EARLY THINNING IN BOTTOMLAND HARDWOODS

Madison P. Howell, III and Lawrence E. Nix[1]

Abstract—A 23-year-old sprout origin stand in the Congaree river bottom near Columbia S.C was commercially thinned in 1994 using standard "Leave Tree", "Trainer Tree", and "Corridor" methods. The stand consisted of 260-325 trees per acre and 28-31 cords per acre. There were 90-140 potential crop trees (30 to 40 percent commercial oaks) of different bottomland species, oaks (*Quercus* spp), sycamore (*Platanus occidentalis*), sweetgum (*Lyquidambar styraciflua*), green ash (*Fraxinus pennsylvania*), red maple (*Acer rubrum*), and sugarberry (*Celtis laevigata*). After 5 years of growth, the effect of thinning on residual crop tree quality was measured by number of epicormic sprouts, degree of logging damage, and vine occurrence. Five years after thinning the 28-year-old stand averages 70 crop trees per acre, 12.4 inches diameter and 2.35 logs commercial height. All thinning methods had twice the number of epicormic sprouts as did the control. Logging damage was the lowest in the trainer tree treatment. Vine occurrence on crop trees was reduced by thinning to half that of the controls (30 versus 60 percent), which is a considerable enhancement in the future quality of crop trees.

INTRODUCTION

Early thinnings in upland and bottomland hardwoods provide the landowner with economic return that would normally be lost to mortality (Gingrich 1971; Kellison and others 1988). These thinnings improve stand quality by changing species composition, selecting quality stems, improving tree spacing, and maintaining crown vigor of desired stems (Carvell 1971).

The thinning of bottomlands favors valuable high quality stems, such as cherry bark (*Quercus pagoda*) and Shumard (*Q. Shumardii*) oaks (Kennedy and Johnson 1984). Some other desirable commercial species to favor with thinnings are green ash, red maple, sweetgum, sugarberry and sycamore. Consideration should be taken to not favor a low quality stem of a high valued species over a high quality stem of a low valued species (Kennedy and Johnson 1984). A crop tree also should be selected based on the vigor and quality of the surrounding stems (Clatterback and others 1987). However, the removal of too many cull trees can leave the stand understocked (Gingrich 1971).

Thinning as early as ages 20-25 years can increase the growth potential and value of bottomland hardwoods on good sites and the increased market for hardwood pulpwood allows productive bottomland sites to be commercially thinned at such early ages (Kellison and others 1988). There is no standard method in thinning hardwoods as it is frequently based on the best judgement of the forester. However, such early thinnings can be marginally commercial if they result in degrade to residual crop trees or require too much time of a professional forester. In early 1993 local consulting foresters approached us concerning the advisability of early thinning in sprout origin bottomland hardwood stands (Personal communication. 1993. Angus Lafaye, Forester, Milliken Forestry, Columbia, SC). The objective of this study was to determine the most effective "standard" commercial thinning method relative to effects of thinning on the future value of residual crop trees in this particular young stand.

METHODS

Study Site

The study site is located in a young bottomland hardwood stand on the Congaree River (a red river) near Columbia, SC. The soil type is a well-drained loamy Typic Udifluvent of the Congaree series. The stand was a 23-year-old sprout origin stand that was KG-blade sheared in 1971. Before thinning the stand consisted of 260-325 trees per acre or 28-31 cords per acre, with 90-140 potential crop trees per acre (30 to 40 percent commercial oaks) of different bottomland species (oaks, sycamore, sweetgum, green ash, red maple, and sugarberry). The criteria for crop trees were that they be a commercial species, have a minimum of one log, of good bole form, minimal epicormic sprouting (less than 3 sprouts in the first log), and be a dominant or co-dominant tree. The stand has a site index (base age 50 years) of 85-95 feet for cherrybark oak.

Experimental Design

The thinning methods were done in a randomized complete block design with four 16-acre blocks containing 4-acre treatments of unthinned control, trainer tree, leave tree, and corridor thinning methods as described by Tinsley and Nix (1998). Each 16 acre block has a main skid trail (20 feet wide) marked down the center with treatments on either side. The control is an uncut area. Analysis of variance for a randomized complete block design was

[1]Forester, Coastal Lumber, Florence, SC; Professor, Department of Forest Resources, Clemson University, Clemson, SC 29634-1003, respectively.

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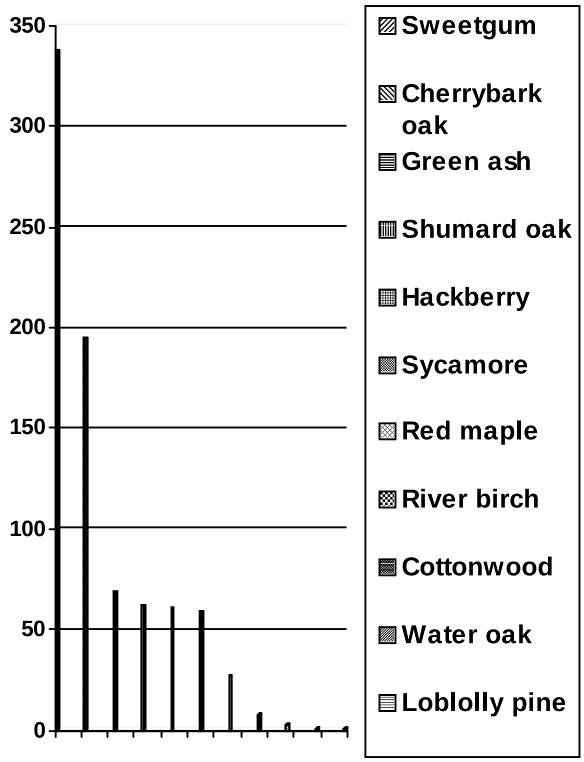

Figure 1— Species prevalence among crop trees (number of the 824 total sampled). Bars in graph from l-r match species list from top to bottom

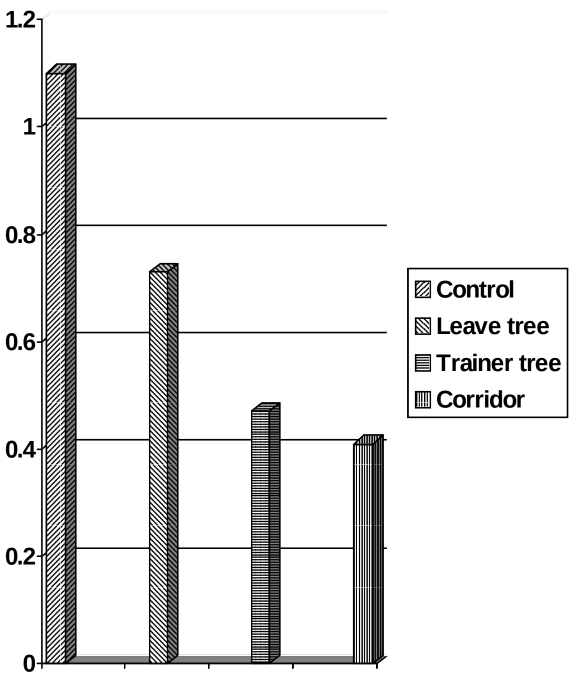

Figure 2— Number of vines on crop trees by thinning method.

performed to test the differences between treatment means (SAS Institute l998). When the treatment means were different Tukey's test at the .05 level of significance was used to test which means were different.

Measurements

A one-acre sampling area was marked in the center of each of the four acre treatment plots, thus, the sample area has a 104.3 feet treatment buffer on all sides. The sample trees were marked before measurements were taken to remove bias from the data. In the corridor treatment the sample crop trees were chosen right up to the edge of the cut strip in order to include the influence of the adjacent open area on future quality. For each crop tree the species, diameter, number of logs, the number of epicormic sprouts (first, second and third log), vine occurrence, vines present in the crown, and logging damage were tallied.

Thinning Methods

All thinning methods were marked to be commercial, at least 10 cords per acre were to be removed (about a 100 trees per acre averaging 8 inches diameter). The trainer tree treatment was designed to leave at least one cull tree near the crop tree to protect it from logging damage and shade out epicormic sprouting on the lower bole. The crop trees were located at 20 by 20 feet spacing (108 trees per acre) in keeping with the 60 percent residual stocking level for upland hardwoods of Gingrich (1971) with about 25 percent more trees per acre added for the more productive bottomland site.

The leave tree method removed all trees except for the crop trees. The same 20 by 20 feet spacing was allowed, but all trees other than crop trees were marked to be cut. If a crop tree was not present at 20 feet, then a reasonable crop tree within a 10 foot radius was left. This method left no protection for the crop trees from logging damage nor shade to suppress epicormic sprouting along the lower bole.

The corridor treatment removed one-third of the volume (about 100 trees per acre) in the cut strip. The forester marked a 20 foot wide cut strip and left a 40 foot wide uncut strip. The cut strips were marked in a 60-degree herringbone pattern to the main skid trail in an attempt to reduce logging damage that results from turning loads. The corridor treatment is an indiscriminate thinning method where crop trees are removed as well as culls.

Vine Control

In most bottomland sites, especially very fertile sites, wild grape vines (*Vitus* spp.) are a problem in the management of high quality crop trees (Smith 1986). Vines can dominate the crown of crop trees causing bad bole form and epicormic sprouting, especially when the vines and crop trees start off as sprouts together. Vines were very prevalent on this site (60 percent of crop trees were infested). Thinning can reduce the number of vines through severing their stems during mechanical harvesting. This is beneficial to the stand. The number and presence of vines in the crowns of crop trees were measured in all treatments.

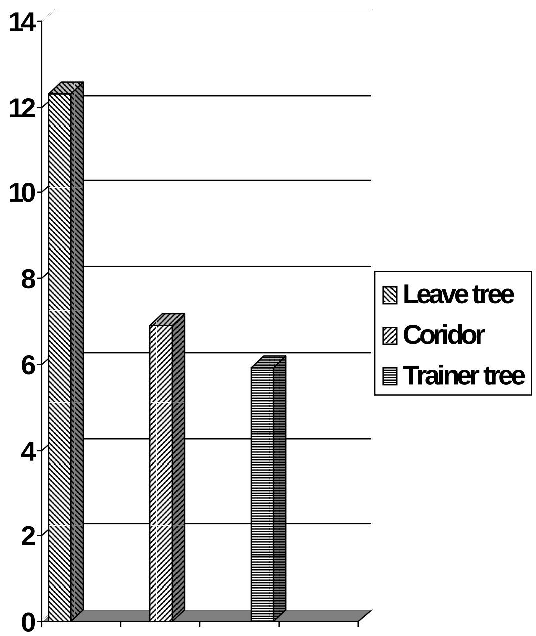

Figure 3— Percent of crop trees damaged from logging by thinning method.

Logging Damage
Thinning operations can be detrimental to the stand because of logging damage. Felling, backing, skidding, and turning with large equipment damage crop trees. This causes a decrease in the number, quality and value of crop trees. Logging damage is reduced through good communication and a well designed harvest plan (Smith 1986). This usually slows down production so an economic incentive (reduction in stumpage value) often is added to reduce careless errors. The objective of each thinning method was explained to the logger and the stumpage value was proportionally decreased to reduce the amount of logging damage that might be caused by haste to make up lost production. However, some logging damage is expected, so each residual crop tree sampled was examined for logging damage.

Epicormic Sprouts
Epicormic sprouts are a source of degrade in hardwood logs. The value of hardwood trees is determined by the grade. The log grade reflects the number and size of clear lumber cuts which can be made from a specific log (Kennedy and Johnson 1984). In opening the canopy the thinning operation may cause epicormic sprouting which will decrease the future financial return. Epicormic sprouts were counted for the first, second and third log of every crop tree sampled.

RESULTS

Residual Crop Trees
The residual stand has an average of 50-90 high quality crop trees per acre depending on the thinning method. Five years after thinning, losses to logging damage and sprout degrade resulted in reducing the leave tree plots to 51.5 crop trees per acre, the corridor method to 81.5, and the trainer tree method to 90.4. This is a drastic reduction in the number of crop trees than that projected before the thinning (at least 100 per acre were to be left). These losses can be partially explained by the premeasurement rejection of crop trees having profuse epicormic sprouting (more than 6 sprouts in the butt log). The remaining crop trees have an average diameter of 12.4 inches and an average height of 2.35 logs. A total of 824 crop trees were sampled and consisted of 41 percent sweetgum, 24 percent cherrybark oak, 8 percent Shumard oak, and 27 percent others (figure 1). An analysis was done to test interactions between treatments and diameter and treatments and species. These interactions were not significant at the 0.05 level.

Vine Occurrence
The number of vines per crop tree was reduced by the thinning treatments. The control trees had nearly twice as many vines as did those of the thinnings (figure 2). Vines were in the crowns of unthinned crop trees nearly two times more often than those thinned (60 versus 30 percent). The control significantly differs from the thinnings which do not differ. The use of heavy machinery in thinnings silviculturally enhanced the future quality of crop trees by reducing the presence of live vines in the crowns.

Logging Damage
Logging damage was kept to a minimum by the following factors: 1) good communications, 2) well-designed harvest plan, and 3) reduced stumpage values charged the logger for less productive methods (Tinsley and Nix 1998). The leave tree thinning damaged 12 percent of the crop trees, the other methods did half of that much damage (figure 3). The leave tree and trainer tree methods differed because the leave tree had no protection from machinery. The trainer tree and corridor thinnings inherently reduce logging damage to residual crop trees.

Epicormic Sprouting
The thinnings caused nearly 3 times more epicormic sprouts on the first log than occurred in the control (figure 4). Similar results occurred on the second and third logs where they existed. The control had significantly fewer sprouts than any of the thinnings. All of the thinnings apparently increased the amount of sunlight in the stand which stimulated epicormic sprouting (Brown and Kormanik 1970). The effects of the thinnings on sprout numbers did not differ. Of the crop tree species Shumard oak had nearly three times the number of sprouts as the other species, a significant difference (figure 5).

Diameter Growth
The average diameter of crop trees in the leave tree thinning was nearly 13 inches, but did not differ from the control. A regression analysis was run to test the correlation

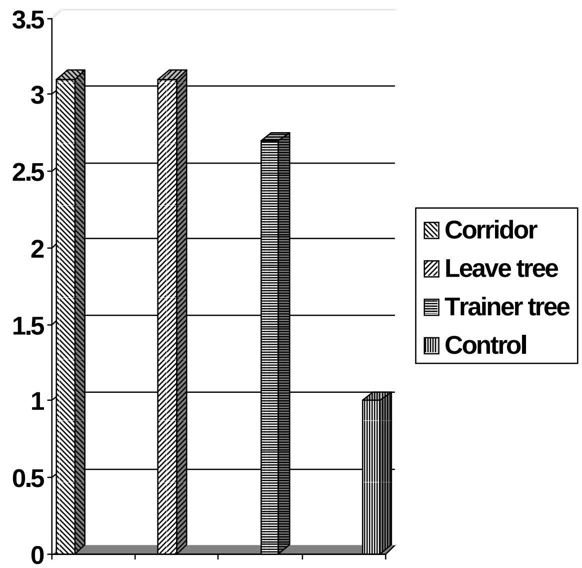

Figure 4— Number of epicormic sprouts on the first log by thinning method.

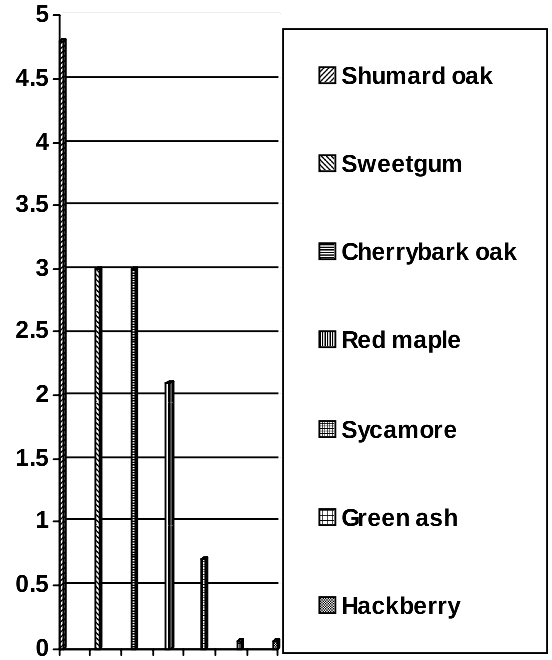

Figure 5— Number of epicormic sprouts on the first log by species.

between diameter and number of epicormic sprouts on the first log. There was a significant negative correlation that showed as the diameter increased the number of epicormic sprouts on the first log decreased, further indication of the negative effect of vigor on epicormic sprouting (Brown and Kormanik 1970).

CONCLUSIONS

All thinning methods met the objective of being a commercial harvest of 10 cords per acre or more and left 100 crop trees per acre. Although the leave tree method was the most productive harvest at 16 cords per acre, five years after thinning it has the greatest reduction of crop trees (over half) due to logging damage and epicormic sprouting. All thinning methods were detrimental to the future stand, producing nearly three times as many epicormic sprouts on the first log as occurred in the control. These sprouts resulted in down grading the number of crop trees left after thinning, reducing the leave tree thinning crop tree numbers by as much as 30 percent.

The control of vines appeared equally as good with the corridor method as the others and it was the most efficient to conduct. However, the corridor method significantly reduced the number of crop trees per acre since a third are removed and another 6 percent were lost to epicormic sprouting. There is no real explanation for the reduced number of vines in the corridor method since machinery activity was confined to the 20 foot wide cut strip. The least amount of logging damage occurred with the trainer tree method, but it was the hardest to mark and least productive for the loggers. The corridor and trainer tree methods proved to be the best thinning methods in this study, but the decision to use either of these methods should be based on careful consideration of the conditions of the existing stand.

If the stand has adequate desirable high quality stems (140 or more per acre) then the corridor method can be used if a target of at least 100 residual crop trees per acre averaging 12 inches diameter is desired. If the existing stand has at least 110 crop trees per acre, then the trainer tree method can be used. Because of the 12 percent logging damage to crop trees, and the 30 percent reduction in crop trees for epicormic sprouting, the leave tree thinning method should not be used in stands such as in this study unless at least 140 desirable crop trees can be marked to be left per acre. The effects of thinning on crop tree quality and growth in these study plots will be monitored again in the future.

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REFERENCES

Brown, C.L.; Kormanik, P.P. 1970. The influence of stand disturbance on epicormic branching. In: Silviculture and Management of Southern Hardwoods, 19th Annual Forestry Symposium. Baton Rouge, LA: LSU: 103-112.

Carvell, Kenneth L. 1971. Silvicultural aspects of intermediate cuttings. In: Proceedings, Oak Symposium; 1971 August 16-20; Morgantown, West Virginia. Upeer Darby, PA: U.S. Department of Agriculture, Forest Service, NE Forest Experiment Station: 60-64.

Clatterbuck, W.K.; Olliver, C.D.; Burkhardt, E.C. 1987. The silvicultural potential of mixed stands of cherrybark oak and American sycamore: spacing is the key. Southern Journal of Applied Forestry 11(3): 158-161.

Gingrich, S.F. 1971. Stocking, growth, and yield of oaks stands. In: Proceedings, Oak Symposium; 1971 August 16-20; Morgantown, West Virginia. Upper Darby, PA: U.S. Department of Agriculture, Forest Service, NE Forest Experiment Station: 65-73..

Kellison, R.C.; Martin, J.P.; Hansen, G.D.; Lea, R. 1988. Regenerating and managing natural stands of bottomland hardwoods. APA 88-A-6. Bottomland Hardwood Management Taskforce, Southeastern Technical Division, American Pulpwood Association, Inc. 26 p.

Kennedy, H.E.; Johnson, R.L. 1984. Silvicultural alternatives in bottomland hardwoods and their impact on stand quality. In: Proceedings, 14th Annual Southern Forest Economics Workshop; 1984 March 13-15; Memphis, TN. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station: 6-18.

SAS Institute 1999. SAS User's Guide: Statistical Version 6. Carey, NC. 484 p.

Smith, D.M. 1986. The Practice of Silviculture. New York: John Wiley & Sons, Inc. 525 p.

Tinsley, M.B.; Nix, L.E. 1998. Early thinnings in a young, sprout-origin, bottomland hardwood stand in South Carolina. In: Proceedings, Ninth Biennial Southern Silvicultural Research Conference; 1997 February 25-27; Clemson, SC. Ashville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station: 170-174.