Southern Forest Experiment Station

Research Note

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Response of Overtopped White Oak to Release

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SUMMARY

Pole sized white oaks increase in volume growth following release from overtopping trees, but the response varies by size, age and appearance of the oaks. Significant increases in epicormic sprouting, height loss by some released trees, and highly variable stem volume growth make overtopped white oak a very questionable source of future crop trees. If overtopped trees are cut, those under 8 inches dbh and less than 80 years of age produce vigorous stump sprouts and provide a source of natural regeneration.

INTRODUCTION

Millions of overtopped white oak are found throughout the Cumberland Plateau region. Are these trees which remain after commercial harvests an asset or a liability? Will they respond favorably to release? Can these trees become crop trees and desirable growing stock? A 2-year study of 240 released and unreleased white oak provides early insight into these questions (table 1). Some trees increased in volume more than others following release from overhead competition. Tree diameter, age, stem form, crown development, and the degree of release were important factors. Dramatic increases in the number and size of epicormic sprouts can be anticipated on almost all released stems.

The white oaks in this study were significantly overtopped by one or more larger trees. Most of the sampled white oak were suppressed, but a few larger ones were classed intermediate. Ages ranged from 30 to 100 years, and size ranged from 2 to 14 inches dbh. The two study areas were typical of upland hardwood land having been cut periodically during the past 50 years or more. However, no cutting had been done during the last 15 years and the stands were fully stocked. Site quality on study areas ranged from 80 to 70 for mixed oak.

Table I.-Average characteristics of sample trees at t/me of study initiation

	Sample trees	Age	Height	Diameter	Volume
	no.	yrs.	ft.	inches	cu. ft.
Experiment I-released					
High quality'	42	53'	51	6.0	5.5
Medium quality*	37	60	42	5.9	4.8
Low quality[3]	25	62	35	0.4	4.3
Experiment II					
Not released	40	50	45	6.2	6.2
Experiment III					
Partially released	40	49	45	5.7	5.2
Not released	40	49	45	5.6	5.0

[1]High quality-Straight stem, good crown.
[2]Medium quality-Some sweep to bole, moderate crown.
[3]Low quality-Crook in bole or sparse crown or both.

The study was installed in three experiments. Experiments I and II were located on the Domain of the University of the South in Franklin County and experiment III was located on Franklin-Marion State Forest in Marion County.

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Experiment I

The purpose of this experiment was to determine whether easily recognized tree characteristics of overtopped white oak are related to response after release. The 104 selected trees covered a range of diameters, ages, and quality classes.

Forty-two trees were classified as high quality, 37 as medium quality, and 25 as low quality, using the following criteria:

High Quality-Large well formed crown and a straight stem.

Medium Quality-Small but well formed crown, stem having some sweep but no major crooks.

Low Quality-Small or poorly formed crown, crooked stem or stem with major sweep.

An almost complete release of the sample trees was achieved when most trees over 14 inches dbh were commercially harvested, along with many smaller trees. The remaining overstory trees near a sample tree were cut. The average residual basal area around the 104 sample trees was 30 square feet per acre.

Measurements included a pre-release measure of height and volume of the stem by Barr and Stroud dendrometer. Quality estimates were made for each stem and epicormic sprouts were tallied on the first 18 foot log by sprout size. After the second growing season following release, the measurements were repeated. Height and volume determinations were made from fixed relocatable points. The relationship of diameter, age, and quality class to growth were evaluated by regression analyses.

Total stem volume growth was predicted with the iollowing equation:

$$Y = a + b(D) + b(\frac{D}{A})$$

Where: D=Sample tree diameter breast height (in inches)
A=Age of tree (in years)
Y=Total stem volume growth (cu. ft. per 2years).

The cubic volume growth of released trees was directly related to tree diameter and to a ratio of tree diameter over age. For a given diameter and diameter/age ratio, high quality trees responded more vigorously than medium or low quality trees (fig. 1). The response of medium and low quality trees was less predictable than high quality tree response. The regression equation accounted for over 80 percent of the variation in volume growth when applied to the high. quality trees, but only 87 and 52 percent when applied to medium and low quality trees.

The larger trees produced more volume when released than smaller trees. Additional analyses were performed to determine whether percent volume increases were related to tree characteristics. However, these analyses accounted for less than 50 percent of the variation. While some small trees increased dramatically in volume percentage, generally small overtopped trees, particularly those with low diameter/age ratios, were poor candidates for rapid early development following release.

Height growth following release is highly variable with no obvious link between height growth and tree characteristics. The average annual height growth in this experiment was about 0.4 feet in trees of each class. However, 23 of the 104 trees actually lost height after release. Most of the loss was due to stem die-back. If the 23 trees that lost height are deleted from the calculations, the average annual height growth is about 0.7 feet per year.

The average number of epicormic sprouts on the butt log of the 104 trees almost doubled following release, and epicormic sprouts longer than 6 inches increased from 5 to 15 per log (table 2).

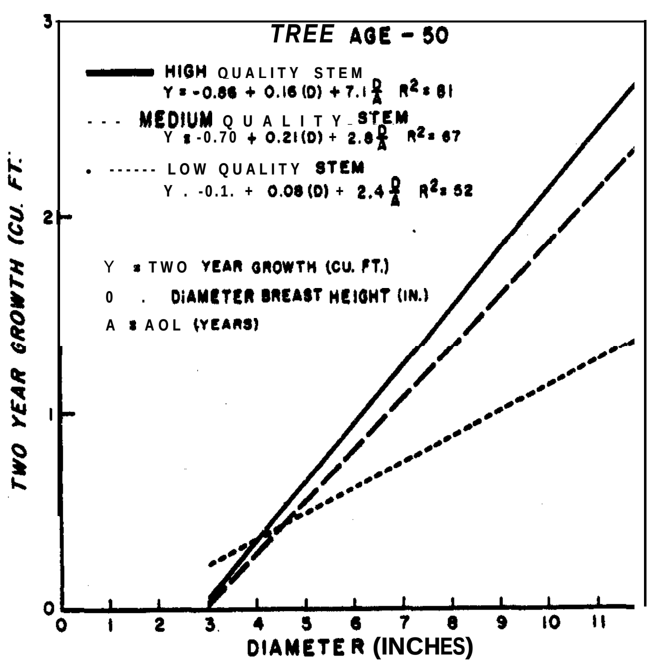

Figure 1. – *Volume growth for high, medium, and low quality white oak at age 50 in relation to stem diameter* Experiment *I*.

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Table 2. — *Epicormic sprouts on high, medium, and low quality[1] white oak before and after release Experiment I*

	Before release				After release				Percent
	<3 in.	3-8 in.	>6 in.	Total	<3 in.	3-6 in.	>6 in.	Total	increase
High quality	2.5	2.8	3.8	9.1	3.6	5.0	13.8	22.4	145
Medium quaiity	2.4	2.9	5.4	11.7	2.8	4.3	15.0	22.2	90
Low quality	2.8	2.3	5.9	11.0	2.0	3.1	14.3	19.4	75
Avg. Number Epicormic Sprouts	...	...	...	...	..	...	...	...	...
on butt log	...	...	...	10.6	...	...	...	21.3	101

[1] High quality-straight stem, good crown: medium quality-some sweep to bole, moderate crown: low quality—crook in bole or sparse crown or both.

Experiment II

This experiment compared the response of the high quality trees released in experiment I with a similar population of high quality unreleased overtopped white oak growing nearby in a fully stocked stand. Tree measurements and analyses were similar to those described in experiment I.

Both released and unreleased trees made substantial gains in stem volume during the 2 year period (fig. 2). However, the equations predicted that a 30-year-old released tree, 6 inches dbh, will average 0.75 cubic feet growth per year while a similar unreleased tree will gain only 0.35 cubic feet per year. As age increased in relation to stem size, cubic volume increase declined.

Comparing released and unreleased trees provided more evidence that release may have an early negative effect on height growth. Only 4 released trees grew more than 2 feet in height in two years while 11 unreleased trees grew over 2 feet. Seven of the released trees actually lost height while only one unreleased tree lost height. The average annual height growth was 0.4 feet for released trees and 0.7 feet for unreleased trees.

Epicormic sprouts on the first 16 foot log increased on both released and unreleased trees. However, the increase averaged 13 per tree on released stems and 6 per tree on unreleased stems. Epicormic sprouts longer than 6 inches greatly increased on the released trees.

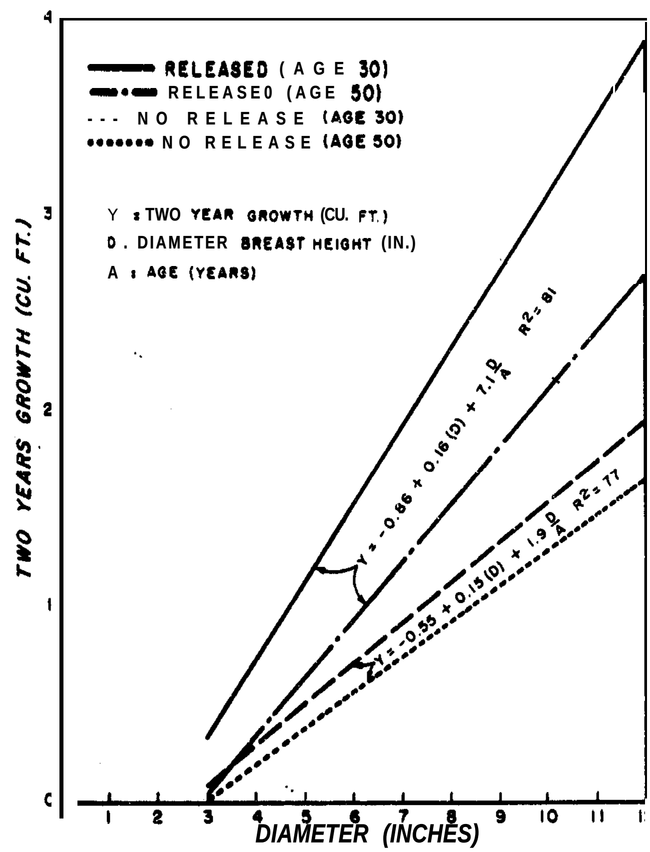

Figure 2.— *Volume growth for released and unreleased white oak in relation to tree age and stem diameter. Experiment I and II.*

Experiment III

In this experiment four treatments were imposed on 160 high quality but overtopped white oak. Treatments consisted of either (1) removal of directly overtopping trees, (2) removal of directly overtopping trees plus cutting the sample tree, (3) no release but cut sample trees, and (4) no release and no cutting.

The release imposed in treatments 1 and 2 removed directly overtopping trees but left considerable side shade. The average basal area of residual trees around the sample trees as indicated by prism counts was 60 square feet per acre. Therefore, the partial release achieved in this experiment is comparable to the release that might follow selection cutting or heavy thinning. Volume measurements and counts of epicormic sprouts of the standing oak trees were completed as in experiment I. After each growing season, number and height of stump sprout development has been monitored on the sample tree stumps.

Both the partially released trees and the unreleased trees continued to grow, with little difference in cubic volume increment between them. The partially released trees did not respond in the same manner as the completely released trees in experiment I. The difference in residual basal areas, 30 square feet per acre in experiment I compared with 60 square feet per acre in experiment Ill, probably accounts for the growth difference. Height growth was about 0.4 feet per year for both partially released and unreleased trees. Epicormic sprouting increased 120 percent in partially released and 46 percent in unreleased butt logs. Stump sprouting was prolific on both released and unreleased stumps of trees less than 8 inches and under 60 years of age (table 3). Of the 80 felled trees, all but 10 had stump sprouts by the second year.

Table 3.—*White oak stump sprouting one and two years after telling Experiment III*[1]

Tree size inches dbh	Partially released		Unreleased	
	One year sprouts per stump	Two year sprouts per stump	One year sprouts per stump	Two year sprout3 p&stump
	average number			
1.6-1.9	6	6	14	10
2.0-3.9	12	10	14	15
4.Ck5.9	16	13	15	14
6.0-7.9	22	22	21	19
8.0+	1	2	2	S
Avg. sprout8 per stump	11	11	14	13

[1]One year data published as "Size and age of tree affect white oak sprouting." C. E. McGee, Research Note SO-239, 1978, 2 p.

DISCUSSION

The presence of millions of overtopped white oak in the Cumberland Plateau presents difficult choices to area forest managers. To cut the mostly unmerchantable pole-sized trees sacrifices many years growth and time before merchantable trees can develop. However, early data from this study show rather strongly that many of these overtopped trees are not good choices for crop trees. Generally, the indicated practice would be to fell all overtopped and unmerchantable trees left after a heavy commercial harvest.

Occasionally, however, the presence of enough 8-l 2 inch dbh trees to restock a stand may provide an opportunity to avoid completely starting over. This study has shown that most trees in the 6-12 inch dbh category will increase diameter growth rapidly following release. Some of these trees will maintain their rate of height growth, but others will initially lose height. Most of the released trees will have large increases in the sire and number of epicormic sprouts. These trees will eventually produce sawtimber, but the overall log quality will be low and individual tree performance highly variable. The critical factor is having enough good trees to fully restock the stand and occupy the site. Many stands will have a few good overtopped trees but not enough for full restocking. Only a few stands will have enough of the overtopped trees of the size and quality to justify leaving them for crop trees.

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