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Stand Response of 16-Year-Old Upland Hardwood Regeneration to Crop-Tree Release on a Medium Quality Site in the Southern Appalachians after 24 Years

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Abstract

A crop tree release was made in a 16-year-old upland hardwood stand on a medium-quality site using one of two treatments: mechanical or chemical. After 24 years there was no significant difference in stand response between the two treatments as measured by mean increase in stand diameter, basal area, total height, height to base of live crown, or clear bole length.

Keywords: Appalachian hardwoods, chemical release, hardwood silviculture, mechanical release, precommercial thinning, upland oaks.

Introduction

The response by commercial species to various types and levels of crop tree release[2] has been well documented (Perkey and others 1994). Mechanical methods are usually used, but chemical treatment may be desirable where aggressive sprouting and regrowth from the cut stems could reduce the long-term response to release by the crop trees. Much information is available on the response of species and the amount of release for individual trees, but less is known about the long-term advantage of the method of controlling competition in stands. This note reports results of a long-term study comparing mechanical with chemical methods of crop tree release.

Materials and Methods

The study was installed in the Bent Creek Experimental Forest (35.50°, 82.625°), about 10 miles southwest of Asheville, NC, in the Southern Appalachian Mountains. The study was installed in a 16-year-old stand of stump sprouts and advance regeneration that originated from clearcutting a predominantly shortleaf pine (*Pinus echinata* Mill.) stand with a midstory of mixed hardwoods. The major arborescent component consisted mostly of oaks (*Quercus* spp): scarlet (*Q. coccinea* Muenchh.), black (*Q. velutina* Lam.), and white (*Q. alba* L.). Minor canopy and midstory species included red maple (*Acer rubrum* L.), sourwood [*Oxydendrum arboreum* (L.) DC.], and blackgum (*Nyssa sylvatica* Marsh). Productivity of the study area is moderate; site index at 50 years ranges from 65 to 75 feet for upland oaks.

Four 1-acre treatment plots were located near one another in an area of relatively uniform site quality. Each plot was subdivided into a grid of 56 subplots. The best potential crop tree, ideally an oak of dominant or codominant (DC) crown class, was identified in each subplot. A desirable intermediate or suppressed (IS) tree was selected when a DC was not present. Each crop tree was completely released, i.e., crown touching on all sides, in May 1985 using one of two treatments: mechanical (chainsaw felling) or chemical (injection with 2, 4-D+Picloram), depending on which treatment was assigned to that plot. Untreated (control) plots were not used because the study objective was to determine the differential response of the 1-acre stand of crop trees to the method of release and not to determine the amount of response of individual trees to release; a study to address that question was underway in a similar stand on a nearby site (Meyers and others 2008). Response variables measured on each crop tree included diameter at breast height (d.b.h.), total height, height to base of live crown, and length of clear bole; stand basal area was calculated from d.b.h. of crop trees on each plot. The study design was completely randomized with two replications of each treatment. Analysis of variance was used to test for significant

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[2] Crop tree release is a cultural treatment, similar to thinning, to free selected trees of the future harvest from competing vegetation with goals of increasing growth and quality. The two most commonly used methods to release crop trees from competition are chemical (herbicide injection) and mechanical (chainsaw girdling or felling).

differences (P ≤0.05) between treatment means of the five variables after 24 years of response to the two methods of crop tree release. Equality of variances was determined using Bartlett's test (P ≤0.05).

Results and Discussion

Stand responses to crop tree release were mixed for the two treatments (table 1), but all differences in responses between the two treatments were small and of little practical importance. D.b.h., basal area, and clear bole increment were greatest for the chemical treatment, but increase in total height and height to base of crown were best for the mechanical treatment. Neither method of crop tree release resulted in a significant difference for any of the measured response variables.

Uniform spacing required occasional selection of IS crop trees. When released, the IS trees received full light from all sides and were reclassified as DC. Thirty percent (68) of the total 224 crop trees in the study were classified initially as IS (table 1, footnotes c and d). Overall crop tree mortality was 5 percent and was slightly higher for DC trees (8 percent) than for IS (4 percent). At the end of the study, 30 percent of the surviving crop trees were also classified as IS. However, 28 of the original 68 IS crop trees had increased their crown position to DC during the 24 years since their release, but a similar number decreased from DC to IS.

In summary, results of this study suggest the response of crop trees to release on medium-quality sites is similar if the competition is controlled by either mechanical or chemical methods.

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The study was designed by Donald E. Beck, Research Forester, and installed by Ralph M. Hooper, Lead Forest Technician. Jacquelyne Adams, Forestry Technician, relocated the study plots and collected the final field data. All personnel are with the Southern Research Station.

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Table 1—Mean ± SE of initial stand response variable and increment 24 years after 16-year-old upland hardwood crop trees were released using two treatments on a medium quality site

	Initial value by treatment[a]		Total increment by treatment[b]	
Stand response variable	Chemical[c]	Mechanical[d]	Chemical	Mechanical
Diameter breast height (inches)	3.75 ± 0.05	3.55 ± 0.25	4.70 ± 0.30	4.40 ± 0.20
Stand basal area (feet^2/acre)	4.70 ± 0.10	4.25 ± 0.55	17.60 ± 1.30	16.40 ± 1.40
Total tree height (feet)	27.75 ± 1.35	27.60 ± 1.70	25.95 ± 0.25	26.95 ± 0.75
Height to base of crown (feet)	12.20 ± 1.60	12.30 ± 1.60	12.85 ± 1.05	13.45 ± 1.95
Clear bole length (feet)	0.95 ± 0.15	1.40 ± 0.50	11.45 ± 0.95	10.75 ± 0.25

[a] Except for basal area, values were the mean of the living crop trees selected on each 1-acre treatment plot; basal area was the total of the living crop trees on each treatment plot.

[b] Analysis of variance indicated no significant differences (P ≤0.05) between the two treatments for any of the stand response variables.

[c] In 1984, the crown class of 27 of the total 112 crop trees was classified as intermediate or suppressed; in 2008, 28 of the 104 surviving trees were so classified.

[d] In 1984, the crown class of 41 of the total 112 crop trees was classified as intermediate or suppressed; in 2008, 35 of the 108 surviving trees were so classified.