Series Paper I

Why Not Selling Your Best Southern Pine Trees in a First Thinning Can Make Sound Economic Sense using Three Wood Product Classes

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Introduction

Many private non-industrial forest landowners (NIPFLs) that own pine plantations have to make thinning decision at some point. An obvious objective with any timber sale is to realize as much income as possible. But should this be the overriding objective in a first thinning? In almost every case the answer should be NO! The first thinning primary objectives should be: (1) remove trees that have some defect or have inferior growth characteristics that will always keep them in the lowest price category; pulpwood. (2) Allow the best trees that have no defects and are the most dominant in the stand to grow at an accelerated pace into more valuable solid wood products after the thinning.

From an NIPFL's perspective, there are at least three ways to grow value from timber, across time. These are, in order of increasing importance; (1) real product price appreciation, (2) wood volume growth, and (3) individual tree stems moving to higher value product classes through growth and management; i.e., pulpwood—to--chip-n-saw—to—sawtimber—to peeler logs and poles. If we look at trees in a pine stand as inventory, we are generally best to liquidate the portion of inventory that will not grow significantly in value as soon as possible. The portion of inventory that does not grow appreciably in value are trees with defects. Trees targeted for removal (liquidation) during the first thinning generally have defects such as crook, sweep, many/large branches, a fork below 17 feet, and/or a disease (fusiform canker on the stem or pitch canker). Trees that should be included in a first thinning with the defective trees are those that occupy the lower portions of the overall canopy (suppressed or intermediate trees) that commonly do not respond positively to a thinning as the larger dominant and co-dominant trees would. Good quality, defect-free crop trees that are generally larger stems, respond to a thinning as more of the site's resources become available to them (water, nutrients, and sunlight). These crop trees grow at a faster rate after a thinning due to less competition for the site's resources.

Trees are sold by product classes (Table 1). Wood product classes are based on two major factors: defects and diameter classes (to a given length which is highly correlated to diameter). Defects generally determine whether a tree is pulpwood, the lowest valued wood. If a tree has no visible defects, then the diameter dictates what wood product the tree falls into.

From an economic standpoint, a forest landowner wants to grow as much of the highest valued wood as possible (i.e. hold the portion of inventory that will grow into the highest valued products). In the example we use here, that class is sawtimber (ST) with a diameter at 4 ½ feet above groundline (also called diameter at breast height; dbh) of 13 inches or greater with no defects and is relatively straight (some sawmills may take smaller diameter trees). <u>Pine sawtimber is worth over 6-times what pine pulpwood is worth</u> (TM-S 2005, Table 1). Pine sawtimber trees are used to cut dimension lumber (2"x 4"x 8's, 2"x 4"x 10's, 2"x 6"x 10's, 2"x

8"x 12's, 4"x 4"x 10's and larger lumber). Pine chip-n-saw (CNS) trees have no visual defects, are relatively straight, and have dbh of 9 to 13 inches. Pine chip-n-saw is worth over 3.5 times the value of pine pulpwood (Table 1). Trees that qualify as CNS trees are used to make small dimension lumber; 2"x 4"x 8's, 2"x 4"x 10's, and some 4"x 4"x 8's primarily (chip-n-saw mills will vary what dimension lumber they manufacture and the diameter size limit as well).

How does a landowner make the most of his/her pine stand (inventory) from a financial standpoint? Should the landowner (a) sell some of their best and largest trees (inventory with potential for high valued products in the future) in the first thinning and make more money in the thinning or (b) are they better off with cutting primarily the trees with defects (inventory that is of low current and low future value) and smaller sized trees, leaving the best trees to grow at a faster rate to the higher valued product classes? This paper addresses these questions using three common pine product classes.

Scenarios and Assumptions

A forest landowner has 100 acres of 16-year-old loblolly pine and is considering two thinning options. The options are as follows:

Scenario #1: Thin to allow the best crop trees (inventory with the potential for high value with time) to grow into more valuable product classes making more $/ton later in the life of the stand but with reduced profits from the 1st thinning. The landowner thinks that removing trees with poor form, a fork below 17', small, suppressed, and a stem canker in the first thinning will allow his best crop trees to grow at a better rate.

Scenario #2: Thin to achieve a higher per acre price by selling some of the better crop trees along with trees that are defective (stem canker, fork below 17 feet, large/many branches, crocked trees).

Stand information:

(1) Loblolly pine, 1st thinning is to occur @ age 16-years when basal area is 137 ft^2/acre and approximately 440 trees per acre (TPA).
(2) Thin back to 65 ft^2/acre: Scenario #1: 157 trees per acre (TPA) for row +low thin[1] ; Scenario #2: 195 TPA for the row + even thinning[2].
(3) Stand site index is 65 feet (base age 25-years) for dominant and co-dominant trees with a mean annual increment (MAI) of 4.4 tons/acre/year from establishment through age 16-years and an MAI of 4.6 tons/acre/year from age 17- through 27-years.

Two thinning types:

Scenario 1: A row removal + low thinning in the leave rows removing over 90% pulpwood trees (diseased, deformed, forked below 17 ft, and stem cankered trees) and 20% of the good crop trees (in the thinned rows). A total of 283 TPA are removed in this thinning operation (74 ft^2 basal area/acre and 34.3 tons/acre removed) while leaving 157 TPA (65 ft^2 basal area/acre and 35.6 tons/acre).

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[1] row + low thinning: removing every 3rd, 4th or 5th row and thinning from below: removing smaller diameter and/or poorer quality trees (100% of 4 to 8 inch dbh classes , 30% of the 9 inch class, and 25% of the 9 to 12 inch classes) to achieve desired stand conditions after thinning.

[2] row + even thinning: removing every 3rd, 4th or 5th row and thinning 100% of 3 to 6 inch dbh classes and 50% of 6 to 12 inch dbh classes in this case..

Scenario 2: A row removal + even thinning in the leave rows resulting in removal of 75% of the relatively smaller-diameter and poorer quality pulpwood or suppressed trees and 40% of the larger good crop trees from the stand. A total of 245 TPA are removed in this thinning operation (74 ft^2 basal area/acre and 36.0 tons/acre) while leaving 195 TPA (65 ft^2 basal area/acre and 34.4 tons/acre).

Table 1. Pine stumpage prices (TM-S © 1st Qtr 2005)

Product class (abbreviation: dbh, form specs)	Per ton price	Per cord price
Pulpwood (PW: 4.6 to 9.5" dbh) to a 3" top	$7	$18
Chip-N-Saw (CNS: 9.6 to 12.5" dbh, good form) to an 6" top	$25	$68
Sawtimber (ST: >12.5" dbh, good form) to an 8" top	$43	$115

Winyield © version 1.11 (Hepp 2001) is the model used for this paper to estimate trees per acre by diameter class and product class distributions (Figure 1), tons per acre (Figure 2), and value per acre (Figure 3) for trees harvested and trees per acre remaining (Figure 4) by thinning type. Winyield then grew out the stand and generated trees per acre by diameter class and thinning type (Figure 5), merchantable CNS and ST wood (tons per acre, Figure 6), value by CNS and ST product classes (Figure 7), and dollar value per acre from the clear-cut at age 27-years (Figure 8).

Thinning diameter distributions, wood production and value per acre (age 16-years)

A total of 59 trees per acre in the 8 through 11 inch diameter classes that were harvested in the thinning at age 16-years with the row + low thinning scenario #1 (Figure 1). Comparatively, there were a total of 108 trees per acre in the 8 through 11 inch diameter classes that were harvested in the thinning at age 16-years with the row + even thinning scenario #2 (Figure 1).

A total of 34.3 and 36.0 tons per acre were harvested from the row + low thin and row + even thin, respectively at age 16-years. There were 21.0 and 11.3 tons of 5 through 7 inch dbh class trees harvested by the row + low and row+ even thin, respectively (Figure 2). Conversely, 13.3 and 24.7 tons of 8 through 11 inch dbh class trees were harvested with the row+ low and row + even thinning (Figure 2).

1st Thin economic estimates with Scenario #1:

Landowner makes = $288/acre for 1st thinning ($248 as PW and $40 as CNS per acre, Figure 3)

1st Thin economic estimates with Scenario #2:

Landowner makes = $314/acre for 1st thinning ($234 as PW and $80 as CNS per acre, Figure 3)

Note that the economic gain in selling approximately 50 extra good crop trees (inventory with potential for the highest valued products with time) per acre did result in more revenue from the 8 through 11 inch diameter classes but less revenue in the 6 and 7 inch diameter classes (Figure 3). But the question is "is it worth a landowner selling more good crop trees (high valued inventory with time) in a 1st thinning than is needed to achieve a RBA of 65 sq. ft. per acre?" The residual crop tree diameter distribution (Figure 4) shows 157 trees per acre in the 8 through 11 inch diameter classes for the row + low thin stand and 108 trees per acre in the 8 through 11 inch diameter classes for the row + even thin stand.

Clear-cut diameter distributions, wood production, and value per acre (age 27-years)

By age 27-years (11 years post-thinning) the loblolly pine diameter distribution favors the row + low stand (Figure 5) with 51 trees per acre in the sawtimber class (13" dbh class and larger, highest valued inventory) versus 33 trees per acre from the row + even thin scenario. Total CNS and ST wood production for the row + low was 69.7 tons per acre compared to 51.9 tons per acre for the row + even thin (Figure 6). That is a difference of 17.8 tons per acre of CNS and ST wood valued at $25 and $43 per ton. The row + low thin and row + even thin produced similar amounts of wood, 90.9 and 89.5 tons per acre, respectively. The row + low thin produced 35.7 tons per acre of CNS and 34.0 tons per acre of ST, 6.6 and 11.2 tons per acre more of CNS and ST respectively, than the row + even thin (29.1 CNS and 22.8 ST tons per acre, Figure 7). The row + even thin produced more PW volume (the low valued inventory; 37.5 tons per acre) than the row + low thin (21.2 tons per acre, Figure 7).

The clear-cut revenue generated from the row + low thin is $2597 per acre at age 27-years. The clear-cut revenue generated from the row + even thin is $2042 per acre at age 27-years, $555 per acre less than the row + low thinning. The majority of revenue in both thinning scenarios came from the CNS and ST sized trees by age 27-years.

<u>Rate of return (ROR) of marked thin in scenario #1 compared to #2</u>

The rate of return (ROR = $((\text{return}/\text{cost})^{1/\text{years}} - 1) \times 100$) for scenario 1 versus scenario 2 is $((555/26)^{1/11} - 1) \times 100$ or 32%. A forest landowner may look at the thinning alternatives as giving up $26/acre at age 16-years to realize an extra $555/acre eleven years later. Let's assume that a landowner had the stand marked (painted trees for either "leave" or "take" depending on the timber sale contract) by a professional forester for $45/acre. The total cost per acre at age 16-years is now $26 + $45 or $71. Solving for ROR ($((555/71)^{1/11} - 1) \times 100$) we get 20.5 %, still an attractive rate of return. In this case, it was worth the loss of $26 in wood sales and a cost of $45 per acre to mark the stand to get more of the best crop trees to grow an extra $555 per acre in wood value eleven years later.

<u>SUMMARY</u>

In addressing the question of how a landowner makes the most of his/her pine stand from a financial standpoint. Does the landowner (a) sell some of their best and largest trees in the first thinning (potentially high valued inventory) and make more money in the thinning or (b) are they better off with cutting primarily the trees with defects and smaller sized trees (low valued inventory with low appreciation internal rates), leaving the best trees to grow at a faster rate to the higher valued product classes? <u>In this case, the landowner is best off harvesting primarily the defective trees (low value inventory), removing very little of the good quality large trees and growing the good crop trees (inventory that with time will be high valued products) out to final harvest.</u>

Scenario #1 vs Scenario #2:

►Total revenue generated by thinning type: $2885 per acre ($288 + $2597) for the row + low thinning and $2356 per acre ($314 + $2042) for the row + even thinning.

►Landowner **gains $26/acre** in revenues due to selling some of his/her best trees as chip-n-saw in 1st thinning @ age 16-years with the row + even thinning,

►BUT **loses $555/acre** ($2597/acre - $2042/acre) in final harvest value @ age 27-years with the row + even thinning.

DISCUSSION

►It is very important that the first thinning be done at the right time and the right way.

►The major objectives of the first thinning should be (1) to remove (liquidate) those trees are and always will be in the lowest valued product class (pulpwood, low valued inventory) and (2) leave as much of the larger trees that are defect free (future high value inventory) in the stand in good condition.

►Forest management decisions that landowners make, including the type of first thinning, are decisions that must be carefully planned and executed. In this case, the first thinning decision that is made has large financial consequences and has to be lived with for a relatively long period of time.

If the goal of a forest landowner is to have a row + low thinning performed in their pine stand then they have two major options: (1) have a professional forester mark the "leave" (or "take" trees, whichever is the lesser of the trees to mark) with paint (usually blue) or (2) have a competent logger select those defective and smaller trees for removal during the thinning operation. If option #1 (professional forester mark "leave" or "take" trees) is the only way to achieve a 5th row + low thinning, then that is what a landowner should do. There are some loggers that can perform a reasonably good "low" thinning (removing the defective trees and the lower canopy position trees). The bottom-line is to do that thinning operation that will give you the best results: leaving the potentially high valued inventory to grow and liquidating the low valued inventory in the thinning.

The "row + low" and "row + even" thinning options used in this paper could be accomplished using common 3rd, 4th or 5th row + selection thinning practices. Each of these thinning types has their advantages and disadvantages. For more information on 3rd, 4th and row + selection thinning methods and their advantages and disadvantages see Dickens, Dangerfield and Moorhead 2005 paper on row + selection thinning methods.

Other important factors that effect the financial outcomes of first thinning options include: (1) rotation age (shorter rotation ages may reduce the thinning method differences due to less product class differentiation, while longer rotation ages than the one used here may increase the thinning method differences), (2) first thinning residual basal area (higher residual basal area can decrease thinning type and quality financial differences while a lower residual basal area can increase thinning type and quality financial differences), (3) percent defect in the stand, (4) current and future stumpage prices, and (5) first thinning timing.

Literature Cited

Timber Mart South (TM-S) ©. 2005. First Quarter 2005 Georgia average stumpage prices. Warnell School of Forest Resources, University of Georgia, Athens, GA

Hepp, T.E. 2001. WINYIELD © v 1.1. Forest Growth, Yield, and Financial Analysis Tool for Southern Forests. Tennessee Valley Authority, Norris, TN.

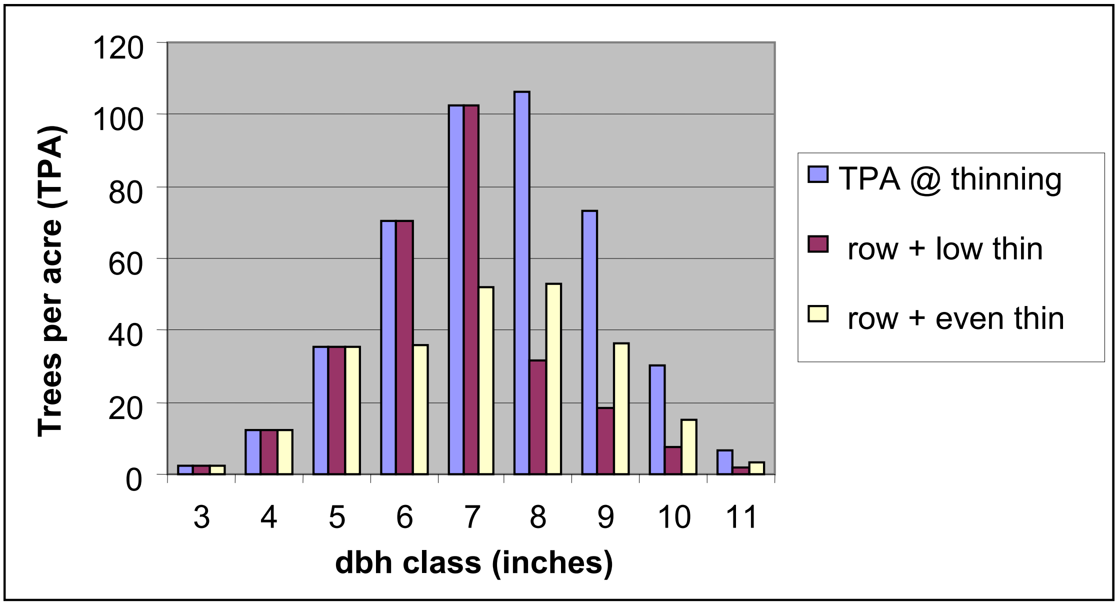

Figure 1. Harvested loblolly pine trees per acre @ age 16-years based on thinning type and trees per acre (TPA) just prior to thinning.

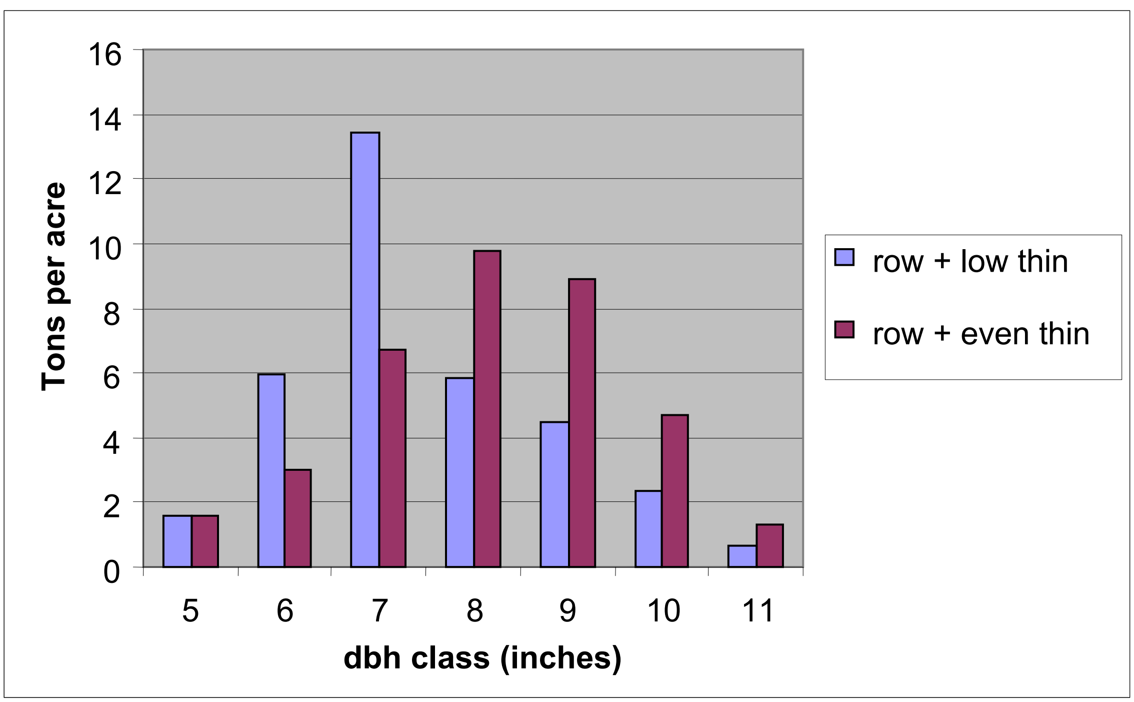

Figure 2. Harvested loblolly pine merchantable wood @ age 16-years based on thinning type.

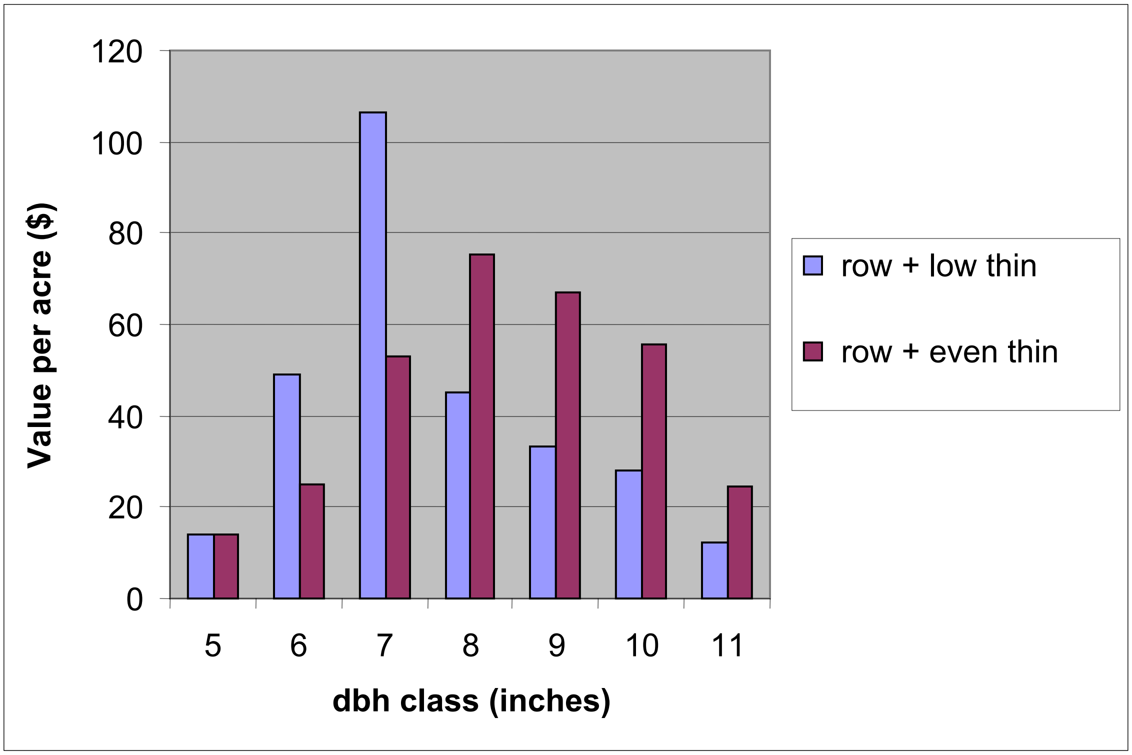

Figure 3. Harvested loblolly pine wood value @ age 16-years based on thinning type.

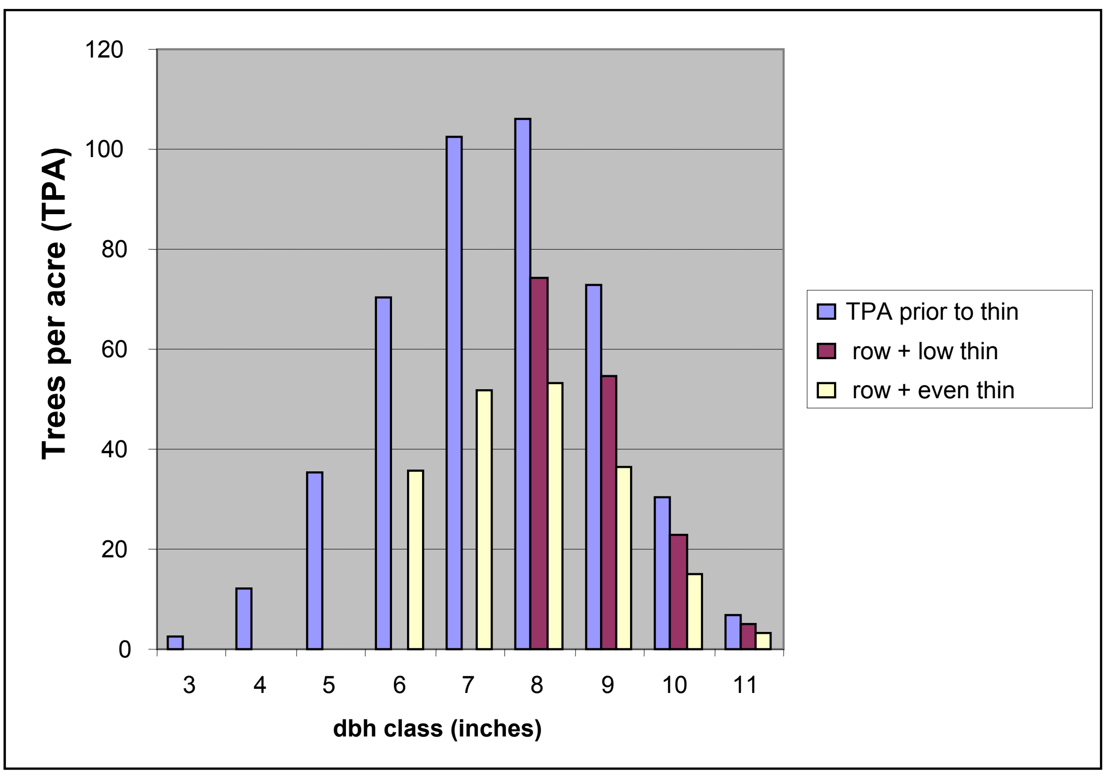

Figure 4. Residual loblolly pine trees per acre after the thinning @ age 16-years by dbh class and thinning type and trees per acre prior to the thinning.

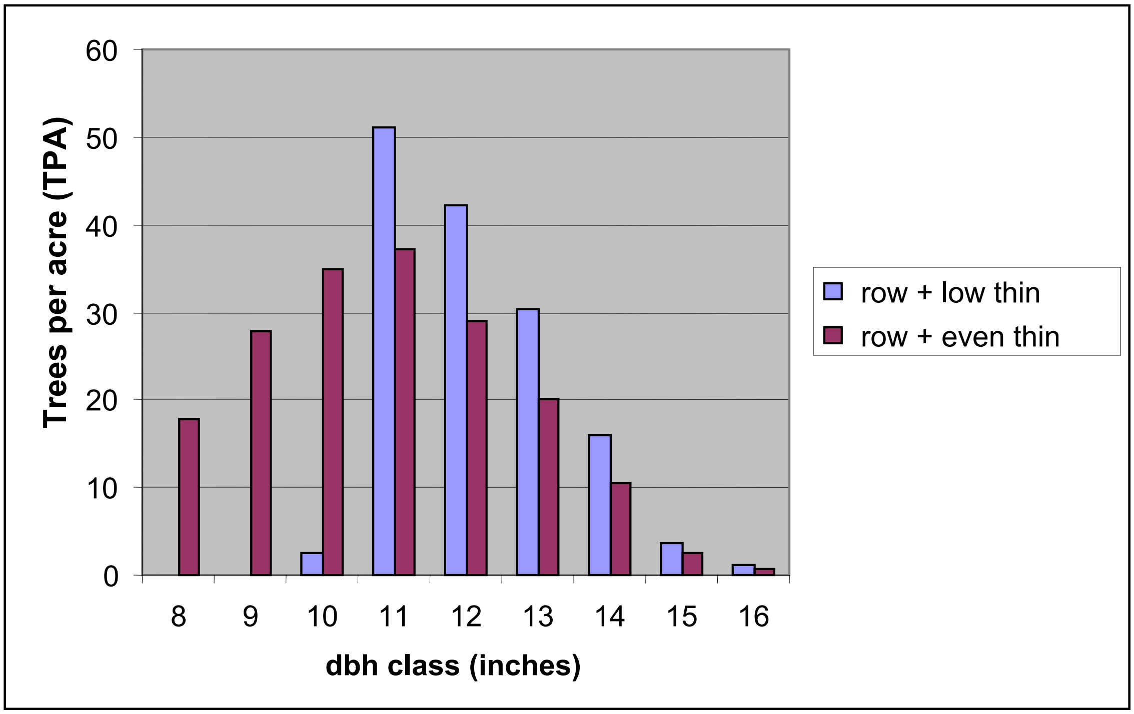

Figure 5. Loblolly pine diameter distribution @ age 27-years by dbh class and thinning type (11 years after 1st thinning).

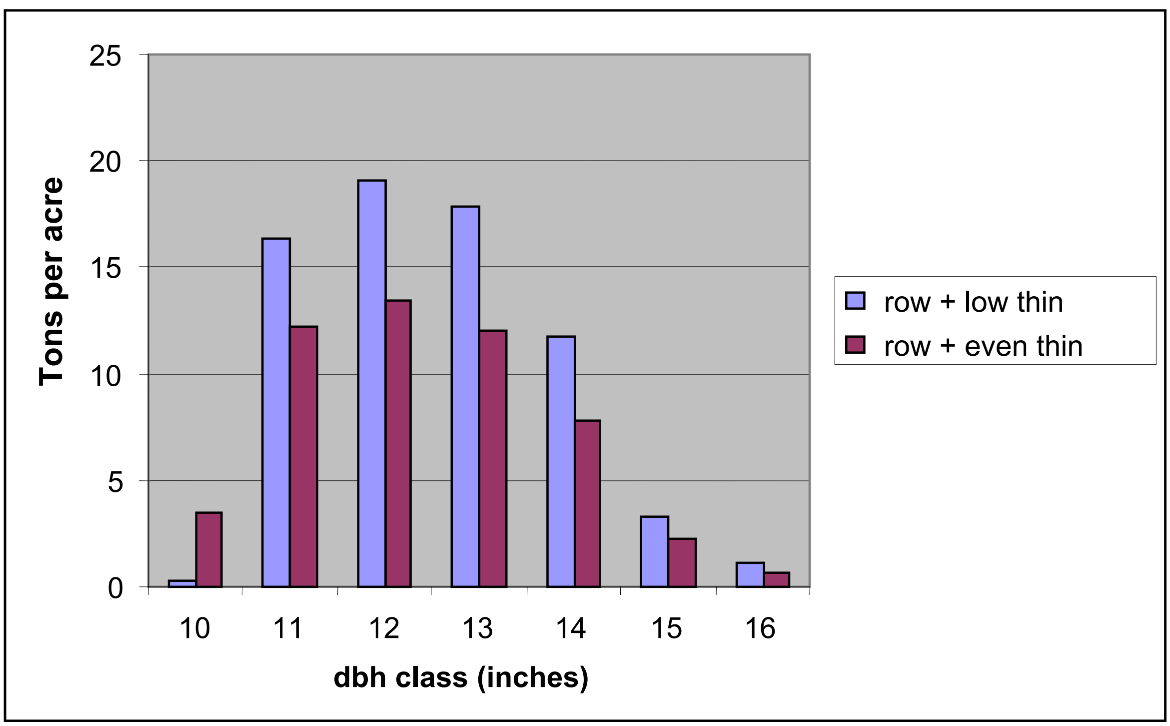

Figure 6. Loblolly pine chip-n-saw and sawtimber production at age 27-years by dbh class and thinning type (11 years after 1st thinning).

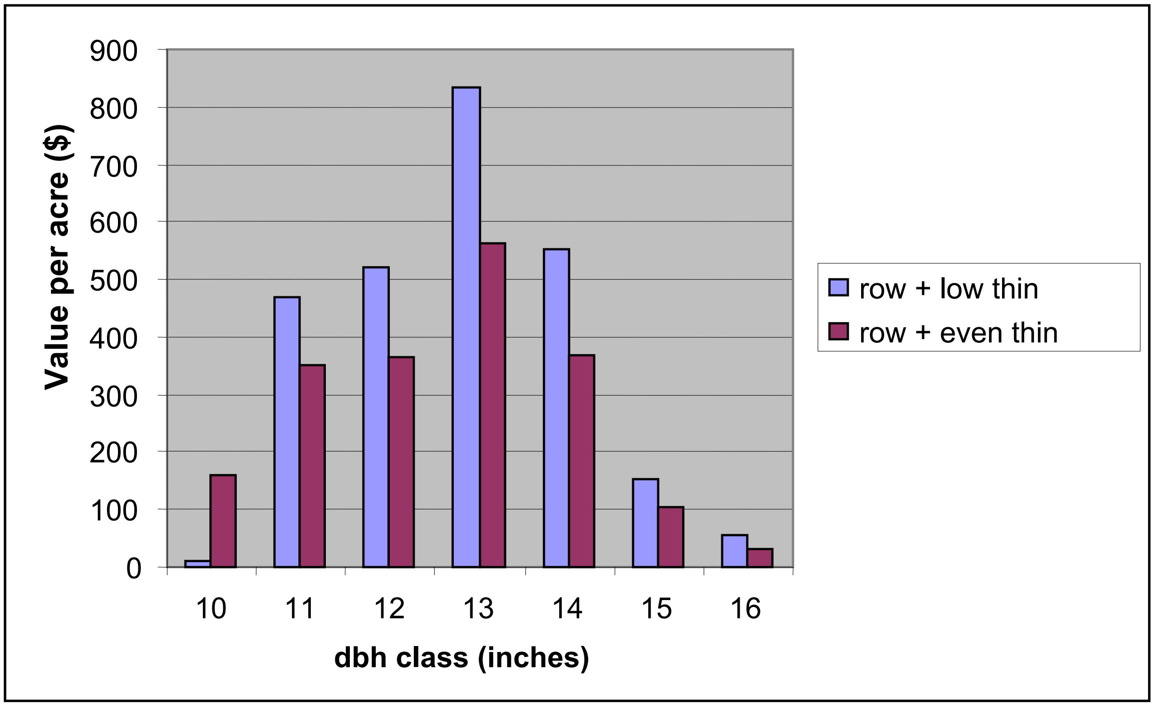

Figure 7. Loblolly pine chip-n-saw and sawtimber value by dbh class and thinning type at age 27-years (11 years after 1st thinning).

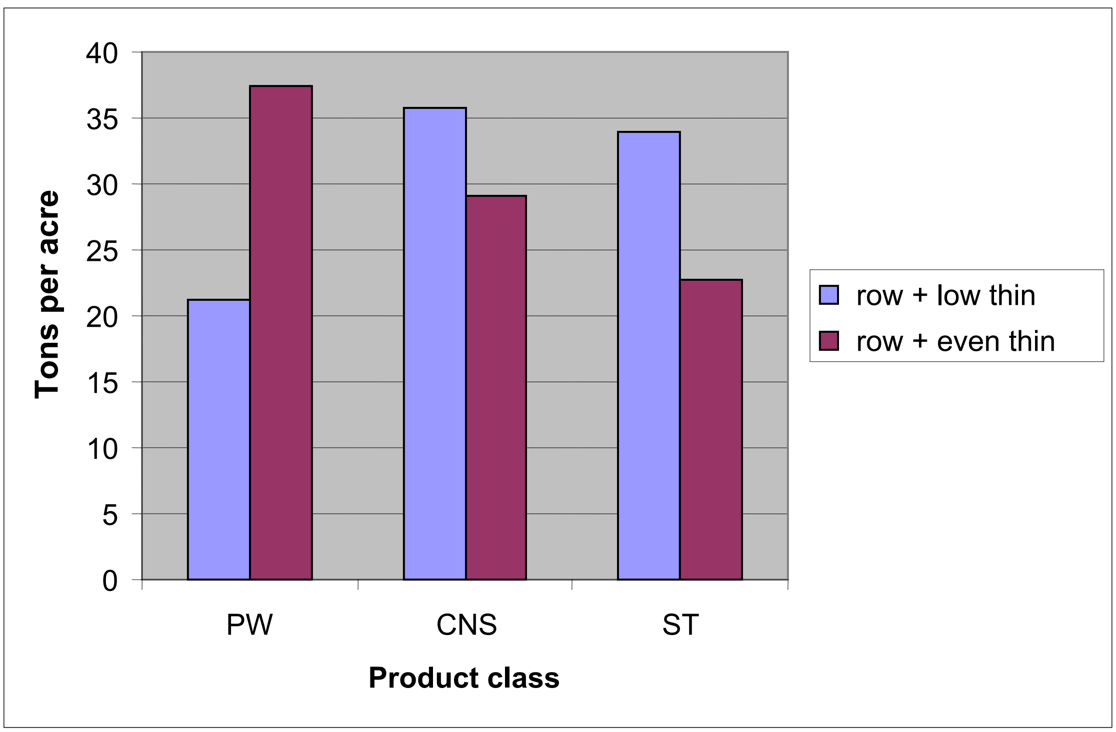

Figure 8. Loblolly pine three product class distribution by thinning type at age 27-years (11 years after 1st thinning). PW=pulpwood, CNS=chip-n-saw, ST=sawtimber.