COMPARING ALTERNATIVE SLASHING TECHNIQUES ON A MIXED HARDWOOD FOREST: 2-YEAR RESULTS

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Abstract-Regenerating commercially important species following the harvest of an existing mixed hardwood stand requires adequate advance regeneration of the desired species and control of competing vegetation. These objectives can be achieved by removing the noncommercial stems before or after harvesting. This study was designed to evaluate the efficacy of pre- and post harvest slashing alternatives and to assess cost differences between the alternatives. Four treatments (pre- and postharvest slashing, with and without herbicide stump treatment) and a control were selected. Each treatment was applied to a 120 feet x 120 feet plot within which measurements were taken on four l/l 0-acre subplots. Each treatment was replicated six times within the harvest area, resulting in a total study area size of 9.9 acres. Preliminary results indicate that there was little difference between treatments in the total number of stems.

INTRODUCTION

A primary concern in harvesting mixed hardwood stands in the central hardwood region is ensuring adequate regeneration of the preferred commercially important species such as oak. Often competition from undesirable trees is too great for the commercially important species to overcome.

One means of enhancing oak regeneration is to control the competing species by slashing either prior to or immediately following harvest operations. Little information is available, however, to assess the relative effectiveness of the various slashing alternatives. Loftis (1978, 1985) evaluated the effectiveness and costs associated with preharvest treatments in southern Appalachian hardwoods. The results suggest that four years after clearcutting, preharvest treatments reduce the number of stems of undesirable species and increase the portion of desirable species in the stand. Ten years after clearcutting, stands that had received preharvest treatments were dominated by single stems of desirable species and stocking was excellent. Stands treated after the harvest operation contained a smaller percentage of desirable stems.

The research reported by Loftis used the postharvest treatments as a check on the effectiveness of the preharvest treatments. Moreover, only preharvest treatments involved herbicide applications. The purpose of our study was to evaluate how a stand developed after clearcutting when a variety of pre- and postharvest treatments were applied.

OBJECTIVES

The primary goal of the study was to evaluate alternative slashing techniques following harvest in a mixed hardwood forest. Specific objectives were to 1) assess the effect of pre- and post-harvest slashing and herbicide stump treatment of noncommercial stems on species composition flowing a silvicultural clearcut and 2) compare the costs associated with the pre- and post-harvest treatments.

METHODS

The site selected for the study is located on the Oak Ridge Forestry Experiment Station and consists of a 17-acre watershed. Elevations in the south-facing drainage range from 970 to 1100 feet above sea level. The harvested forest was comprised primarily of oaks (59 percent), yellow-poplar (*Liriodendron tulipifera*) (14 percent), miscellaneous hardwoods (10 percent), and pine (6 percent).

Five treatments were developed forcomparison in the study:

1 Preharvest Slash only
2 Preharvest Slash with Herbicide Stump Treatment
3 Postharvest Slash only
4 Postharvest Slash with Herbicide Stump Treatment
5 Control.

The five treatments were applied to 120 feet x 120 feet (0.331-acre) plots within the watershed. This plot size was large enough to distinquish individual treatments from surrounding treatments while allowing for several replications within the 17-acre study area. Each set of five treatments form a replication.

The 0.331-ac plots were located in the study site with the northwest corner serving as the starting point. From this point, the northwest corner of the initial plot was located approximately 25 feet to the southeast. Subsequent corners were located at 120-foot intervals by traveling on lines parallel and perpendicular to the initial line. A total of

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Table l-Species distribution by treatment, all stems, 1998

Species	Preharvest Slash	Preharvest Slash Herbicide	Postharvest Slash	Post-Harvest Slash & Herbicide	Control
Yellow-poplar	49.9	36.6	36.6	30.9	37.5
Red Maple	16.0	23.0	18.9	15.5	16.8
White Oak	2.1	2.8	2.9	2.6	3.3
Red Oaks	2.3	2.8	2.2	3.5	1.9
Blackgum	9.6	7.5	11.8	5.7	6.5

30 plots were identified in the study site, representing 6 replications.

Within each plot, four l/1000-acre subplots were established for intensive sampling. These were located by running a line south 13 degrees east from the northern corner of each plot to establish the first subplot center. The remaining three center points were located by running a 60-foot line parallel to the boundary lines.

Plots were assigned to different replications by establishing groups of plots that were similar in terms of species composition, density, and location. A computer-generated design for incomplete blocks developed by Arnold Saxton of the Tennessee Agricultural Experiment Stations was used to assign treatments to plots.

The initial inventory was conducted on June 18-21, 1996. The inventory included all merchantable timber from 6 inches in DBH and above, with all sawtimber size hardwoods graded. All trees were measured within the subplots regardless of size during the last two weeks of September 1996. Data were recorded by 1 foot height classes up to 4 feet. Trees taller than 4 feet were classified into less than 1.5 inches DBH or larger than 1.5 inches DBH (exact DBH was recorded for this class).

Preharvest slashing was conducted on the designated plots during the first two weeks of October 1996. All stems greater than 1 foot in height were treated. On each plot, starting and ending times for treatment were recorded. The number of stems cut per plot was recorded as stems greater than or less than 1.5 inches DBH. Garlon 3A 50/50 with water and red dye was used on all noncommercial stumps in the plots designated as preharvest slashing and herbicide stump treatment. Start and stop times were recorded for herbicide application as well as the amount of herbicide used and the number of stumps treated.

The timber harvest operation was conducted from February 5 to April 30, 1997. Approximately 118.9 MBF (Doyle) of hardwood sawtimber, 7.0 MBF of pine sawtimber, 29.2 cords of hardwood pulpwood, and 9.0 cords of pine pulpwood were removed.

Postharvest slashing was conducted on the designated plots on August 1, 1997, with start and stop times recorded as well as the number of stems cut per plot. The stems were categorized by DBH (less than or greater than 1.5 inches). Postharvest slashing and herbicide treatment plots were treated on August 15, 1997. The stump treatment consisted of Garlon 4 50/50 with oil and red dye. As with the preharvest treatments, start and stop times were recorded for herbicide application as well as the amount of herbicide used and the number of stumps treated.

All subplots were remeasured two years after harvest (summer 1998) to assess the effectiveness of the various treatments. Similar data were collected as described above for initial measurements of the treatment plots: species and number of stems by height class up to 4 feet and by diameter class of stems greater than 4 feet.

Table 2-Species distribution by treatment, stems > 4 feet, 1998[a]

Species	Preharvest Slash	Preharvest Slash & Herbicide	Postharvest Slash	Postharvest Slash & Herbicide	Control
Yellow-poplar	22.8a	20.8ab	12.6c	15.8c	14.3c
Red Maple	13.1a	23.0b	18.9a	15.5a	25.5a
White Oak	0.2ab	0.2ab	0.6bc	0.7c	O.la

[a] Similar letters represent percentages that are not significantly different at a = 0.05.

Table 3—Average activity by treatment

Treatment	Cutting (# trees/acre)	Herbicide (# trees/acre)	Time (minutes)	cost ($/acre)
Preharvest	948		129	$25.65
Preharvest/Herbicide	1383	607	310	$94.39
Postharvest	308		121	$19.69
Postharvest/Herbicide	426	387	216	$57.64

RESULTS AND DISCUSSION

The results of the two-year data suggest that the four treatments may vary in their effects on species composition, although statistical analysis reveals few significant results. Table 1 depicts the total number of stems by major species that were counted on the subplots. Few discernible differences were identified by this preliminary analysis. Yellow-poplar and red maple *(Acre rubrum)* were the predominant species for all treatments and the control plots. Oaks comprised less than 7 percent of the stems for all treatments. Plots with herbicide treatments (both pre- and postharvest) contained a **larger** component of oaks than the control or non-herbicide treatments.

Examining species composition differences among the larger stems (> 4 feet) revealed some statistically significant differences among treatments. Table 2 lists the percent of all stems counted for the species of primary interest by treatment type. Preharvest treatments resulted in a significantly larger portion of the stems being comprised of yellow-poplar saplings. Conversely, postharvest treatments contained a significantly larger percentage of large white oak saplings than the control or preharvest treatments.

The cost results reveal that the preharvest treatments were significantly more expensive than the post harvest treatments for both non-herbicide and herbicide alternatives (table 3). These results are similar to those reported by Loftis (1978) and can be explained by the level of activity required in each plot. The work crews treated more than 3 times as many stems in the preharvest plots than they recorded in the postharvest plots. The harvesting activity resulted in many of the stems in the postharvest plots being severed before treatment was applied. As a consequence, less work was required after harvest-which reduced the costs considerably. Loftis (1978) noted, however, that an equally effective alternative could have been employed that would have reduced the preharvest treatment costs substantially. In the Oak Ridge study, similar modifications in the treatments would reduce costs as well.

No conclusions can be drawn, however, regarding the cost-effectiveness of the alternatives. Although the preliminary results suggest that postharvest treatments have resulted in desirable species comprising a greater **percentage of** the larger stems than in the preharvest treatments, it is too early to conclude that this will continue throughout the life of the stand. Loftis (1985) reported that desirable stems in plots receiving postharvest treatments were beginning to be replaced by undesirable sprouts **in many instances by** year 10. If similar patterns emerge in the Oak Ridge stand, the cost-effectiveness of the alternatives could change significantly.

REFERENCES

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