REGENERATION RESPONSE TO MIDSTORY CONTROL FOLLOWING LONG-TERM SINGLE TREE SELECTION MANAGEMENT OF SOUTHERN APPALACHIAN HARDWOODS

Jason R. Lewis, John W. Groninger, and David L. Loftis[1]

Abstract—Sustainability of the single tree selection system in the mixed hardwood forests of the southern Appalachians is compromised by insufficient recruitment of oak species. In 1986, portions of a stand at Bent Creek Experimental Forest that have been under single tree selection management since 1945 were subjected to a midstory herbicide treatment in an effort to improve the competitive status of oak species. Regeneration density of oak species and red maple, the primary competitor species, were measured in the treated stand and an untreated control in 2003. The results of this study suggest the potential for oak recruitment has been increased by the herbicide treatment.

INTRODUCTION

In the southern Appalachian Mountains, single tree selection may be implemented to balance esthetic and timber production concerns. Long-term use of this system on productive sites may lead to decreased dominance of oak species in younger age classes at the expense of shade tolerant tree species. Red maple, in particular, has been widely observed to increase in dominance in partially cut stands (Abrams 1998). Red maple seedlings and saplings may form a subcanopy to the exclusion of oak and other less shade tolerant tree species. Midstory control with herbicides has been implemented in Appalachian hardwoods stands with short-term evidence of success in promoting the growth of shade intolerant species (Kochenderfer and others 2001). However, the long-term impact of this treatment has not been reported.

The objective of this study was to evaluate the effects of a single midstory herbicide treatment on the development of regeneration in a Southern Appalachian hardwoods forest under long-term single tree selection management.

METHODS

Site History

The treated and untreated compartments in this study are part of the farm woodlots at the Bent Creek Experimental Forest near Asheville, NC. The farm woodlots were installed in 1945 in order to examine the economic returns from periodic small harvests (Della-Bianca and Beck 1985). Most of the early harvests were improvement cuts with large numbers of defective or poorly formed trees being removed (McGee 1970).

Throughout the 1960s and 1970s, the site was managed exclusively under the single tree selection system. All cuts were made to adhere to de Liocourt's diameter distribution for unevenaged stands (McGee 1970). Little attention was paid to the species composition of the regeneration. The last harvest of overstory trees occurred in 1983. In 1986, an experiment was installed to improve the species composition of the regeneration by creating better growth conditions for oak species. The experiment was conducted on two compartments, each roughly 30 acres in size with similar soils and slope position (Beck and Della Bianca 1985). One compartment received an herbicide treatment of the undesirable midstory species while the other remained untreated.

Data Collection and Analysis

Regeneration was sampled in fall, 2003. Thirty 0.01-acre plots were established in each compartment for a total of 60 plots. Trees were identified by species, and height was measured for all individuals between 1- and 20-feet tall. Diameter was determined on all individuals > 1.0 inches d.b.h.

Shannon's index of diversity and means for regeneration data were calculated for each sample plot. Treatment differences in diversity and regeneration density were evaluated using a t-test with $\alpha < 0.05$.

RESULTS AND DISCUSSION

The herbicide treatment generally improved the competitive status of oak saplings relative to red maple. Oak density was significantly greater than that of red maple in the 1-, 2-, and 3-inch diameter classes in the herbicide treatment (figs. 1 and 2). Red maple density was reduced by the herbicide treatment, with significant differences recorded in the 2- and 3-inch d.b.h. classes. Total oak sapling density was low, however, even in the treated stand, averaging 30 trees per acre in the 1-, 2-, and 3-inch size classes combined.

Among individuals in the ≤ 10 feet height classes, no significant treatment differences were detected in the number of oak or red maple stems (figs. 3 and 4). However, a trend toward higher numbers was evident in the herbicide treatment for oaks in the ≥ 4 feet size class and for red maple in all size classes. Red maple density was generally higher than oak in all but the smallest height classes.

Shannon's index of diversity was unaffected by the herbicide treatment, averaging 1.72 and 1.68 for the treated and untreated sites, respectively.

[1] Graduate student and Associate Professor, respectively, Department of Forestry, Southern Illinois University Carbondale, Carbondale, IL 62901; and Project Leader, USDA Forest Service, Southern Research Station, Bent Creek Experimental Forest, Asheville NC 28804.

Citation for proceedings: Connor, Kristina F., ed. 2006. Proceedings of the 13th biennial southern silvicultural research conference. Gen. Tech. Rep. SRS–92. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 640 p.

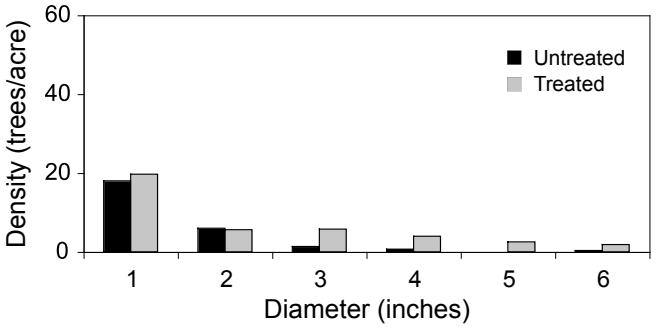

Figure 1—Oak species density response to midstory herbicide control by diameter class.

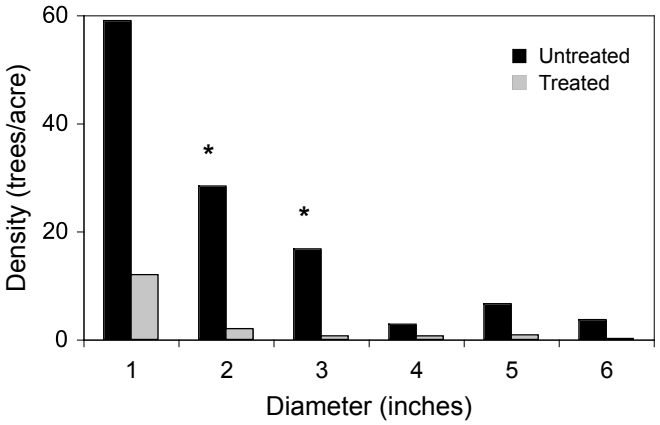

Figure 2— Red maple density response to midstory herbicide control by diameter class. Significant treatment differences within a diameter class are indicated by an asterisk.

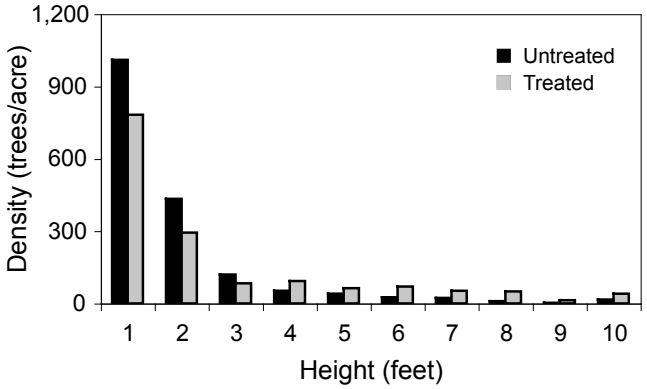

Figure 3—Oak species density response to midstory herbicide control by height class.

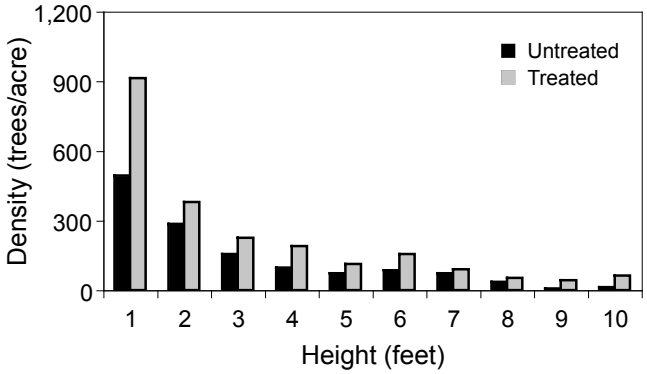

Figure 4—Red maple density response to midstory herbicide control by height class.

CONCLUSIONS

The herbicide treatment improved the competitive status of oak species relative to red maple. However, red maple remained a common component of the seedling and sapling size classes. Follow-up midstory treatments or overstory removal could allow larger oak stems to approach overstory status. Under this scenario, oak recruitment would be more likely to occur in the treated stand. In the absence of further midstory or canopy disturbance, the competitive status of oak is likely to decline at the expense of the more shade tolerant red maple. The cessation of overstory removal treatments since 1983 is inconsistent with typical single tree selection management scenarios and may be at least in part responsible for dampening the tree growth response to the herbicide treatment.

LITERATURE CITED

Abrams, M.D. 1998. The red maple paradox. Bioscience. 48: 355-365.

Della-Bianca, L.; Beck, D.E. 1985. Selection management in southern Appalachian hardwoods. Southern Journal of Applied Forestry. 9: 191-196.

Kochenderfer, J.D.; Zedaker, S.M.; Johnson, J.E. [and others]. 2001. Herbicide hardwood crop tree release in central West Virginia. Northern Journal of Applied Forestry. 18: 46-54.

McGee, C.E. 1970. Regeneration of the Bent Creek farm woodlot. Office Report. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station, Bent Creek Experimental Forest. 19 p.