United States
Department of
Agriculture

Forest Service

Southern
Research Station

Research Note
SRS–13

First-Year Growth and Quality Response of Residual Hardwood Poletimber Trees Following Thinning in an Even-Aged Sawtimber Stand

Daniel A. Skojac, Jr., Andrew W. Ezell,
James S. Meadows, and John D. Hodges

February 2007

Abstract

First-year diameter growth and epicormic branching responses of hardwood poletimber trees retained following thinning in a sawtimber stand are reported. Poletimber trees were classified as either superior or inferior poletimber, and then retained on separate plots receiving identical thinning treatments. Comparison of responses by the two classes of poletimber was used to evaluate their future potential for grade sawtimber in the thinned sawtimber stand. Thinning treatments included an unthinned control, two levels of the desirable treatment (retained preferred and desirable sawtimber and either superior or inferior poletimber), and two levels of the acceptable treatment (retained preferred, desirable, and acceptable sawtimber and either superior or inferior poletimber). Preliminary results indicated that future sawtimber production from residual superior poletimber trees may be a realistic option but appears less likely from their inferior poletimber counterparts. The desirable treatment yielded significant first-year diameter growth of superior poletimber trees (0.20 inches), but also stimulated greater production of new epicormic branches on the potentially more valuable superior poletimber trees. The acceptable treatment minimized the production of epicormic branches on superior poletimber trees (only 2.2 new branches) during the first year.

Key words: Diameter growth, epicormic branching, hardwood, poletimber, thinning, tree class.

Introduction

Poletimber trees (5.5 to 12.5 inches diameter at breast height [d.b.h.]) are usually abundant in the midstory of most previously unmanaged even-aged bottomland hardwood sawtimber stands. Many of these trees are in poor health and of low quality and have no potential for grade sawtimber production. To improve stand health and quality, these trees are typically removed during thinning for pulpwood. Fewer scattered poletimber trees in these stands are of good form and quality and exhibit potential to yield sawlogs. The most effective and profitable utilization of these trees, however, is arguable. Should these trees be removed for pulpwood as well, or if they are retained, can they reasonably be expected to yield sawlogs by rotation age? Retention of these trees poses no risk to their current merchantability. If thinning fails to yield grade sawtimber from these trees, as a product, they remain pulpwood. However, if they develop a grade sawlog before the end of the rotation, their value and the value of the residual stand is dramatically increased. Alternatively, removal of these trees provides immediate compensation in the form of pulpwood, whereas future sawtimber production, though more profitable, is not guaranteed. Those poletimber trees favored during thinning must compete for site resources with larger sawtimber neighbors, while preserving bole quality under reduced stand density levels. Poor growth history and susceptibility to epicormic branching may prevent these trees from producing a grade sawlog. Given this uncertainty, practical guidelines for poletimber retention are needed when planning thinning operations in these even-aged sawtimber stands.

A new system of tree classes[1] developed for the management of southern hardwoods attempts to separate poletimber trees based on their potential for sawtimber production, and could be used as a guide when selecting poletimber trees for retention following thinning in sawtimber stands. This new system expands Putnam's (Putnam et al. 1960) set of four tree classes to five tree classes used exclusively for sawtimber (in descending order of desirability): (1) preferred growing stock, (2) desirable growing stock, (3) acceptable growing stock, (4) cutting stock, and (5) cull

Daniel A. Skojac, Jr., Forestry Technician, and James S. Meadows, Principal Silviculturist, USDA Forest Service, Southern Research Station, Southern Hardwoods Laboratory, Stoneville, MS 38776; Andrew W. Ezell, Professor of Forestry, and John D. Hodges, Professor Emeritus, Department of Forestry, Mississippi State University, Starkville, MS 39762.

[1] Meadows, J.S., Skojac, D.A. A new tree classification system for southern hardwoods. Manuscript in preparation. Authors can be reached at U.S. Department of Agriculture Forest Service, Southern Hardwoods Laboratory, P.O. Box 227, Stoneville, MS 38776.

stock; and creates two additional classes for poletimber: (1) superior poletimber stock and (2) inferior poletimber stock. Under the new system, superior poletimber trees must be of a desirable or acceptable species for the site and management objectives, be in good condition, pose little risk of mortality or degrade, and have the potential to make a Grade 2 or better butt log when minimum diameter limits are reached. Inferior poletimber trees are believed to have little potential for sawtimber production and are incapable of meeting Grade 2 butt log requirements when sawtimber diameters are reached. These trees should be removed during the next entry into the stand because they are of an undesirable or unmerchantable species, are in poor condition, pose serious risk of mortality or degrade, or exhibit symptoms of disease.

Utilizing this new tree classification system, a study was initiated to determine the potential of poletimber trees to produce grade sawtimber following various levels of thinning in an even-aged bottomland hardwood sawtimber stand. First-year growth and quality response of residual poletimber trees are reported.

Site Description

The experiment was conducted in an even-aged bottomland hardwood stand within the alluvial floodplain of the Red River, on Barksdale Air Force Base in southwestern Bossier Parish, in northwestern Louisiana. The study site is part of a larger 188-acre stand that was approximately 60 to 65 years old at the time of study establishment. Prior to treatment, the stand averaged 119 trees (75 poletimber trees) and 110 square feet (30 square feet in poletimber) of basal area per acre in trees 5.5 inches and larger at d.b.h. Quadratic mean d.b.h. was 13.1 inches. Average stand stocking was 92 percent (Goelz 1995). Stand basal area consisted of 47 percent red oak [cherrybark oak (*Quercus pagoda* Raf.), Nuttall oak (*Q. nuttallii* Palmer), water oak (*Q. nigra* L.), and willow oak (*Q. phellos* L.)], 38 percent sweetgum (*Liquidambar styraciflua* L.), and 15 percent other species, primarily pecan [*Carya illinoensis* (Wangenh.) K. Koch] and American elm (*Ulmus americana* L.). The study area contained nearly equal areas of both Perry clay (very-fine, smectitic, thermic Chromic Epiaquerts) and Gallion silt-loam (fine-silty, mixed, superactive, thermic Typic Hapludalfs) (U.S. Department of Agriculture Soil Conservation Service 1962, U.S. Department of Agriculture Natural Resources Conservation Service 2003). Site indices based on the Baker and Broadfoot (1979) site evaluation method were estimated as 104 feet for cherrybark oak, 97 feet for water and willow oak, 94 feet for Nuttall oak, and 107 feet for sweetgum.

Procedure

In December of 2003, the following five treatments were applied to 2.0-acre plots measuring five by four chains and replicated three times in a randomized complete block design: (1) unthinned control, (2) desirable growing stock with superior poletimber (DesSupP), (3) desirable growing stock with inferior poletimber (DesInfP), (4) acceptable growing stock with superior poletimber (AccSupP), and (5) acceptable growing stock with inferior poletimber (AccInfP). Tree classes (see footnote[1]) were used to establish the cutting priority within treatments, such that each treatment was defined by the tree classes to be retained (table 1). Treatments 2 and 3 were classed as desirable and

Table 1—List of five thinning treatments, including tree classes to be retained following application of thinning treatments

	Treatments				
Tree class	Control	DesSupP	DesInfP	AccSupP	AccInfP
Preferred	X	X	X	X	X
Desirable	X	X	X	X	X
Acceptable	X			X	X
Cut	X				
Cull	X				
Superior poletimber	X	X		X	
Inferior poletimber	X		X		X

DesSupP = desirable growing stock with superior poletimber stock; DesInfP = desirable growing stock with inferior poletimber stock; AccSupP = acceptable growing stock with superior poletimber stock; AccInfP = acceptable growing stock with inferior poletimber; X = tree classes to be retained following application of thinning treatment.

4 and 5 as acceptable. Under traditional marking rules, superior poletimber trees would be residual growing stock and inferior poletimber trees would be part of the overburden component to be removed during thinning. We retained inferior poletimber trees in two of the four thinning treatments to compare responses between superior and inferior poletimber trees, particularly within treatments characterized by similar overstory removal.

Prior to treatment, species, d.b.h., tree class, and crown class were recorded for every tree ≥ 5.5 inches d.b.h. on 0.6-acre interior measurement plots of three by two chains. Sawtimber tree classes were assigned to trees ≥ 12.5 inches d.b.h., and poletimber tree classes to trees between 5.5 and 12.4 inches d.b.h. Immediately following thinning, d.b.h. and number of epicormic branches on the 16-foot butt log were recorded for residual poletimber trees. Individual epicormic branches were tallied according to their location by height and cardinal direction on the butt log section so that new epicormic branches could be detected in the following year. Diameter growth and epicormic branching were assessed 1 year after treatment.

Results

Residual Stand Conditions

Thinning intensities were defined by initial stand quality, expressed as tree class, and were not bound to predetermined levels of residual stand density. Postharvest residual stand conditions are summarized in table 2. By design, desirable treatments were more heavily thinned than acceptable treatments. Within both levels of sawtimber retention (i.e., desirable and acceptable), reduction in stand density was greater in those treatments retaining superior poletimber than in corresponding treatments retaining inferior poletimber. Therefore, thinning was heaviest in the DesSupP treatment and lightest in the AccInfP treatment. All four levels of thinning significantly reduced residual stand density relative to the unthinned control.

Residual Poletimber Characteristics

Prior to thinning, the stand contained many weak, poorly formed, or otherwise defective poletimber trees we classified as inferior poletimber. A smaller number of poletimber trees met our criteria for the superior class. Therefore, following thinning, inferior poletimber trees were on average three to four times as numerous as superior poletimber trees in corresponding thinning treatments (table 3). Within the thinned treatments, superior poletimber trees were nearly equally distributed between the red oaks and sweetgum, whereas sweetgum accounted for > 65 percent of residual inferior poletimber trees. Residual superior poletimber trees in this stand were approaching minimum sawtimber size (12.5 inches d.b.h.) and were no more than 2.5 inches below sawtimber d.b.h. at the postharvest evaluation (table 3). In contrast, inferior poletimber trees were nearly 2.0 inches smaller in diameter than their superior poletimber counterparts, and averaged > 4.0 inches below minimum sawtimber d.b.h. Superior poletimber trees also averaged fewer than four epicormic branches on the butt log, a level acceptable for grade sawtimber production (table 3). In contrast, inferior poletimber trees in corresponding thinning treatments averaged two to three times more epicormic branches than their superior poletimber counterparts, but these differences were not significant.

Diameter Growth

Diameter growth response of surviving superior poletimber trees in the DesSupP treatment was significant after the first year (table 4). Diameter of superior poletimber trees

Table 2—Residual stand conditions immediately following application of treatments

Treatment	Trees per acre	Basal area	Quadratic mean diameter	Stocking
	number	*feet²/acre*	*inches*	*percent*
Control	113 a[a]	117 a	13.8 b	98 a
DesSupP	34 d	42 d	15.0 b	35 d
DesInfP	64 c	59 c	13.1 b	50 c
AccSupP	38 d	65 c	17.7 a	52 c
AccInfP	87 b	80 b	13.1 b	67 b

DesSupP = desirable growing stock with superior poletimber stock; DesInfP = desirable growing stock with inferior poletimber stock; AccSupP = acceptable growing stock with superior poletimber stock; AccInfP = acceptable growing stock with inferior poletimber.
[a] Means followed by the same letter within a column are not significantly different at the 0.05 level of probability using Duncan's New Multiple Range Test.

Table 3—Postharvest trees per acre, average diameter, and number of epicormic branches on the butt log of residual poletimber trees by treatment

Treatment	Tree per acre	Diameter	Epicormics
	number	*inches*	*number*
Control	68.9	8.4 b[a]	8.6 a
DesSupP	10.6	9.9 a	3.0 a
DesInfP	35.6	8.1 b	7.3 a
AccSupP	10.6	10.3 a	3.6 a
AccInfP	45.9	8.4 b	10.6 a

DesSupP = desirable growing stock with superior poletimber stock; DesInfP = desirable growing stock with inferior poletimber stock; AccSupP = acceptable growing stock with superior poletimber stock; AccInfP = acceptable growing stock with inferior poletimber.

[a] Means followed by the same letter within a column are not significantly different at the 0.05 level of probability using Duncan's New Multiple Range Test.

in the DesSupP treatment grew four times as much as that of poletimber trees in the unthinned control, and twice as much as that of inferior poletimber trees in either inferior poletimber treatment (DesInfP and AccInfP). First-year diameter growth of inferior poletimber trees in both overstory treatments was uniformly low and did not differ significantly from growth of poletimber trees in the unthinned control.

Within each of the five treatments, individual species groups responded similarly in initial diameter growth (fig. 1). As a group, red oak poletimber trees averaged 0.09 inches in first-year diameter growth in the unthinned control, compared to an average of 0.18 inches in diameter growth in the DesSupP treatment. Similarly, sweetgum poletimber trees averaged 0.06 inches in diameter growth during the first year in the unthinned control, compared to an average of 0.17 inches in diameter growth in the DesSupP treatment. Despite this wide variation in response, first-year diameter growth response within individual species groups was not significant across the five levels of thinning.

Epicormic Branching

In general, production of new epicormic branches by poletimber trees increased as stand density decreased (table 4). Poletimber trees in desirable treatments produced significantly more new epicormic branches than poletimber trees in the unthinned control. Both superior and inferior poletimber trees produced nearly twice as many new epicormic branches in desirable treatments as they did in corresponding acceptable treatments during the first year. Average production of new epicormic branches by poletimber trees in acceptable treatments did not exceed 2.2 branches and did not differ significantly from that for the unthinned control.

Production of new epicormic branches during the first year varied by individual species group (fig. 2). Production of new epicormic branches by red oak poletimber trees varied by treatment, but differences were not significant. Thinning had no effect on the production of new epicormic branches by residual sweetgum poletimber trees, which averaged fewer than three new epicormic branches during the first year after thinning across treatments.

The total number of epicormic branches doubled on superior poletimber trees in the desirable treatment, but increased by only one branch on those in the acceptable

Table 4—Average tree diameter and diameter growth of residual poletimber trees 1 year after thinning, by treatment, and total number of epicormic branches and number of new epicormic branches for those trees, by treatment, 1 year after thinning

Treatment	Diameter year 1	Diameter growth	Total epicormics year 1	New epicormics
	- - - - - *inches* - - - - -		- - - - - - - - *number* - - - - - - - -	
Control	8.6 b[a]	0.05 b	7.9 a	1.2 c
DesSupP	10.3 a	0.20 a	6.7 a	4.3 a
DesInfP	8.3 b	0.09 b	8.2 a	3.1 ab
AccSupP	10.6 a	0.13 ab	4.4 a	2.2 bc
AccInfP	8.4 b	0.10 b	10.8 a	1.5 c

DesSupP = desirable growing stock with superior poletimber stock; DesInfP = desirable growing stock with inferior poletimber stock; AccSupP = acceptable growing stock with superior poletimber stock; AccInfP = acceptable growing stock with inferior poletimber.

[a] Means followed by the same letter within a column are not significantly different at the 0.05 level of probability using Duncan's New Multiple Range Test.

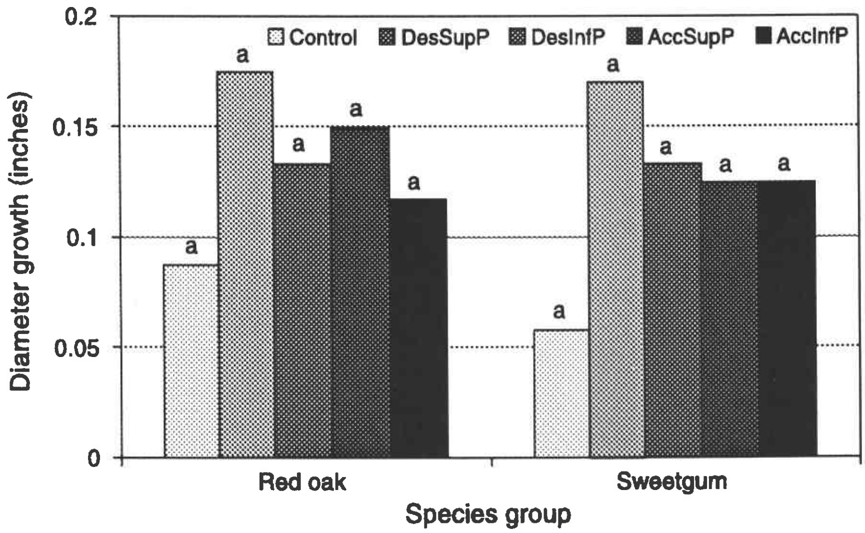

Figure 1—Average diameter growth of residual poletimber trees by species group 1 year following five levels of thinning. Means with the same letter within a species group are not significantly different at the 0.05 level of probability using Duncan's New Multiple Range Test. DesSupP = desirable growing stock with superior poletimber stock; DesInfP = desirable growing stock with inferior poletimber stock; AccSupP = acceptable growing stock with superior poletimber stock; AccInfP = acceptable growing stock with inferior poletimber.

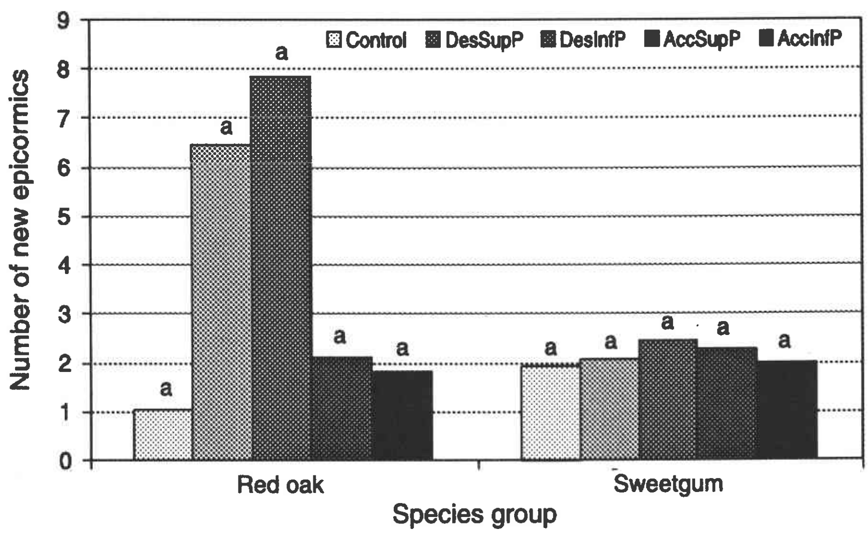

Figure 2—Average number of new epicormic branches produced on the butt log of residual poletimber trees by species group 1 year following five levels of thinning. Means with the same letter within a species group are not significantly different at the 0.05 level of probability using Duncan's New Multiple Range Test. DesSupP = desirable growing stock with superior poletimber stock; DesInfP = desirable growing stock with inferior poletimber stock; AccSupP = acceptable growing stock with superior poletimber stock; AccInfP = acceptable growing stock with inferior poletimber.

treatment during the first year (tables 3 and 4). The total number of branches on inferior poletimber trees only slightly increased during the first year, but were still too numerous for production of high-quality sawtimber.

Although epicormic branch totals on superior poletimber trees were half that of inferior poletimber trees in some cases, there still were no significant differences across treatments in total epicormic branches after the first year.

Conclusions

Retention of poletimber trees in the expectation that they will produce sawtimber is an attractive but uncertain option when planning thinning operations in even-aged sawtimber stands. Retaining poletimber for sawtimber production requires that improved growth and maintenance of bole quality be achieved following thinning. A new tree classification system (see footnote 1) was used in this study to segregate poletimber trees with high potential to produce grade sawtimber from those of low potential. Our first-year results indicate that future production of grade sawtimber from trees initially classed as superior poletimber may be a realistic possibility, but that such production is highly unlikely for trees classed as inferior poletimber. First-year diameter growth of superior poletimber trees was up to twice as great as that of inferior poletimber trees. Superior poletimber trees also maintained fewer total epicormic branches than inferior poletimber trees after the first year. The desirable treatment enhanced the diameter growth of the superior poletimber trees but promoted greater epicormic branching, particularly among red oaks, and reduced stand stocking below optimum levels to fully occupy the site. The acceptable treatment minimized epicormic branching on superior poletimber trees during the first year across all species but did not improve growth beyond that of inferior poletimber trees or that of unreleased poletimber trees in the control. The first-year response of the superior poletimber trees in both treatments reflects the inherent tradeoff between improved growth and loss of bole quality associated with most partial cutting in hardwood stands. Further assessment of superior poletimber trees will be required to determine if the initial increase in epicormic branching in the desirable treatment continues and if growth rates within the acceptable treatment can improve over time.

Acknowledgments

The authors thank Barksdale Air Force Base and Matthew Stroupe, staff forester, who helped locate a study site. We also thank the technicians at the Southern Hardwoods Laboratory for their help in the field.

Literature Cited

Baker, J.B.; Broadfoot, W.M. 1979. A practical field method of site evaluation for commercially important southern hardwoods. Gen. Tech. Rep. SO-26. New Orleans: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station. 51 p.

Goelz, J.C.G. 1995. A stocking guide for southern bottomland hardwoods. Southern Journal of Applied Forestry. 19: 103-104.

Putnam, J.A.; Furnival, G.M.; McKnight, J.S. 1960. Management and inventory of southern hardwoods. Agric. Handb. 181. Washington, DC: U.S. Department of Agriculture, Forest Service. 102 p.

United States Department of Agriculture, Natural Resources Conservation Service, Soil Survey Division. Official soil series descriptions. http://ortho.ftw.nrcs.usda.gov/osd/ [Date accessed: October 2003].

United States Department of Agriculture, Soil Conservation Service. 1962. Soil survey of Bossier Parish, Louisiana. Washington, DC: U.S. Government Printing Office. 144 p.