Response to

CROP-TREE RELEASE

by 7-year-old stems of Red Maple Stump Sprouts and Northern Red Oak Advance Reproduction

by G. R. Trimble, Jr.

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NORTHEASTERN FOREST EXPERIMENT STATION
FOREST SERVICE, U.S. DEPARTMENT OF AGRICULTURE
6816 MARKET STREET, UPPER DARBY, PA. 19082
F. BRYAN CLARK, STATION DIRECTOR

ABSTRACT

This paper deals with crop-tree release of two species typical of a fair site: red maple stump sprouts and northern red oak advance reproduction. A study was made to test the feasibility of doing a crop-tree release immediately after the canopy closed and crown classes could be distinguished. The study was made in a 7-year-old even-aged hardwood stand on the Fernow Experimental Forest near Parsons, West Virginia.

A comparison of the following variables was made between released and control trees: total height growth, dbh growth, length of clear stem, and change in crown class. For the red maple sprouts, two crown classes were studied: dominants and codominants. For the red oak, three crown classes were studied: dominants, codominants, and intermediates. After the initial measurements, repeat measurements were made at 2 and 5 years following treatment.

We conclude from this study that for the type of release, species, and site studied, release had no significant effect on height growth.

The data indicate that diameter growth was favorably affected by release of the red maple stump sprouts, but release had no significant effect on the diameter growth of red oak advance reproduction.

Length of clear stem was retarded during the 5-year period by release, but during this period red oak cleared up at a faster rate than red maple.

Changes in 5-year crown class indicate that release had a minor effect on red oak, where crowns retrogressed heavily in dominance in both the release and control categories. However, released red maple codominants were definitely more dominant than controls 5 years after release.

Mortality was slight in all of the stem categories.

THE AUTHOR

GEORGE R. TRIMBLE, JR., now retired, was timber management project leader for the USDA Forest Service's Northeastern Forest Experiment Station at its Timber and Watershed Laboratory at Parsons, West Virginia. He received his forestry training at the University of Maine. He worked for a number of years in watershed-management research both in West Virginia and New Hampshire, and has worked on forest-management problems in most of the northeastern states.

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INTRODUCTION

THIS IS A COMPANION paper to Research Paper NE-253 "Response to crop-tree release by 7-year-old stems of yellow-poplar and black cherry" (*Trimble 1973*). The earlier paper dealt with the response of two typically desirable species that usually follow clearcutting on an excellent site, while this paper deals with two species typical of a fair site. Although the studies were carried out in the same way on both areas, site quality and species were different. The organization of this paper is similar to that of the previous one to facilitate comparisons of results.

The objective of this study was to test the feasibility of making a crop-tree release as soon as crop trees could be selected—immediately after the canopy closed and crown classes could be distinguished. The purpose of making the operation so early was to enhance the possibility of improving species composition. A crop-tree release was used rather than an area-wide thinning because releasing individual trees is much less expensive; and when interest rates are considered, the carrying charge for work done early in the life of a stand mounts high. Each dollar spent in a stand at 7 years of age, if carried at 6 percent interest to the end of the rotation at 80 years, would have to result in an increase of harvest returns of $70 just to break even. However, in a managed stand, some of the effects of precommercial operations would be realized sooner in commercial thinnings. And if such operations increased growth rates they would result in shortened rotations.

To measure the biological response to the release, a number of variables were examined in detail. More data are needed before detailed guidelines can be developed for operations of this kind—or even before a good case can be made that precommercial operations are financially feasible.

DESCRIPTION OF THE AREA

The study locale was the Fernow Experimental Forest near Parsons, West Virginia. Site quality was fair: about site index 60 for oak. The soil was a well-drained Calvin channery silt loam derived from sandstone and shale. Elevation of the study area was 2,300 feet, and slope averaged about 25 percent. Annual rainfall was about 59 inches and was well distributed throughout the year. The frost-free growing season was about 4½ months.

The 7-year-old stand developed as a result of clearcutting a 55-year-old, well-stocked, unmanaged stand that contained a number of old residuals from the previous harvest. For sawlog management the second-growth trees were too young for clearcutting. This stand contained a wide variety of species, such as red maple (*Acer rubrum* L.), the upland oaks (*Quercus* L.), blackgum (*Nyssa sylvatica* Marsh.), sourwood (Oxy*dendrum arboreum* (L.) DC.) and other typical dry site species. The research clearcut produced 6,547 board feet of sawlogs and 14 cords of pulpwood per acre. All 1- to 5-inch stems left standing were treated with a basal spray of 2,4,5-T in oil and most of them died (*Trimble and Wendel 1966*).

STUDY METHODS

Two species were studied: red maple stump sprouts and northern red oak (*Q. rubra* L.) seedlings and seedling sprouts. The red oaks were advance reproduction. Of the red maple sprouts, two crown classes were studied: dominants and codominants. Of the red oak, three crown classes were studied: dominants, codominants, and intermediates. The number of released and control trees were as follows:

Species and initial crown dominance class	*No. of released stems*	*No. of control stems*
Red maple sprouts		
Dominant (40 stems)	20	20
Codominant (39 stems)	20	19
Red oak advance reproduction		
Dominant (20 stems)	10	10
Codominant (40 stems)	20	20
Intermediates (39 stems)	19	20

We had intended to sample 20 trees in each of three crown classes but were unable to find suitable intermediate red maple sprouts; we were also unable to find 20 dominant red oaks.

The sample trees were permanently numbered in the 7-year-old hardwood stand. The following measurements were taken on each of them: total height, dbh, and length of clear stem. Measurements were repeated after two and five growing seasons. At each repeat measurement, crown positions were reclassified.

After the initial crown classification and stem measurements were made, the crop trees designated for treatment were released by removing from within a 5-foot radius all stems that were over half as tall as the crop tree (*Trimble 1971*). Grapevines growing in the treated crop trees were severed. This operation left all released trees in a dominant crown position, including those that had originally been intermediate.

RESULTS

Effect on Height

When the data were analyzed for the 5 years after treatment, they indicated that the height growth of released trees did not differ significantly (at the 5-percent level) from the height growth of the control stems (table 1). This was true for both red maple and red oak and for all crown classes.

However, when we look at the data for the 2-year period and the following 3-year period

Table 1.—Average total heights and average height-growth rates for released and unreleased stems

Crown class before treatment	Treatment	Sample trees[a]	Average height[b]			Average height growth		
			At 7 years	At 9 years	At 12 years	7 to 9 years annual	9 to 12 years annual	7 to 12 years annual
		No.	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*
RED MAPLE STUMP SPROUTS								
Dominant	Release	20	16.2	22.7	28.8	3.05	2.03	2.44
Dominant	Control	20	16.2	22.1	28.5	2.95	2.13	2.46
Codominant	Release	19	14.7	20.4	26.0	2.85	1.87	2.26
Codominant	Control	18	13.7	19.2	24.9	2.75	1.90	2.24
RED OAK ADVANCE REPRODUCTION								
Dominant	Release	10	11.6	15.4	22.7	1.90	2.43	2.22
Dominant	Control	10	12.1	16.3	23.2	2.10	2.30	2.22
Codominant	Release	20	9.2	12.3	18.2	1.55	1.97	1.80
Codominant	Control	20	9.4	12.6	18.3	1.60	1.90	1.78
Intermediate	Release	19	7.5	9.9	13.2	1.20	1.10	1.14
Intermediate	Control	19	7.7	10.3	12.8	1.30	.83	1.02

[a] Total number of sample trees alive 5 years after release.
[b] Based on number of sample trees alive after 5 years.

Table 2.—Average dbh and average dbh growth rates for released and unreleased trees

Crown class before treatment	Treatment	Sample trees[a]	Average dbh[b]			Average dbh growth		
			At 7 years	At 9 years	At 12 years	7 to 9 years annual	9 to 12 years annual	7 to 12 years annual
		No.	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
RED MAPLE STUMP SPROUTS								
Dominant	Release	20	1.5	2.4	3.4	0.45	0.33	0.38
Dominant	Control	20	1.5	2.0	2.8	.25	.27	.26
Codominant	Release	19	1.2	2.0	2.9	.40	.30	.34
Codominant	Control	18	1.0	1.4	1.9	.20	.17	.18
RED OAK ADVANCE REPRODUCTION								
Dominant	Release	10	0.9	1.3	2.0	0.20	0.23	0.22
Dominant	Control	10	.9	1.3	1.8	.20	.17	.18
Codominant	Release	20	.6	1.0	1.5	.20	.17	.18
Codominant	Control	20	.6	.9	1.4	.15	.17	.16
Intermediate	Release	19	.4	.6	.9	.10	.10	.10
Intermediate	Control	19	.5	.6	.8	.05	.07	.06

[a] Total number of sample trees alive 5 years after release.
[b] Based on number of sample trees alive after 5 years.

separately, a different picture emerges. *For the red oak*, for the 2-year period after release (7 to 9 years), released stems of all crown classes grew slightly slower than the control stems. For the following 3-year period, the situation was reversed; released stems of all crown classes grew slightly faster than the control stems. The height-growth relationship to release for the two periods was the same as we found for yellow-poplar (*Liriodendron tulipifera* L.) and black cherry (*Prunus serotina* Ehrh.) on the better site. The height growth of *red maple stump sprouts* for the two periods was the opposite of that found for red oak advance reproduction: released stems grew slightly faster during the first part of the 5-year period and control stems grew faster during the last 3 years of the period.

None of the differences between growth rates of the released stems and those of the control stems was statistically significant (at the 5-percent level). However, the consistent direction of the differences within species suggests that there are real differences in growth between released and control stems.

Another height-growth relationship for both released and control stems shows up in the data. For the first 2 years, red maple sprouts grew faster than red oak in both dominant and codominant crown classes; for the last 3 years, dominant red oak grew faster than dominant red maple and the growth of codominants was about the same for both species. It appears that the faster height growth rate of red maple stump sprouts over red oak (seedlings and seedling sprouts combined) lasted about 8 to 10 years after clearcutting.

Effect on Diameter

For the 5-year period, released red maple stump sprouts grew significantly (5-percent level) faster in diameter than control stems in both the dominant and codominant classes (table 2). Differences were greater for the codominant than for the dominant stems. The trend of differences was the same for both the first 2 years and the last 3 years.

For the red oak trees, only the intermediate stems showed significantly greater growth in dbh of the released stems.

Like height growth, diameter growth was greater for the more dominant crown classes. Unlike the height-growth relationship, however, where red oak caught up with red maple when the trees were between 8 and 10 years old, diameter growth of the red maple exceeded that of red oak until the end of the study period.

Effect on Length of Clear Stem

Release retarded natural pruning for all crown classes of both species throughout the 5-year period of study (table 3). The differences (as percentages) were greater for red maple than for red oak.

At the beginning of the study period, and before any trees were released at 7 years, comparable crown classes of both species had about the same length of clear stems; but 5 years later, after release, both control and released trees of red oak had greater clear lengths. This indicates that at somewhere around 7 years of age stems of red oak advance reproduction begin to clear up faster than red maple stump sprouts.

Effect on Dominance Classification

Crown classes were determined before release, and all released trees were left in a dominant position. The control (unreleased) trees were left in their original crown position. At 5 years, all sample trees were again classified as to their crown positions (table 4). The changes over this 5-year period lead to the following conclusions:

For both species, many trees of most crown classes retrogressed in dominance. Retrogression was greater with oak than it was with red maple, and it was greater with the lower crown classes (as determined on the original stems). Also, more of the released stems than of the controls retained their original crown position, except for the intermediate red oak, where both released and control stems were dropping rapidly behind.

Many of the red oak dominants were, after 5 years, still in good position even though they had lost some dominance: 80 percent of the released stems were still dominant or codominant as were 70 percent of the controls. Red maple had held its crown position better: of the dominant stems, 95 percent of both released and control dominants were still dominant or codominant. And release had had a definitely favorable effect on codominant red maple stems; 85 percent of them were still dominant or codominant as contrasted with only 32 percent of the controls.

In general, after 5 years the effects of release on crown position were appreciable for red maple stump sprouts, both original dominants and codominants. For red oak, however, release had had less effect.

Table 3.—Average length of clear stem and average clear-stem increase for released and unreleased trees

Crown class before treatment	Treatment	Sample trees[a]	Average length of clear stems[b]			Average clear stem increase		
			At 7 years	At 9 years	At 12 years	7 to 9 years annual	9 to 12 years annual	7 to 12 years annual
		No.	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*
		RED MAPLE STUMP SPROUTS						
Dominant	Release	20	3.1	3.2	4.5	0.05	0.43	0.28
Dominant	Control	20	3.0	4.0	7.9	.50	1.30	.98
Codominant	Release	19	2.9	3.3	4.4	.20	.37	.30
Codominant	Control	18	2.9	4.3	8.0	.70	1.23	1.02
		RED OAK ADVANCE REPRODUCTION						
Dominant	Release	10	3.0	3.4	7.0	0.20	1.20	0.80
Dominant	Control	10	3.0	5.9	11.8	1.45	1.97	1.76
Codominant	Release	20	2.5	3.4	7.5	.45	1.37	1.00
Codominant	Control	20	2.5	3.5	8.0	.50	1.50	1.10
Intermediate	Release	19	2.9	3.8	6.0	.45	.73	.62
Intermediate	Control	19	2.6	4.1	6.6	.75	.83	.80

[a] Total number of sample trees alive 5 years after release.
[b] Based on number of sample trees alive after 5 years.

Table 4.—Five-year change in crown class

Crown class before treatment	Treatment	Crown class 5 years later								Dead		Dead and overtopped
		Dominant		Codominant		Intermediate		Overtopped				
		No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.	Pct.
RED MAPLE STUMP SPROUTS												
Dominant	Release	17	85	2	10	1	5	0	0	0	0	0
Dominant	Control	3	15	16	80	1	5	0	0	0	0	0
Codominant	Release	9	45	8	40	1	5	1	5	1	5	10
Codominant	Control	1	5	5	27	9	47	3	16	1	5	21
RED OAK ADVANCE REPRODUCTION												
Dominant	Release	2	20	6	60	2	20	0	0	0	0	0
Dominant	Control	0	0	7	70	3	30	0	0	0	0	0
Codominant	Release	1	5	6	30	11	55	2	10	0	0	10
Codominant	Control	0	0	6	30	10	50	4	20	0	0	20
Intermediate	Release	0	0	1	5	6	32	12	63	0	0	63
Intermediate	Control	0	0	1	5	5	25	13	65	1	5	70

Effect on Mortality

Of the 178 trees in the original samples, only three died during the 5-year period (table 4). Thus the mortality has been very low, and from the looks of the stand it will not increase markedly in the near future, except for the intermediate red oak. This is somewhat in contrast to our study of yellow-poplar and black cherry on an excellent site where 5-year mortality was heavy among intermediates and even codominants, especially the controls. Several conditions probably account for this difference: (1) the canopy is naturally denser on the better site, (2) a heavy stand of American chestnut sprouts is dying and opening up the canopy on the poor site, (3) a lower percentage of sample trees were in the intermediate class on the poorer site (no red maples below codominant position were studied), (4) red oak and red maple, especially the latter, are more tolerant of shade than yellow-poplar and black cherry, and (5) young stump sprouts—in the case of red maple—outgrow young seedlings, and the stems of yellow-poplar and black cherry studied were seedlings (or in some cases of the latter, small seedling sprouts).

Effect on Grapevines

On the better sites grapevines were found to be highly damaging to young stems after clearcutting, but we found them to be of no importance on this fair site. When the crop trees were selected in 1968, we found grapevines growing in only three trees. All of these were control dominant red maple sprouts and the vines were not cut. Five years later, only two of these trees had grapevines in them, and the vines were doing no damage. No new vines had grown into other trees.

This information substantiates our general observation that grapevines are primarily a pest on better sites.

CONCLUSIONS AND DISCUSSION

We conclude from this study that for the type of release, species, and site studied, release had no significant effect on height growth.

The data indicate that diameter growth was favorably affected by release of the red maple stump sprouts, but release had no significant effect on the diameter growth of the red oak advance reproduction.

Length of clear stem was retarded during the 5-year period by release, but during this period red oak cleared up at a faster rate than red maple.

Changes in 5-year crown class indicate that

release had a minor effect on red oak, where crowns retrogressed heavily in dominance in both released and control trees. However, released red maple codominants were definitely more dominant than controls 5 years after release.

Mortality was slight in all of the stem categories.

Grapevines were not a problem in this study.

As a first observation, it appears that red oak stems were released too soon or were not released heavily enough. We found that the competition affecting these red oak stems was not largely from sprout regrowth of the stems cut during release—as it was in the study of yellow-poplar and black cherry on the better sites—but came mostly from sprout growth of American chestnut and from chestnut oak stump sprouts outside the 5-foot radius. Had the second growth stems of chestnut oak been older at the time of clearcutting, stump sprouting would have been less vigorous. This leads us to believe that it might have been practicable to release these red oak stems at this early age if the release had been carried out to a greater radius around the stem than 5 feet—or if the clearcutting had been delayed until the stand was older, or both.

On the other hand, the release of red maple stump sprouts appears to have been beneficial, probably because they were so much taller originally.

An additional interesting observation is that very little of the competition to the released red maple stump sprouts came from regrowth of the many stems cut in each clump at release time. Few of these have resprouted.

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