

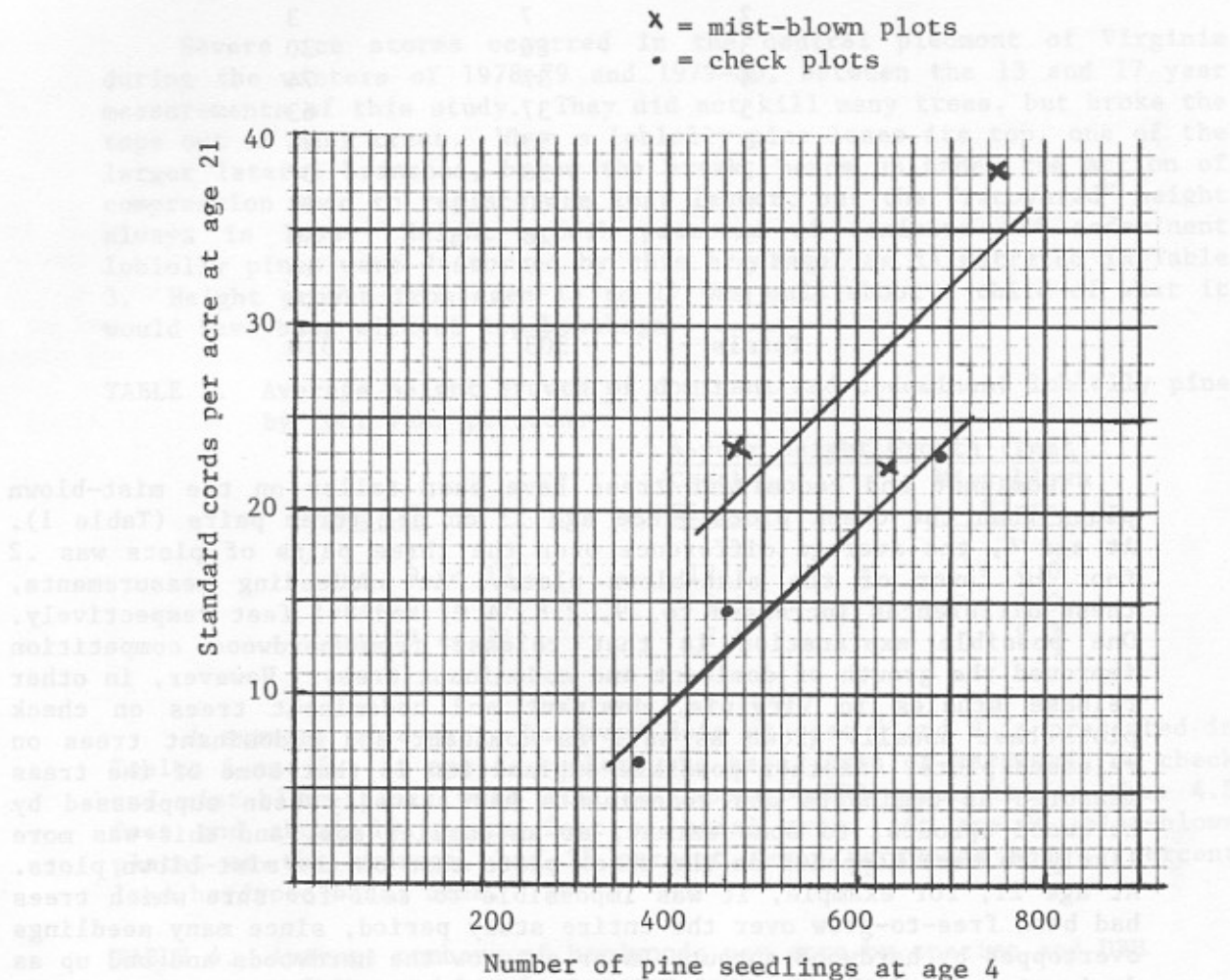


FIGURE 2. Pine cordwood yields at age 21 relative to number of loblolly seedlings per acre at age 4.

used to adjust for the different numbers of seedlings present at age 4 (so that average number of seedlings on the three check plots was equal to the average number on the three mist-blown plots), the average difference in yield at age 21 was reduced from 13.4 to 11.0 standard cords per acre^{1/}.

TABLE 2. Average number of loblolly pines per acre by DBH class at age 21.

<u>DBH</u>	<u>Check Plots</u>	<u>Mist-blown Plots</u>
2	7	3
3	26	30
4	37	74
5	37	63
6	53	94
7	50	87
8	60	93
9	26	40
10	7	16
11		10
<u>Totals</u>	<u>303</u>	<u>510</u>

Dominant and codominant trees have been taller on the mist-blown plots than the check plots since age 13 on all three pairs (Table 1). At age 4, the average difference over the three pairs of plots was .2 foot in favor of the mist-blown plots. At succeeding measurements, these differences increased to .9, 2.8, 4.0, and 4.5 feet respectively. One possible explanation is that release from hardwood competition improved the growth of dominant and codominant trees. However, in other release studies in Virginia, dominant and codominant trees on check plots have usually grown as well as dominant and codominant trees on released plots. Another possible explanation is that some of the trees measured as dominants and codominants had actually been suppressed by hardwood sprouts, to some extent, at an earlier age, and this was more likely to have happened on the check plots than on the mist-blown plots. At age 21, for example, it was impossible to tell for sure which trees had been free-to-grow over the entire study period, since many seedlings overtopped by hardwood sprouts later outgrow the hardwoods and end up as dominant and codominant trees. To check this possibility, we looked at

1/ Pulpwood yields at age 21 were subjected to an analysis of variance, and yields on mist-blown plots were significantly greater than yields on the check plots (probability of larger F = .025). Yields were also subjected to an analysis of covariance, which adjusted for differences in numbers of seedlings present at age 4. After this adjustment, the difference in yields between mist-blown and check plots was not statistically significant (probability of larger F = .160). With only six plots, however, covariance adjustment for numbers of seedlings left only one degree of freedom for error.

the height of the tallest tree and the average height of the tallest two trees measured on each plot. Results were similar to what was found averaging all dominant and codominant trees. For the two tallest trees per plot, average differences were .9, 2.7, 3.2, 4.3, and 3.0 feet in favor of the mist-blown plots for the five measurements. The most likely explanation is that there are differences in site index between the members within the three pairs of plots, and by coincidence the lower site index plot was randomly selected each time for the check plot. No attempt was made to adjust yields for differences in site index, but as with the differences in initial numbers of loblolly pines per acre, higher site index on the mist-blown plots would account for some of the differences in yields.

Severe ice storms occurred in the central piedmont of Virginia during the winters of 1978-79 and 1979-80, between the 13 and 17 year measurements of this study. They did not kill many trees, but broke the tops out of many trees. When a loblolly pine loses its top, one of the larger lateral branches, below the break, bends up under the action of compression wood to replace the lost leader, but the "recovered" height always is less. Height growth patterns of dominant and codominant loblolly pines were distorted by this breakage, as illustrated in Table 3. Height growth from ages 13 to 17 was only about a third of what it would have been without top breakage.

TABLE 3. Average height growth of dominant and codominant loblolly pine by four year periods.

Period	4-year Height Growth (feet)	
	Check Plots	Mist-blown Plots
Age 9 to 13	12.1	14.0
Age 13 to 17	2.7	3.9
Age 17 to 21	8.8	9.3

A summary of average hardwood data at ages 4 and 9 is presented in Tables 4 and 5. At age 4, numbers and basal area of hardwoods on check and mist-blown plots were similar, about 4,500 stems taller than 4.5 feet and about 10 square feet of basal area. At age 9, mist-blown plots, on the average, had 25 percent fewer hardwoods and 41 percent less hardwood basal area.

TABLE 4. Average numbers of hardwoods per acre by species and DBH class, and basal area per acre, at age 4.

Species	Check Plots				Mist-blown Plots			
	DBH				DBH			
	1/4	1	2	Totals	1/4	1	2	Totals
Oaks	1,797	1,273	43	3,113	1,977	1,313	53	3,343
Red maple	267	107	-	374	503	117	-	620
Black gum	390	53	-	443	437	7	-	444
Misc.	493	23	-	516	317	40	-	357
Totals	2,947	1,456	43	4,446	3,234	1,477	53	4,764
Basal Area				9.9				10.3

TABLE 5. Average numbers of hardwoods per acre by species and DBH class, and basal area per acre, at age 9.

Species	Check Plots						Mist-blown Plots					
	DBH					Totals	DBH					Totals
	1/4	1	2	3	4		1/4	1	2	3		
Oaks	970	1,360	403	100	10	2,843	743	1,157	210	33	2,143	
Red maple	117	220	30	7	-	374	450	240	37	7	734	
Black gum	433	247	3	-	-	683	200	43	-	-	243	
Hickory	20	10	3	3	-	36	70	43	-	-	113	
Yellow pop.	143	90	3	-	-	236	37	50	-	-	87	
Dogwood	80	127	-	-	-	207	60	63	-	-	123	
Misc.	213	63	7			283	47	7			54	
Totals	1,976	2,117	449	110	10	4,662	1,607	1,603	247	40	3,497	
Basal Area						28.3					16.6	

A summary of average hardwood data from the measurement at age 21 is presented in Tables 6 and 7. Mist-blown plots had 22 percent fewer hardwoods and 35 percent less hardwood basal area. Hardwood basal area in intermediate, codominant and dominant trees averaged 23.4 square feet on the check plots and 12.1 square feet (48 percent less) on the mist-blown plots.

TABLE 6. Average numbers of hardwoods per acre by species and DBH class at age 21.

		Check Plots							
		DBH							
Species	1	2	3	4	5	6	7	Totals	
Chestnut oak	420	143	97	34	50	20	3	767	
Red oak	200	97	73	24			3	397	
White oak	90	40	17	3	3			153	
Red maple	217	73	27	27	3	7		354	
Black gum	253	20						273	
Yellow poplar	93	40	13					146	
Dogwood	103	17						120	
Hickory	27	3						30	
Miscellaneous	20			3				23	
Totals	1,423	433	227	91	56	27	6	2,263	

		Mist-blown Plots									
		DBH									
Species	1	2	3	4	5	6	7	8	9	Total	
Chestnut oak	147	157	64	70	10					448	
Red oak	180	104	53	13	10				3	363	
White oak	77	33								110	
Red maple	363	53	17							433	
Black gum	213	7	3							223	
Yellow poplar	17	20	3							40	
Dogwood	76	10								86	
Hickory	33	3								36	
Miscellaneous	27									27	
Totals	1,133	387	140	83	20				3	1,766	

TABLE 7. Average numbers of hardwoods per acre by DBH class and crown class, and basal area by crown class, at age 21

DBH	Check Plots				Totals
	Over-topped	Intermediate	Codominant	Dominant	
1	1,423				1,423
2	433				433
3	170	47	10		227
4	17	67	7		91
5	3	3	50		56
6		7	17	3	27
7				6	6
Totals	2,046	124	84	9	2,263
B.A.	27.4	9.9	11.3	2.2	50.8

DBH	Mist-blown Plots				Totals
	Over-topped	Intermediate	Codominant	Dominant	
1	1,133				1,133
2	387				387
3	97	43			140
4	10	43	30		83
5	3	14	3		20
6					
7					
8					
9				3	3
Totals	1,630	100	33	3	1,766
B.A.	20.7	7.8	3.0	1.3	32.8

Figure 3 shows the relationship of pine cordwood yields at age 21 to basal area of intermediate, codominant and dominant hardwoods, for the six plots. A simple linear regression fitted to these data accounted for 91 percent of the variation in cordwood yields^{2/}. A regression of yields over total hardwood basal area (all trees greater than one-half inch DBH) accounted for 84 percent of the variation in yields.

2/ Estimated standard cords = $40.78 - 1.085 (\text{hardwood basal area})$, $r^2 = .913$

At age 21 there were 28 dominant and codominant hardwoods on the three check plots and 11 on the three mist-blown plots. Of these 39 trees, 36 were chestnut oak, 2 were scarlet oak, and one was a black oak. The average height of dominant and codominant hardwoods was 47.4 feet on the check plots and 48.0 feet on the mist-blown plots. At the same time, the average height of dominant and codominant loblolly pines was 50.5 on the check plots and 55.0 on the mist-blown. Some of these hardwoods will continue to grow rapidly enough to maintain a place in the canopy, especially on the southwest check plot, where the final stand will be a pine hardwood mixture with hardwood predominating.

• = check plots
X = mist-blown plots

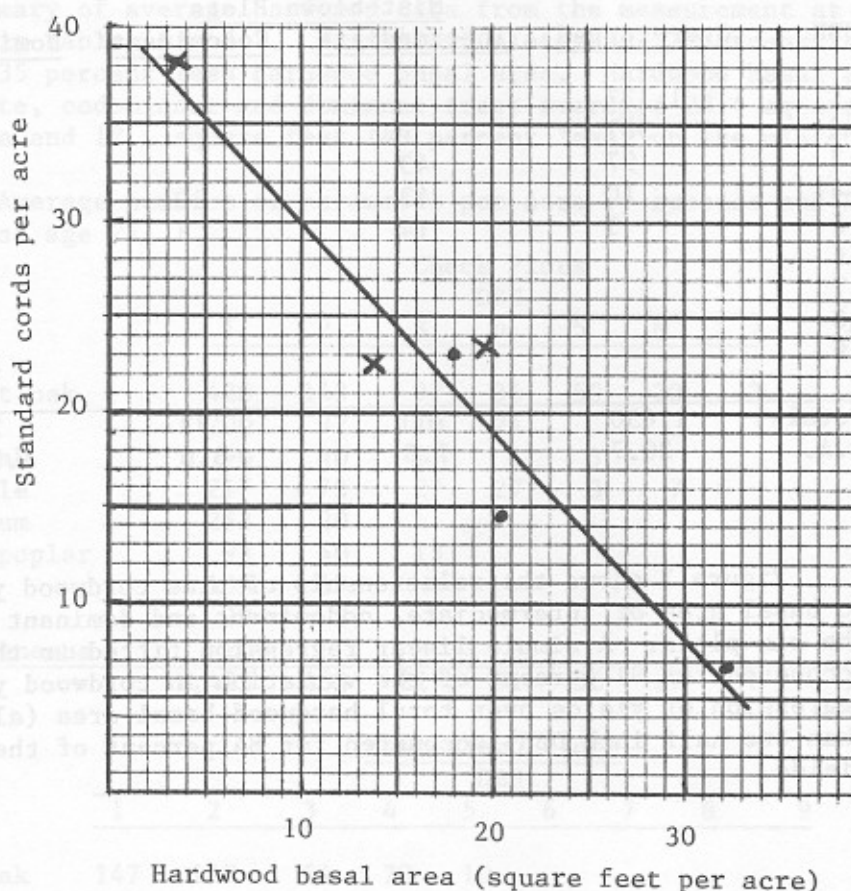


FIGURE 3. Pine cordwood yields at age 21 relative to basal area of intermediate, codominant and dominant hardwood trees.