CROP TREES AND QUALITY IN BOTTOMLAND HARDWOODS TEN YEARS AFTER AN EARLY THINNING IN A YOUNG SPROUT-ORIGIN STAND IN SOUTH CAROLINA

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Abstract—A 23-year-old, mostly sprout-origin stand in the Congaree river bottom near Columbia, SC, was commercially thinned in 1994 using three methods of thinning: (1) the "Leave tree", (2) "Trainer tree", and (3) "Corridor" methods. The stand was created in 1971 by KG-blade shearing a 90-year-old, heavily cutover bottomland hardwood stand. Before thinning, the stand had 260 to 300 trees averaging 8 to 9 inches d.b.h. and 28 to 31 cords per acre. There were 80 to 100 potential crop trees per acre (30 to 40 percent commercial oaks) of different bottomland species (oaks, sycamore, sweetgum, green ash and red maple). After-thinning, stocking levels were targeted to meet 80 to 100 crop trees per acre. In early 2000 and 2005, the effects of thinnings on residual stand quality were determined by measuring the diameter and number of stems per acre, epicormic sprouts in the first log, logging damage, and residual vine encumbrance, respectively, of residual crop trees. In 2000, the stand had 50 crop trees per acre, averaging 12.4 inches d.b.h. and 2.35 logs merchantable height. In 2005, the stand averaged 45 crop trees per acre, 15.7 inches d.b.h., and 1.8 logs merchantable height. The leave tree thinning resulted in a minor increase in epicormic sprouts, 1.3 in the first log per tree versus 0.33 for the control. All thinnings reduced vine encumbrance of crop trees from 40 to 24 percent, an enhancement in quality. Logging damage was lowest in the trainer tree thinning but is not now appreciable in any of the thinnings. The control has 53 crop trees per acre, the leave tree 46, the trainer tree 41, and the corridor 40, respectively. Diameter is greatest in the leave tree, 16.2 inches, having increased by 3.8 inches since the 2000 measurements.

INTRODUCTION

Early thinnings in 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 often favors valuable high quality stems of species such as cherrybark (*Quercus pagoda* Raf) and Shumard (*Q. shumardii* Buckley) oaks (Kennedy and Johnson 1984). Other desirable commercial species favored when they occur are green ash (*Fraxinus pennsylvanica* Marshall), sweetgum (*Liquidambar styraciflua* L.) and sycamore (Platanus occidentalis). A crop tree should be selected based on the vigor and quality of the surrounding stems (Clatterbuck and others 1987). However, the removal of too many cull trees can leave the stand understocked; consequently, some type of residual stocking guide should be employed (Gingrich 1971).

Thinning as early as ages 20 to 25 years can increase the growth potential and value of bottomland hardwoods on good sites. The improved market for hardwood pulpwood allows such sites to be commercially thinned at those ages (Kellison and others 1988). However, such early thinnings can be marginally commercial if they result in degrade to residual crop trees (Kennedy and Johnson 1984). In early 1993, a local consulting forester approached us concerning the advisability of early thinning in bottomland hardwoods on the Congaree River near Columbia, SC (Personal communication. 1993. Angus Lafaye, President, Milliken Forestry Company, P.O. Box 23629, Columbia, SC 29224-3629). As a result of this interest, a study was installed to determine the most effective "standard" commercial thinning method relative to its effects on the future value of residual crop trees in a young sprout origin 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 has a site index (base age 50 years) of 90 to 95 feet for cherrybark oak and has low wet areas interspersed among drier, low broad ridges. The stand was a 23-year-old sprout-origin stand that was KG-blade sheared in 1971. According to the consulting forester (Lafaye 1993), many residual young sapling and pole-sized oaks were left to grow unsheared during the shearing operation.

Before thinning, the stand consisted of 260 to 300 trees per acre, averaging 8 to 9 inches diameter at 4.5 feet height (d.b.h.), 28 to 31 cords per acre, and 80 to 100 potential crop trees per acre (30 to 40 percent commercial oaks) of different bottomland species (oaks, sycamore, sweetgum, and green ash). Many of the crop trees, up to 60 percent in some areas, were infested with grape vines (*Vitus* spp). The criteria for crop trees were that they be a commercial species, have a minimum of one log, be of good bole form, with minimal epicormic sprouting (less than 3 sprouts in the first log), and be a dominant or co-dominant tree not severely infested with grape vines.

Experimental Design

The thinning methods were done in a randomized complete block design with 4 16-acre blocks containing 4-acre treatments, each of an 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

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wide) marked down the center with treatments on either side. Analysis of variance for a randomized complete block design was performed to test the differences between treatment means (SAS Institute 2002). When the treatment means were different, Tukey's test at the 0.05 level of significance was used to test which means were different.

Measurements

A 1-acre sampling area was marked in the center of each of the 4-acre treatment plots. The sample trees were marked before measurement 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, d.b.h., number and grade of logs, the number of epicormic sprouts in the first log, severity of vine infestation, and logging damage were noted.

Thinning Methods

All thinning methods were marked to be commercial, at least 10 cords per acre were to be removed (about 100 trees per acre averaging 8 inches d.b.h. and 60 feet tall). 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 approximately 20 by 20 feet spacing where possible, but often a less-than-desirable tree had to be chosen in keeping with the 60 percent residual stocking level suggested for upland hardwoods by Gingrich (1971).

The leave tree method removed all trees except for the crop trees. The same 20 by 20 feet spacing was attempted and 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.

The corridor treatment removed one-third of the volume per acre (about 100 trees per acre), and felling and skidding was done 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.

RESULTS

Residual Crop Trees

A total of 720 crop trees were sampled and consisted of 41 percent sweetgum, 24 percent cherrybark oak, 8 percent Shumard oak, and 27 percent others (mostly sycamore). The residual stand has an average of 40 to 50 high quality crop trees per acre, depending on the thinning method. Ten years after thinning, losses to logging damage, butt rot, windthrow, and sprout degrade has resulted in the leave tree thin with 46 crop trees per acre, the trainer tree method with 41, and the corridor thin with 40. The control has 53 crop trees per acre. This is a drastic reduction in the number of crop trees projected before the thinning in 1994 (at least 100 trees 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), logging damage, or other defects. Howell and Nix (2002) found that the number of crop trees in this stand had dropped from 80 to 50 per acre in the first 5 years after the 1994 thinnings.

Vine Infestation

The number of crop trees with severe vine infestation was reduced by the thinning treatments. The controls had nearly twice as many trees with severe vine infestation than did the thinnings (22.5 versus 12 trees per acre, respectively). The vine infestation in the control is significantly greater than the thinnings (at the 0.05 level), but the thinnings do not differ. In this case, 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). Ten years after thinning, logging damage is no longer a significantly visible factor in this stand, but along with butt rot and windthrow, may have caused some mortality of crop trees.

Epicormic Sprouting

Ten years after the thinnings, epicormic sprouts, though minor, are still significantly greater in the leave tree thinning, 1.3 per tree in the first log, compared to the control, 0.37 per tree (0.05 level). All of the thinnings apparently increased the amount of sunlight in the stand which stimulated epicormic sprouting (Brown and Kormanik 1970). However, the trees in the treatments have sufficiently closed their canopies and reduced the epicormic sprouting to less than 1 in the first log in all but the leave tree thinning.

Diameter Growth

Ten years after thinning the average d.b.h. of crop trees in the leave tree thinning is 16.2 inches and is significantly greater (0.05 level) than the control (14.8 inches). Crop trees in the leave tree thinning have grown 3.8 inches in d.b.h. since the last measurement in 2000 (Howell and Nix 2002), over an inch more than did those in the controls during the same 5 year period.

CONCLUSIONS

All thinning methods met the objectives of being a commercial harvest of 10 cords per acre or more and 10 years ago initially left a reasonably stocked stand of 60 to 80 crop trees per acre. The leave tree method was the most productive harvest at 16 cords per acre, and 10 years later it has the most crop trees per acre (46) of the thinnings. The corridor method, which was the most efficient harvest method with its ready-made skidding corridors, has only 40 crop trees per acre left, probably because it cut one third of all trees including the crop trees. All thinning methods were beneficial to the future stand by reducing vine infestation of crop trees with no major increase in epicormic sprouts or logging damage. However, the drastic loss of crop trees (almost 50 percent) in all the stand areas remains a puzzle.

We suspect that the sprout origin of many of the sheared stems dating back to 1971 resulted in an excessive mortality due to butt rot and vine infestation in this often wet stand. Since it floods up to 3 feet height throughout most of the stand each year and there was abundant evidence of washout around the base of many stems, perhaps windthrow was a contributing factor as many of the young crop stems had quite large crowns in 1994.

The corridor and leave tree thins 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 at least 140 desirable high-quality, well-anchored stems along with at least 100, 8-inch d.b.h. culls per acre, then the corridor method can be used if a target of at least 100 residual crop trees per acre is desired. If the existing stand has at least 110 crop trees per acre with 220 8-inch d.b.h. culls, then the trainer tree method can be used. Because of the initial 12 percent logging damage to crop trees and the 30 percent reduction in crop trees due to epicormic sprouting, the leave tree thinning method should not be used in stands such as these unless at least 100 desirable crop trees per acre can be marked to be left. The effects of thinning on crop tree quality and growth in this study probably will not be monitored again in the future due to the impending retirement of the author.

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