CONDITIONING Loblolly Pine Stands in Eastern Maryland FOR REGENERATION

by S. Little and J. J. Mohr

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Contents

Study area 3
Methods 3
Results
Pine reproduction 5
Hardwood competition . . 8
Discussion 13
Summary 17
Literature cited 18
Appendix (tables) 19

THE RESULTS of this experiment provide a strong case for site conditioning in advance of harvest cuttings. Conditioning treatments are highly desirable from both silvicultural and economic considerations. Foresters who manage industrial holdings in this area should give serious thought to providing such treatments. State foresters working with private owners should direct their recommendations and programs toward this end.

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On Maryland's Eastern Shore, loblolly pine stands are commonly the most profitable type of forest. The climax hardwoods here are of relatively low value on most sites. Other conifers occur here: pond pine and its gradations to loblolly are common associates in certain sections, and Virginia and shortleaf pines are found on the drier sites. However, because loblolly generally grows faster than the other pines, it ranks as the most desirable species.

Many of today's best loblolly stands originated on old-field sites, the pines having seeded in when cultivation ceased. Unfortunately hardwoods also invade these areas, but usually somewhat more slowly than the pines, so that they form dense understories by the time the pines are mature. When the pine stands are logged, these hardwoods tend to take over much of the growing space. Heavy logging may damage or uproot many of the hardwoods, but logging alone does not set them back enough to enable relatively pure stands of pine to become established for the next crop.

Figure 1.—Original stand conditions in the study area before conditioning treatments.

Certain supplemental measures do provide the desired pine stands—if applied just before seedfall in years of heavy seed crops. In one study, for example, a hot slash burn in early September after a seed-tree cutting permitted loblolly pine to form a relatively pure stand, whereas in adjacent unburned plots the pines gained dominance only in spots that were much disturbed during logging. However, such a summer burn can be applied effectively only under suitable weather conditions in years with good seed crops (3, 5).

Measures that would be effective in both good and bad seed years were needed. So in 1952 the Northeastern Forest Experiment Station and the Maryland Department of Forests and Parks started tests of other treatments for reproducing loblolly pine stands, namely, winter burning and shelterwood cutting, singly and in combination. This report presents results of those treatments, and compares them in relation to the chemical tools and other treatments that are now being used to favor pine on the Eastern Shore.

Study Area

The study was established in 1952 in a 47-year-old, old-field pine stand of about 41 acres in the Pocomoke State Forest, Worcester County. A light cut for piling had been made among the overstory trees during World War II.

As is usual in such stands, the overstory was mostly loblolly pine, with a dense understory of several hardwood species (fig. 1). Among the stems of all sizes, hardwoods predominated, accounting for 81 percent.

Red maple was the most abundant of the hardwood species, but sweetgums, hollies, blackgums, and black oaks(black, water, and willow oaks) also were common. Other hardwoods included white oak and swamp chestnut oak, sweetbay, and occasional yellow-poplars (table 1, in Appendix).

The hardwoods predominated among stems less than 6 inches in diameter, and were especially numerous among 3-inch and smaller stems. Most of the pine reproduction, about 1,200 seedlings per acre, was relatively young and only a few inches tall.

Methods

The 41-acre study area was divided into 8 treatment plots of about 5 acres each. In the center of each plot a 1-acre subplot was established for studying changes in stand composition. These subplots provided most of the study data, and are referred to below simply as plots.

In the 1-acre plots all trees 0.6 inch d.b.h. (diameter breast high) and larger were tallied by 1-inch diameter classes and species in 1952, before any treatments were made, and periodically thereafter to record treatment effects. Smaller trees were tallied at the same times on 30 permanently marked milacre quadrats in each plot.

Treatments to condition the stand for pine regeneration were applied at various times before a seed-tree cutting was made in 1958. Each of the following treatments was carried out on two 5-acre plots:

- Prescribed burning on 23 March 1953 and on 3 April 1956.
- Shelterwood cutting—a commercial cutting of pine pulpwood between 1 January and 31 March 1957, followed by the poisoning of hardwoods 3 inches d.b.h. and larger in early April 1957.
- A combination of the above treatments.
- None (control plots).

In both prescribed fires the usual height of flames was about 2 feet. They generally consumed the litter and part of the F layer of the forest floor, but did not burn into the H layer. All burning was done when the burning index was about 20 and when winds did not exceed 6 miles per hour; all fires were set to burn with the wind.

The harvest of pine pulpwood in 1957, mostly from the smaller overstory trees, removed about 20 percent of the pine basal area—31 square feet per acre of the total of 155 square feet of pine basal area per acre tallied in 1956. The cutting yielded 5.24 units of 180 cubic feet each per acre. The stumpage price was $3 a unit, a return of $15.72 an acre.

Poisoning was done by applying 2,4,5-T (8 pounds acid equivalent per 100 gallons of No. 2 fuel oil) in ax frills. A State Forest crew of four men did this work at an average cost of $8.41 per acre ($0.71 for material, $7.70 for labor at $1 per man-hour). The stumpage return from the pulpwood sale was sufficient to pay both this cost and the cost of the prescribed burning.

On 3 September 1958 the State of Maryland sold the remaining timber with the stipulation that all except marked seed trees (about 6 per acre) be removed by 1 April 1959, and that the seed trees be removed the following year. The main cutting actually was completed by mid-February 1959, and the seed trees were taken out in late November the same year. Most of the skidding was done with crawler tractors.

Results

PINE REPRODUCTION

Advance Reproduction

All treatments made prior to the 1958-59 seed-tree cutting favored the establishment of pine reproduction: plots prescribe-burned and shelterwood-cut gained 5,467 seedlings per acre between 1952 and 1958, and stocking by milacre quadrats increased from 37 percent to 93 percent (table 2, Appendix). The stocking in plots that were only prescribe-burned or only shelterwood-cut also increased, but not nearly so much as under the combination treatment. During the same period, the stocking of pine reproduction in the untreated plots decreased slightly.

These changes are, of course, net changes. In loblolly pine reproduction under a stand, there is naturally a continual turnover from some seedlings dying and from new ones starting. Besides this natural turnover, the prescribed burns temporarily wiped out all pine reproduction, and logging disturbances in the pulpwood cutting eliminated many seedlings. However, both treatments were followed by the establishment of far more new seedlings than were present before.

Effect of Seed-Tree Cutting on Advance Reproduction

The 1958-59 logging eliminated most of the advance pine reproduction—94 percent of it for all plots combined. For the combination treatment, seedlings per acre were reduced from 6,517 to 500, and stocked quadrats from 93 percent to 32 percent. For the other treatments, which had considerably less advance reproduction, only an insignificant amount of stocking remained after the cutting (table 3, Appendix).

Survival of advance pine reproduction through the logging operation was, of course, greatly affected by the amount of disturbance. No seedlings survived in loading areas, haul roads, skid trails, or heavy slash accumulations. Most of the surviving seedlings were found in spots where the forest floor had not been disturbed and little or no slash had been deposited.

Logging disturbances were severe and extensive in this operation—probably more so than in many Eastern Shore cuttings—both because the stand contained a large volume and because more than half of the trees were put into piling. Piling stems were peeled in the woods, thus adding to the volume of slash and increasing the ground disturbance. Slash covered 65 percent of the area, and much of it was relatively deep. Skid trails, haul roads, and loading areas covered about 33 percent. Skid trails had severely disturbed forest floors, and disturbances on the haul roads and loading areas were even greater. There the forest floor was ground into the soil, the soil was severely churned, and water stood on the surface during the winter and early spring.

About 49 percent of the seedlings that survived the logging died during the following summer. Some of this mortality could be attributed to logging injuries and some to the great change in environment, but most of it resulted from damage by Pales or similar weevils.

Consequently, advance pine reproduction contributed little to restocking the cutover area, even though it had ranged as high as 6,500 seedlings per acre and 93-percent stocking by milacre quadrats before the harvest cutting (table 3, Appendix).

Subsequent Reproduction

The 1958 crop of pine seed was very light in the study area. Based on 16 1/16-milacre seed traps, maintained from 3 November to 27 April, the seedfall was only about 29,000 seeds per acre, of which 19,000 were sound. By way of comparison, this catch of sound seed was only 13 percent of that from a good crop in 1951 that was sampled in another seed-tree cutting (3). Despite the light crop in the present study, average stocking by treatments in the fall of 1959 was fairly good: 2,083 to 2,450 pine seedlings per acre, and 75 to 82 percent by milacre quadrats.

This 1959 stocking suffered an overwinter loss of 24 percent of the seedlings and 14 percent in terms of stocked quadrats.

Disturbances incident to the harvest, in November 1959, of the six seed trees per acre were largely responsible for these losses. Pales or similar weevils caused only a small amount of mortality during the 1960 growing season.

A large increase in pine reproduction occurred in 1960 as a result of the 1959 seed crop. Even though the seed trees were removed before all the 1959 seeds had fallen, seed-trap catches indicated that 66,000 pine seeds per acre, of which 54,000 were sound, had been distributed. In late August 1960 the average stocking by treatments was 7,000 to 9,200 pine seedlings per acre, with 93 to 97 percent of the quadrats stocked.

In the fall of 1961, 2 years after the seed trees were removed, pine reproduction still was plentiful in all treatments at 7,000 to 8,900 seedlings per acre, and some seedlings were up to 5 feet tall. However, appreciable differences already were appearing among treatments in the degree of dominance exhibited by the young pines in relation to competing hardwoods. For the three treatments collectively, the pine seedlings definitely were free to grow on 55 to 65 percent of the quadrats, whereas with no treatment before the seed-tree cutting, seedlings were free to grow on only 30 percent of the quadrats. We estimate, on the basis of these early results and general silvical observations in the region, that:

1. *The combination treatment* used before seed-tree cutting will be sufficient to produce another predominantly pine stand; that is, 85 to 90 percent of the stems in the next overstory will be pines.

2. *Single treatments* will be somewhat less effective: after the shelterwood cutting, possibly 75 to 80 percent of the next overstory will be pines; and after the prescribed burning, possibly 65 to 70 percent will be pines.

3. *Where no conditioning treatment* was used, pines may form 45 to 50 percent of the next stand.

The differences described above, and those anticipated in the future, are not direct effects of conditioning or harvest-cutting treatments on the amount of pine reproduction; rather, they are effects of those treatments on the hardwood tree and shrub competition.

HARDWOOD COMPETITION

Effect of Conditioning Treatments

During the first 4 years of the study the only treatments were two prescribed burns, in 1953 and 1956, on four of the plots. These burns reduced the numbers of hardwoods larger than 0.5 inch d.b.h. by 65 percent. Meanwhile hardwoods of this size on unburned plots increased by 8 percent. The burns were most effective on stems in the smaller size classes (fig. 2). By diameter classes, 1-inch stems were reduced by 86 percent, 2-inch stems by 29 percent, and 3- to 5-inch stems by only 0.4 percent. However, numbers of stems less than 0.6 inch in diameter were not greatly affected because enough new seedlings started and enough top-killed larger stems sprouted after the burns to roughly balance the kills in this class.

Bark characteristics also influenced fire effects: thin-barked species such as beech, yellow-poplar, sweetbay, red maple, and holly succumbed to fire more readily than such thick-barked species as sweetgum and the oaks.

Still bigger differences in hardwood understories developed after the shelterwood treatment was applied in 1957. By 1958 the number of hardwood stems larger than 0.5 inch in diameter had decreased in the combination treatment to 15 percent of the number present in 1952. The shelterwood treatment alone reduced the hardwoods of this size class to 57 percent of their 1952 number. Some further hardwood decline occurred under the prescribed-burning treatment alone—from 35 percent of the 1952 number in 1956 to 27 percent in 1958. Untreated plots still had 108 percent of the original number of stems, as in 1956.

Effect of Seed-Tree Cutting

The severe disturbances associated with the heavy cutting of 1958-59 greatly reduced the hardwoods of all sizes except those in the smallest class (less than 0.6 inch in diameter). Hardwoods in the 1- and 2-inch diameter classes were reduced 77 to 89 percent between the 1958 and 1959 tallies; differences in abundance of hardwoods of this size due to previous plot treatments had little or no effect on the reduction percentages. Hardwoods 3 inches and larger in diameter were reduced 43 to 47 percent in the untreated and burned-only plots. In the shelterwood and combination plots, where 3-inch and larger trees had been poisoned in 1957, the reductions were 89 and 87 percent. (For actual numbers of stems involved above, see table 4.)

Numbers of stems less than 0.6 inch in diameter were greater in 1959 than before the logging, except under the combination

Figure 2.—Plot prescribe-burned in 1953 and 1956, as it appeared in 1958 just before the seed-tree cutting. Note the relative openness in the lower part of the understory (between 2 and 10 feet above ground) compared to the unburned area shown in figure 1.

treatment. For the control and burned-only treatments, the increases were around 6,000 stems per acre (table 4). These increases came from new seedlings, especially red maple and sweetgum, that started after the logging, and from the sprouting of larger stems that had been cut or broken. Small stems increased only slightly in 1959 under the shelterwood treatment, and decreased under the combination treatment, perhaps because substantial increases had already occurred in these plots after the 1957 shelterwood cutting.

Removal of Seed Trees

The removal of seed trees in November 1959 caused much less damage to hardwoods than the heavier cutting of the previous year. Consequently, most of the change between the 1959 and 1960 tallies reflected growth in size of already established stems. In all treatments the number of hardwoods larger than 0.5 inch in diameter increased (table 4).

Cumulative Effect of Treatments

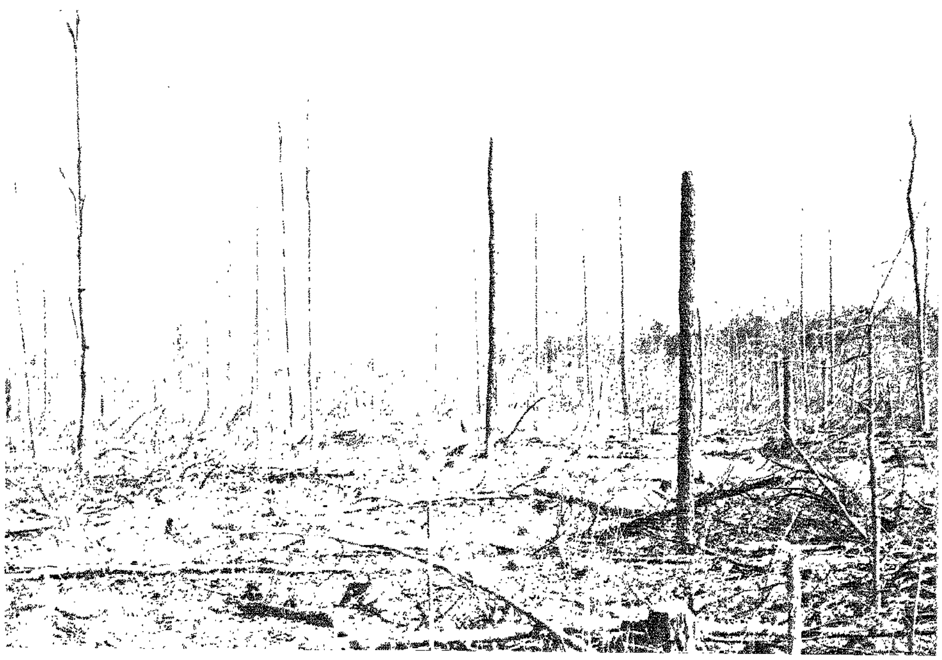
Even though logging damage in the harvest cuttings partly obliterated the differences among prelogging treatments, the 1960 tallies still showed marked differences in numbers of hardwoods larger than 0.5 inch in diameter, as tabulated below (figs. 3 and 4):

Treatment	*1- to 3-inch stems (No. per acre)*	*4-inch and larger stems (No. per acre)*
Prescribe-burned and shelterwood-cut	39	4
Shelterwood-cut	86	4
Prescribe-burned	65	58
None	147	59

The poisoning done in connection with the shelterwood cuttings in 1957 had reduced the number of larger hardwoods to 4 per acre, and most of these were nearly dead (fig. 4). In contrast, in plots not so treated there were 58 or 59 4-inch and larger stems per acre—enough to capture the crown space on possibly 30 percent of the area (fig. 3).

Figure 3.—One of the plots that received no conditioning treatment, as it appeared in the spring of 1960, a few months after seed trees were removed. Note the hardwoods and pulpwood-size pines left in the area.

Figure 4.—One of the plots that had been shelterwood-cut, as it appeared the spring of 1960, a few months after seed trees were removed. Note the absence of residual pines and hardwoods as compared to figure 3.



Treatment effects on numbers of 1- to 3-inch hardwoods in 1960 were somewhat different, mainly because trees in this size category were not poisoned. (Poisoning in 1957 was restricted to 3-inch and larger trees, and most of the 3-inch trees of 1960 presumably were less than 3 inches in diameter in 1957.) So, the 1- to 3-inch hardwoods present in 1960 reflect the single and combined effects of only the burning and cutting treatments, namely: fewest trees in the combination treatment, most trees in the untreated controls (fig. 5), and intermediate numbers of trees

Figure 5.—A thicket of small hardwoods and shrubs, relatively undisturbed by the harvest cuttings. Three years after seed trees were removed, such thickets were most common in plots that had received no conditioning treatments, although a few occurred also in the shelterwood-cut plots.

in the two single treatments. Although hardwoods of this size cannot so quickly expand their crowns and prevent pine reproduction in openings from becoming dominant, their lead is sufficient that nearby pines often will be unable to overtake them.

From 1960 through 1962, most of the differences in hardwood competition continued to be in stems larger than 0.5 inch d.b.h.; however, some residual effects of the conditioning treatments on amounts of smaller growth were apparent, particularly between burned and unburned plots. On the unburned plots, especially the check plots, dense brushy hardwood thickets often occupied spots where little or no logging disturbance had occurred (fig. 5). Although some 1- to 3-inch stems commonly were present, the distinguishing characteristic of the thickets was a dense growth of smaller material. Such thickets seriously interfere with establishment and growth of pine reproduction. Similar thickets had not developed on the burned plots.

The extent to which the larger residual hardwoods and thickets of smaller hardwood growth dominated the sites after harvest cutting varied both among and within treatments. Some spots and small patches that were sufficiently open to permit successful pine regeneration could be found in all plots. However, only in the combination conditioning treatment was well distributed, free-to-grow pine reproduction established in 1962 over plot areas as a whole (fig. 6).

Discussion

There is little reason to be concerned about advance pine reproduction in Eastern Shore pine stands similar to the stand used for this study. When such stands are cut heavily, logging damage will eliminate the bulk of the advance reproduction, and mortality will be high among seedlings that do survive the logging because of damage by Pales (and possibly other) weevils.

Damage by these weevils is greatest on small established seedlings or on newly planted seedlings; damage to seedlings during their first year from seed is negligible (7). Observations on the

Figure 6.—Well distributed, free-to-grow pine reproduction characteristic of plots that had received the combination of conditioning treatments. View below was taken 3 years after seed trees were removed.

Eastern Shore indicate that the damage is most important in areas planted within a few months after cutting, and where heavy reliance on pine regeneration is placed on the planted seedlings.

To bypass the problems of logging and weevil damage to advance reproduction, regeneration after logging seems logical. A simple and practicable way to obtain this regeneration is by use of seed trees. In this study, although the 1958 crop of pine seed was very light, 6 seed trees per acre still provided more than 2,000 seedlings per acre, and stocked 75 to 82 percent of the milacre quadrats. The good 1959 seed crop raised the number of pine seedlings to 7,000 or more per acre, and the stocking to

93 to 97 percent. Despite the usual ups and downs in pine seed crops that are typical of most forest trees, we believe that seed-tree cuttings similar to those used in this study will practically always provide more than enough pine reproduction.

Conditioning stands for regeneration before the final harvest cutting is advisable even though most of the resultant advance pine reproduction does not survive. There are several reasons for this conditioning:

1. Most important is the fact that, with adequate conditioning, little work will be needed after the cutting to regenerate another pine stand. Furthermore, conditioning treatments can be made with less regard to specific timing than in the treatment of already cutover areas.

2. Conditioning—assuming it includes as an integral part a pulpwood cutting of the smaller trees in advance of the main harvest cutting for sawlogs or piling—salvages trees that otherwise would die before the final cutting and, moreover, the pulpwood will often pay the cost of other cultural measures. Mortality among the smaller (overtopped and intermediate) trees of pulpwood size in mature or nearly mature pine stands is considerable. In our study, 5 percent of the overstory pines died during the first 4 years, before any cutting was done; during the next 2 years, after the shelterwood cuttings were made, mortality was 3.7 percent in the uncut plots and 1 percent in the cut plots. Furthermore, when no advance cutting for pulpwood is done, many of the smaller living trees are broken or otherwise damaged in logging the larger trees. And, if left standing after a commercial clearcutting, these smaller trees—damaged or not—grow but slowly and suffer high mortality: in one study 31 percent of such stems died in 4 years and survivors grew only 0.6 inch in diameter; the net change in basal area was a loss of 19 percent (4).

3. Conditioning that includes both an advance cutting for pulpwood and measures to reduce the undergrowth improve logging conditions for the final harvest cutting and can be expected to induce operators to pay a higher price for the stumpage. A similar

conclusion has been reached in South Carolina: there logging costs in a relatively brush-free area in a loblolly pine stand were $2.29 less per thousand board feet of sawlogs, and $1.50 less per cord of pulpwood, than in an untreated part of the same stand (*6*).

In conditioning Eastern Shore pine stands for regeneration, the emphasis should be on reducing hardwood trees and shrubs. As this study shows, stimulation of cone production and seedbed improvement usually are not as important as providing conditions that are open enough to enable pine seedlings to gain dominance. A partial exception to the above may be found in very dense, previously unthinned stands. There a light cutting of sawlog or piling trees from the upper canopy, done at least 3 years before the seed-tree cutting, would be advantageous for stimulating cone production.

Several alternative methods are available as conditioning treatments. Some of those methods are quite new and were not accepted practices on the Eastern Shore when the present study was designed. For killing relatively large hardwoods, recently tested injector treatments (*1*) are more effective than the ax-frill techniques formerly used. For eliminating small hardwoods, the light winter fires of this study were adequate, but even better kills probably could be achieved by either repeated summer fires, as used by Lotti et al. (*6*), or by mistblower treatment with 2,4,5-T (*2*). Disking is another possible treatment, but this is less generally useful because overstory trees often are so dense that a tractor-disk outfit cannot be maneuvered effectively, and also because even the heavier disks eliminate relatively few stems in dense hardwood thickets.

Summary

In 1952 a study of prescribed winter burning and shelterwood cutting for regenerating loblolly pine was started in a commercially mature pine stand on the Eastern Shore of Maryland. Burns were made in March 1953 and April 1956. The shelterwood cutting was a commercial cutting of pine pulpwood early in 1957, followed by the poisoning of hardwoods 3 inches d.b.h. and larger. Then, in the fall and winter of 1958-59, all plots received a seed-tree cutting, and in the following November the seed trees were removed.

This report summarizes results through the second growing season after the seed trees were cut. It shows that, although the amount of advance reproduction of loblolly pine can be increased by prescribed winter burning and shelterwood cutting, little of it will survive the disturbances caused by logging a heavy timber stand. However, leaving seed trees for 1 year after cutting should usually give sufficient regeneration—in this study about 2,000 seedlings per acre were present in 1959, and 7,000 to 9,200 per acre in 1960.

Conditioning treatments applied in advance of the main harvest cutting are of value mainly for improving conditions for pine regeneration that starts after the cutting, thereby increasing the proportion of pine in the next stand. Treatment benefits come about largely from reduction of the hardwood competition. Winter fires can greatly reduce the number of small hardwoods, particularly those smaller than 2 inches in diameter. Poisoning can eliminate the larger ones. A shelterwood cutting of pulpwood-size pines done in advance of the main harvest cutting will further reduce understory hardwoods, and also salvage many trees that otherwise would be lost by natural mortality or by breakage during the main cutting. Moreover, the pulpwood usually will pay for the burning and chemical treatments. Without conditioning treatments, the next stand will probably be about a 50-50 pine-hardwood mixture; with adequate conditioning before the main harvest cutting, the next stand should run 85 to 90 percent pine.

Literature Cited

(1) Little, S.
1963. Injector treatments for killing New Jersey and Eastern Maryland hardwoods. Northeast. Weed Control Conf. Proc. 17: 494-501.

(2) ________
1963. Mistblower treatments in regenerating preferred species in the forests of New Jersey, Eastern Maryland, and Eastern Pennsylvania. Northeast. Weed Control Conf. Proc. 17: 517-526.

(3) ________and J. J. Mohr.
1954. Reproducing pine stands on the Eastern Shore of Maryland. U.S. Forest Serv. Northeast. Forest Expt. Sta., Sta. Paper 67. 11 pp.

(4) ________and J. J. Mohr.
1957. Growth and mortality of residual loblolly pines after a seed-tree cutting. U.S. Forest Serv. Northeast. Forest Expt. Sta. Res. Note 75. 4 pp.

(5) ________and J. J. Mohr.
1957. Seedbed treatment increases dominance of natural loblolly pine reproduction. U.S. Forest Serv. Northeast. Forest Expt. Sta. Res. Note 76. 4 pp.

(6) Lotti, T., R. A. Klawitter, and W. P. LeGrande.
1960. Prescribed burning for understory control in loblolly pine stands of the coastal plain. U.S. Forest Serv. Southeast. Forest Expt. Sta., Sta. Paper 116. 19 pp., illus.

(7) Thatcher, R. C.
1960. Influence of the pitch-eating weevil on pine regeneration in East Texas. Forest Sci. 6: 354-361, illus.

Appendix

Table 1.—*Stand composition at start of study, in number of stems per acre*[1]

Species	Size class, inches d.b.h. Less than 0.6	1-2	3-5	6-10	11-20	Total
Pines	1,208	0	1	133	112	1,454
Black oaks	371	5	—	—	—	376
White oaks	117	2	—	2	—	121
Sweetgum	821	111	32	12	3	979
Red maple	2,862	583	70	4	—	3,519
Blackgum	250	114	2	1	—	367
Holly	429	106	16	—	—	551
Sweetbay	146	16	—	—	—	162
Yellow-poplar	—	1	—	1	—	2
Redcedar	—	7	3	—	—	10
All hardwoods	4,996	938	120	20	3	6,077
All species	6,204	945	124	153	115	7,541

[1]Values are rounded off, so widely scattered single trees, as of yellow-poplar, do not show in all classes. Includes all stems larger than 0.5 inch d.b.h.; below that size only the largest member of a sprout clump is included, along with all seedlings.

Table 2.—*Pine reproduction in 1952 and 1958, by treatments*

Treatment	1952	1958	Change, 1952-58
NUMBER OF SEEDLINGS PER ACRE			
Prescribe-burned and shelterwood-cut	1,050	6,517	+5,467
Shelterwood-cut	1,733	2,633	+900
Prescribe-burned	416	2,133	+1,667
None	1,633	1,033	—600
PERCENT OF MILACRE QUADRATS STOCKED			
Prescribe-burned and shelterwood-cut	37	93	+56
Shelterwood-cut	47	68	+21
Prescribe-burned	18	72	+54
None	45	38	—7

Table 3.—*Advance pine reproduction before the seed-tree cutting, just after the cutting, and at the end of the first growing season*

Treatment	Advance reproduction per acre			Milacre quadrats stocked		
	Before cutting	Just after cutting	After the first growing season	Before cutting	After cutting	After one growing season
	No.	*No.*	*No.*	%	%	%
Prescribe-burned and shelterwood-cut	6,517	500	283	93	32	22
Shelterwood-cut	2,633	117	67	68	7	3
Prescribe-burned	2,133	100	0	72	8	0
None	1,033	33	33	38	3	3

Table 4.—*Number of hardwood trees per acre, by size class, treatment, and year*

Year	Size class, inches d.b.h. Less than 0.6*	1-2	3-5	6+	All sizes
	PRESCRIBE-BURNED AND SHELTERWOOD-CUT				
1952	4,900	821	146	30	5,897
1958**	13,500	62	52	33	13,647
1959**	8,833	14	7	4	8,858
1960**	7,567	33	8	2	7,610
Change, 1952-60	+2,667	—788	—138	—28	+1,713
	SHELTERWOOD-CUT				
1952	5,917	1,030	122	22	7,091
1958**	7,200	578	69	22	7,869
1959**	7,700	62	7	3	7,772
1960**	6,050	79	9	2	6,140
Change, 1952-60	+133	—951	—113	—20	—951
	PRESCRIBE-BURNED				
1952	4,000	1,044	114	16	5,174
1958	5,917	159	137	21	6,234
1959	11,917	26	71	13	12,027
1960	10,567	43	64	16	10,690
Change, 1952-60	+6,567	—1,001	—50	0	+5,516
	NO TREATMENT				
1952	5,167	860	103	17	6,147
1958	4,633	911	125	26	5,695
1959	10,817	115	70	16	11,018
1960	10,233	119	69	18	10,439
Change, 1952-60	+5,066	—741	—34	+1	+4,292

*Seedlings and sprout clumps.
**Includes poisoned trees that showed any life above breast height.