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Response to Crop-Tree Release: Sugar Maple, Red Oak, Black Cherry, and Yellow-Poplar Saplings in a 9-Year-Old Stand

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ABSTRACT

Crop trees were released in an Appalachian hardwood stand (site index 70 for northern red oak) that had been clearcut 9 years earlier. We released 134 yellow-poplar, red oak, black cherry, and sugar maple stems of seedling origin to a 5-foot radius around the bole of each study tree; 140 comparable stems were not released. These trees were dominant, codominant, or intermediate, and all treated trees were released to a dominant crown position.

On the basis of results 5 years after treatment, we do not recommend releasing crop trees of seedling origin for the species, site, and methods used in this study. Also, grapevines seriously damaged about one out of four trees that were living 5 years after treatment.

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INTRODUCTION

THE RESPONSE of 7-year-old crop trees to release on excellent sites (site index 80 for northern red oak) and on fair sites (site index 60) was discussed by Trimble (1973, 1974a), In this paper we discuss the response to the release of young hardwood crop trees of seedling origin in a 9-year-old clearcut stand on a good site (site index 70) in the central Appalachians.

We used a 9-year-old clearcut area because, for this particular stand, 9 years was the earliest age at which the stand canopy closed and crown classes could be distinguished. By selecting and releasing crop trees at an early age, it may be possible to control species composition and increase the growth of the most merchantable trees.

DESCRIPTION OF THE AREA

The study was made on the Fernow Experimental Forest near Parsons, West Virginia. The soil is a well-drained Calvin channery silt loam derived from sandstone and shale. The elevation of the study area is about 2,000 feet, and the slope is about 40 percent. Annual precipitation averages 58 inches; the annual frost-free period is about 135 days.

The 9-year-old stand developed after a 55-year-old, well-stocked, unmanaged 12-acre stand was clearcut. An average of 10,600 board feet (International 1/4-inch rule) of sawtimber per acre had been removed; all stems 2.0 inches in diameter at breast height (dbh) and larger had been cut.

METHODS

Four species were studied: yellow-poplar (*Liriodendron tulipifera* L.); northern red oak (*Quercus rubra* L.); black cherry (*Prunus serotina* Ehrh.); and sugar maple (*Acer saccharum* Marsh.). For each species we selected 11 to 40 well-formed, vigorous trees of seedling origin in each of 3 crown classes. Approximately half of the crop trees in each crown class (134) were selected for release; 140 others were not released.

Release consisted of cutting all woody stems that were at least half as tall as the crop trees within a 5-foot radius around each study tree (Figs. 1,2). Grapevines in the crowns of crop trees were cut near groundline.

Figure 1.—A yellow-poplar crop tree of seedling origin before release. The tree is 22 feet tall and is 3 inches in diameter at breast height.

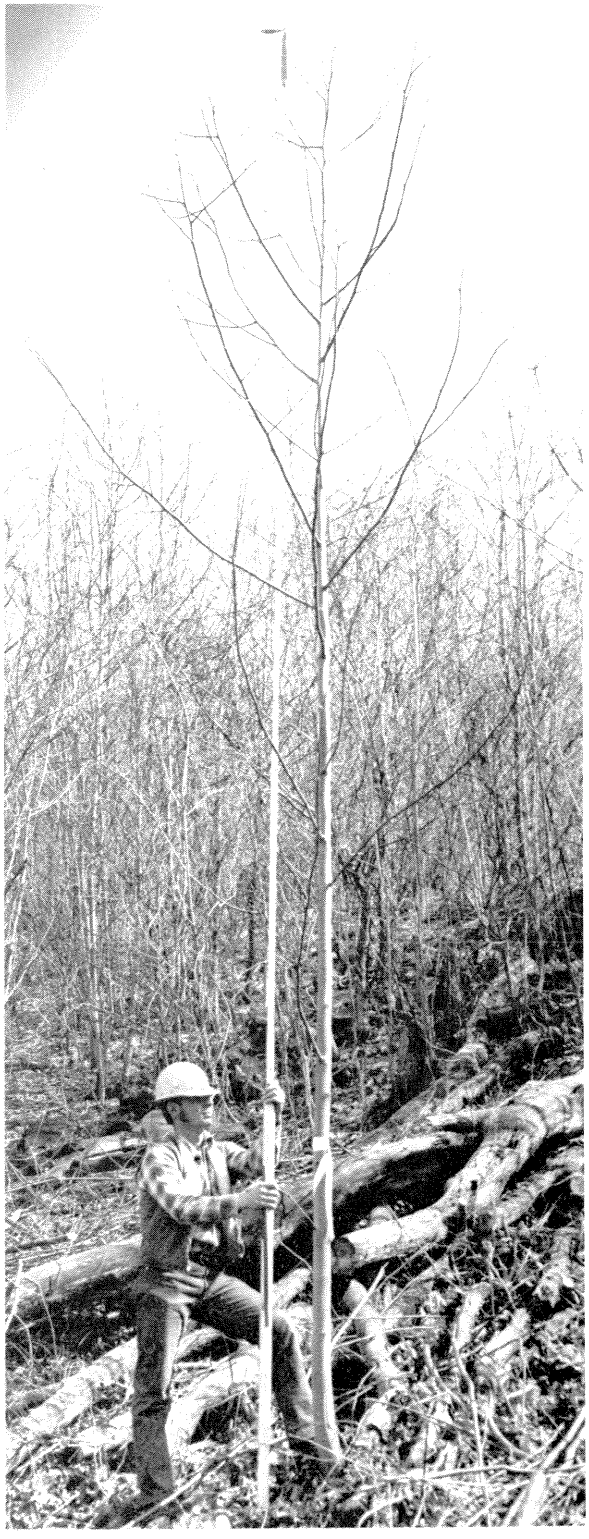

Figure 2.—The same yellow-poplar after release.

Total height, clear bole length, and dbh were measured for each sample tree before treatment, and 5 growing seasons after treatment when the clearcut stand was 14 years old. Five years after treatment, the crown position was reclassified and the study trees were reevaluated as potential crop trees. We used a t-test to determine which differences between treated and control trees were significant at the 5 percent level.

RESULTS

Twenty-one of the 274 crop trees (8 percent) were dead 5 years after treatment; and grapevines severely damaged 64 of the 274 trees (23 percent). This damage included top and limb breakage in addition to the bending of crop trees, resulting in poor stem form and sometimes in death. To distinguish between effects of release and those of grapevine damage, we will first discuss all of the study trees, then the 189 undamaged crop trees that were alive 5 years after treatment, and finally the 64 damaged crop trees.

All trees in the study

Effect on potential crop-tree classification. At age 14, only 64 of the 274 study trees (23 percent) were still considered potential crop trees. This judgement was based on crown class, tree vigor, and stem form. We found that release had not been beneficial—33 of these 64 potential crop trees had not been released (Table 1).

Crop trees not damaged by grapevines

Effect on crown class. Only seven crop trees improved in crown class during the 5-year treatment period; about 80 percent regressed. This was true for both released and nonreleased trees, though all of the treated trees had been released to a dominant crown position (Table 2). Of the 54 originally dominant released and nonreleased trees, 40 (74 percent) were dominant or codominant 5 years after release. However only 21 of the original 81 (26 percent) codominant nonreleased and released study trees were still codominant.

The remaining dominant and codominant trees became intermediate or overtopped, or died. Nearly all of the originally intermediate trees were intermediate, overtopped, or dead 5 years after treatment. Of the 156 originally codominant and intermediate trees, 128 were intermediate, overtopped, or dead.

Effect on height growth. Only the released intermediate red oak and codominant black cherry crop trees had significantly greater height growth than the nonreleased comparison trees (Table 3). But the released dominant yellow-poplar trees grew significantly less than the control trees.

Table 1.—Number of potential crop trees before and 5 years after treatment

Species	Treatment	Dominant		Codominant		Intermediate	
		Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment
Sugar maple	Release	19	8	17	1	15	0
	Nonrelease	11	6	9	1	10	1
Red oak	Release	5	1	20	6	20	2
	Nonrelease	14	8	20	3	13	0
Black cherry	Release	10	5	9	2	3	1
	Nonrelease	12	7	16	3	7	0
Yellow-poplar	Release	5	2	5	3	6	0
	Nonrelease	6	2	10	1	12	1
All species	Release	39	16	51	12	44	3
	Nonrelease	43	23	55	8	42	2

Table 2.—Change in crown class of study trees 5 years after treatment

Crown class before treatment	Treatment	Crop trees at beginning of study	Crown class (5 years after treatment)				Dead
			Dominant	Codominant	Intermediate	Overtopped	
		Number					
		SUGAR MAPLE					
Dominant	Release	9	0	6	0	1	2
	Nonrelease	10	0	7	1	0	2
Codominant	Release	12	0	3	6	2	1
	Nonrelease	5	0	0	1	4	0
Intermediate	Release	13	0	0	3	10	0
	Nonrelease	7	0	1	1	4	1
		RED OAK					
Dominant	Release	2	0	1	1	0	0
	Nonrelease	11	0	8	2	0	1
Codominant	Release	17	0	6	6	4	1
	Nonrelease	16	0	4	9	3	0
Intermediate	Release	18	0	2	5	7	4
	Nonrelease	11	0	0	1	9	1
		YELLOW-POPLAR					
Dominant	Release	5	0	5	0	0	0
	Nonrelease	4	2	1	1	0	0
Codominant	Release	5	2	2	1	0	0
	Nonrelease	9	0	2	3	2	2
Intermediate	Release	6	0	0	1	4	1
	Nonrelease	12	0	1	2	8	1
		BLACK CHERRY					
Dominant	Release	6	1	3	0	0	2
	Nonrelease	7	1	5	0	1	0
Codominant	Release	6	0	2	2	0	2
	Nonrelease	11	0	2	5	4	0
Intermediate	Release	3	0	1	1	1	0
	Nonrelease	5	0	0	0	5	0

Comparisons of height growth for released and control sugar maple and red oak were inconclusive. However in five of six cases the released black cherry and yellow-poplar crop trees grew faster than the control trees. Some of these differences in growth may have been due in part to initial differences in height. Fourteen years after clearcutting, the average height of the tallest sugar maples was about 28 feet; the average height was 26 feet for the tallest red oaks, 32 feet for yellow-poplars, and 34 feet for black cherries.

Effect on diameter growth. The released codominant and intermediate yellow-poplar crop trees had significantly greater diameter growth than the nonreleased trees (Table 4). However, among codominant red oaks, the control trees had significantly less growth than the released trees. The released trees had larger diameter growth than the control trees in 10 of 12 categories for species and crown class.

For red oak and sugar maple, the crop trees that had been in the dominant crown class at 9 years averaged about 2.5 inches in dbh at 14

Table 3.—Average height of study trees before and 5 years after treatment

Crown class before treatment	Treatment	Crop trees living at 14 years	Total height	
			At 9 years	At 14 years
		Number	*Feet*	
		SUGAR MAPLE		
Dominant	Release	7	18.3	28.2
	Nonrelease	8	18.1	28.2
Codominant	Release	11	15.5	24.8
	Nonrelease	5	15.1	21.6
Intermediate	Release	13	13.9	19.1
	Nonrelease	6	13.7	19.8
		RED OAK		
Dominant	Release	2	17.5	27.9
	Nonrelease	10	14.7	25.4
Codominant	Release	16	14.2	23.0
	Nonrelease	16	12.9	22.9
Intermediate	Release	14	12.3	18.3*
	Nonrelease	10	11.5	15.1
		YELLOW-POPLAR		
Dominant	Release	5	13.3	30.1*
	Nonrelease	4	14.1	34.2
Codominant	Release	5	13.8	32.2
	Nonrelease	7	10.9	26.3
Intermediate	Release	5	13.2	23.6
	Nonrelease	11	10.8	18.4
		BLACK CHERRY		
Dominant	Release	4	24.2	39.7
	Nonrelease	7	16.8	30.1
Codominant	Release	4	16.3	32.3*
	Nonrelease	11	15.7	25.9
Intermediate	Release	3	13.6	21.8
	Nonrelease	5	13.2	18.7

* $P<0.05$

years. Similarly, the dominant yellow-poplar and black cherry crop trees averaged about 3.5 inches in dbh.

Effect on length of clear bole. Most of the released trees had shorter lengths of clear bole than the nonreleased trees, but the difference was significant only for codominant red oak and intermediate yellow-poplar trees (Table 5). At the end of the 5-year measurement period, yellow-poplar and black cherry trees that were in the dominant and codominant crown position before release averaged about 13 feet of clear bole; red oak averaged about 12 feet, and sugar maple averaged less than 8 feet.

Crop trees damaged by grapevines

Because grapevines can seriously damage or kill young hardwood trees (Trimble 1974b), we separated the damaged and undamaged crop trees. Although the sample was too small for statistical analysis, certain trends were evident. About 34 percent (64) of the crop trees that were

Table 4.—Average diameter growth of study trees before and 5 years after treatment

Crown class before treatment	Treatment	Crop trees living at 14 years	Dbh	
			At 9 years	At 14 years
		Number	*Inches*	
		SUGAR MAPLE		
Dominant	Release	7	1.3	2.6
	Nonrelease	8	1.4	2.4
Codominant	Release	11	1.2	1.9
	Nonrelease	5	1.1	1.6
Intermediate	Release	13	.9	1.4
	Nonrelease	6	.9	1.4
		RED OAK		
Dominant	Release	2	1.3	2.6
	Nonrelease	10	1.2	2.3
Codominant	Release	16	1.1	2.1*
	Nonrelease	16	1.0	1.7
Intermediate	Release	14	.8	1.3
	Nonrelease	10	.8	1.0
		YELLOW-POPLAR		
Dominant	Release	5	1.1	3.4
	Nonrelease	4	1.1	3.5
Codominant	Release	5	.9	3.1*
	Nonrelease	7	.7	1.9
Intermediate	Release	5	.8	1.7*
	Nonrelease	11	.6	1.1
		BLACK CHERRY		
Dominant	Release	4	2.1	4.6
	Nonrelease	7	1.3	3.0
Codominant	Release	4	1.2	2.6
	Nonrelease	11	1.0	2.0
Intermediate	Release	3	.8	1.5
	Nonrelease	5	.7	1.1

* $P<0.05$

living 5 years after treatment had been severely damaged (Table 6).

The height growth of crop trees damaged by grapevines was lower than that of undamaged crop trees 5 years after treatment. The weighted average height growth for damaged and undamaged trees was: sugar maple: damaged, 4 feet; undamaged, 8 feet; red oak: damaged, 5 feet; undamaged, 10 feet; black cherry: damaged, 9 feet; undamaged, 13 feet. Yellow-poplar was not included in Table 6 because only five trees were damaged.

The effects of grapevines on diameter growth were not as evident as those on height growth; however, in most instances, diameter growth was higher for the undamaged trees. This is particularly true for the trees that already were dominant when they were released.

Because grapevines reduced height growth, the average crown position was also reduced.

Some trees died directly from grapevine damage; 14 years after clearcutting, 70 percent of the crop trees had grapevines in their crowns, and the stand averaged about 1,000 grapevine stems per acre.

SUMMARY

Five years after treatment, 21 of 274 study trees (8 percent) had died; more important, only 64 of these 274 trees (23 percent) were still potential crop trees.

Release did not prevent crown-class regression. Forty of the 54 originally dominant crop trees (22 released; 32 nonreleased) and 21 of the 81 originally codominant crop trees (40 released; 41 nonreleased) were still dominant or codominant 5 years after treatment. But the remaining stems had regressed to intermediate or overtopped crown positions, or had died.

Grapevines had seriously damaged about one-fourth of the 253 study trees that were still alive 14 years after clearcutting; but 70 percent of the study trees had grapevines in their crowns.

Table 5.—Average length of clear bole of study trees before and 5 years after treatment

Crown class before treatment	Treatment	Crop trees living at 14 years	Length of clear bole	
			At 9 years	At 14 years
		Number	*Feet*	
		SUGAR MAPLE		
Dominant	Release	7	4.2	8.0
	Nonrelease	8	3.0	9.4
Codominant	Release	11	3.7	6.8
	Nonrelease	5	2.7	4.9
Intermediate	Release	13	3.8	6.3
	Nonrelease	6	4.3	6.6
		RED OAK		
Dominant	Release	2	7.3	14.0
	Nonrelease	10	5.3	12.5
Codominant	Release	16	5.1	8.8*
	Nonrelease	16	4.9	11.3
Intermediate	Release	14	5.3	9.1
	Nonrelease	10	4.0	8.0
		YELLOW-POPLAR		
Dominant	Release	5	5.3	12.2
	Nonrelease	4	4.6	15.1
Codominant	Release	5	5.3	12.3
	Nonrelease	7	5.1	13.3
Intermediate	Release	5	5.5	6.7*
	Nonrelease	11	4.8	9.0
		BLACK CHERRY		
Dominant	Release	4	4.9	12.7
	Nonrelease	7	6.0	12.6
Codominant	Release	4	6.4	16.1
	Nonrelease	11	4.7	13.3
Intermediate	Release	3	3.8	8.6
	Nonrelease	5	4.8	7.8

* $P<0.05$

Table 6.—Effect of grapevine damage on average height and diameter growth of study trees 5 years after treatment

Crown class before treatment	Treatment	Study trees		Height growth at 14 years		Dbh growth at 14 years	
		Undamaged trees	Seriously damaged trees	Undamaged trees	Seriously damaged trees	Undamaged trees	Seriously damaged trees
		Number		*Feet*		*Inches*	
			SUGAR MAPLE				
Dominant	Release	7	10	10.2	6.2	1.3	1.1
Codominant	Release	11	5	9.3	3.8	.7	.6
	Nonrelease	5	4	6.5	.5	.5	.5
Intermediate	Nonrelease	6	3	6.4	2.4	.4	.2
			RED OAK				
Dominant	Release	2	3	10.4	3.2	1.4	.7
	Nonrelease	10	3	10.7	7.0	1.1	.8
Codominant	Release	16	3	8.8	3.6	1.0	1.3
	Nonrelease	16	4	10.0	6.1	.7	.8
			BLACK CHERRY				
Dominant	Release	4	4	15.6	10.2	2.5	1.6
	Nonrelease	7	5	13.3	9.4	1.7	1.6
Codominant	Release	4	3	16.0	8.2	1.4	1.4
	Nonrelease	11	5	10.1	6.8	1.0	1.0

CONCLUSIONS

On the basis of our results, we conclude that it is inadvisable to release 9-year-old sugar maple, red oak, yellow-poplar, or black cherry crop trees on a good site (site index 70 for northern red oak). Release did not significantly improve height or diameter growth or length of clear stem, nor prevent crown-class regression during the 5-year period after treatment.

To reduce the risk of grapevine damage to crop trees, grapevines should be cut at ground level throughout a stand. But we certainly do not recommend killing all grapevines, because they are a valuable asset to wildlife. Land managers need information from wildlife personnel to achieve a compromise between wildlife and timber.

When released, dominant and codominant study crop trees averaged about 16 feet in height. We believe that forest managers should wait until dominant and codominant crop trees are about 25 feet tall before releasing them.

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