

## Series Paper IV

# Why Not Selling Your Best Southern Pine Trees in a First Thinning Can Make Sound Economic Sense A Comparison of Selling Timber Using Three versus Four Wood Product Classes – Impact on Rotation Length Financial Measures

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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.

If we look at trees in a pine stand as inventory, we are generally best to liquidate the portion of the inventory that will not grow significantly in value. The portion of inventory that does not grow appreciably in value are trees with defects. Trees targeted for removal during the first thinning generally have defects such as: a 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 are generally larger stems that 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. In this paper, four product classes are using in selling timber: pulpwood, superpulp, chip-n-saw, and sawtimber.

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 visual defects and is relatively straight (some sawmills may take smaller diameter trees). Pine sawtimber is worth over 6-times what pine pulpwood is worth (TM-S 2005, Table 1). Pine sawtimber trees are used to cut dimension lumber (2"x 4"s, 2"x 6"s, 2"x 8"s, 2x 10"s, 2"x 12"s, 4"x 4"s, and 4"x 6"s in 8, 10, 12, 14, and 16 feet lengths). 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 are used to make small dimension lumber; 2"x 4"x 8', 2"x 4"x 10' primarily, and some 4"x 4"x 8's. The unsawed remaining wood is chipped and usually sold to a pulp mill. Chip-n-saw mills will vary what dimension lumber they manufacture and the diameter size limit as well. Pine superpulp (SP) trees are those with no or minor stem defects and a dbh of 8 and 9 inches. Superpulp trees are used to make small dimension lumber (2"x 4"x 8's and 2"x 4"x 10's) and the balance of wood is chipped and used for pulp. Three versus four product class prices are used in this paper (Table 1).

How does a landowner make the most of his/her pine stand from a financial standpoint? Should the landowner (a) sell some of their best and largest trees in the first thinning and make more money in the thinning, (b) are they better off with cutting primarily the trees with defects and smaller sized trees, leaving the best trees to grow at a faster rate to the higher valued product classes, and (c) is it financially beneficial to get trees sold using three or four product class prices? This paper addresses these questions.

### **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:** 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 first 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:** 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, crooked trees).

### **Stand information:**

- (1) Loblolly pine, 1<sup>st</sup> thinning is to occur @ age 16-years when basal area is 137 ft<sup>2</sup>/acre and approximately 440 trees per acre (TPA).
- (2) Thin back to 65 ft<sup>2</sup>/acre (157 trees per acre (TPA) for row + low thin and 195 TPA for the row + even thinning).
- (3) Stand site index is 65 feet (base age 25-years).
- (4) The mean annual increment (MAI) from establishment through age 16-years is 4.4 tons/acre/year and from age 17-years through age 27-years the MAI is 4.6 tons/acre/year.
- (5) We assumed in both scenarios: \$250/acre for site prep and planting cost in 1989, an annual management, property tax, and periodic burning cost of \$9/acre (1989 through 2016), and a 10% harvest cost at age 16- and 27-years (2005 and 2016). The land was assumed to be already owned. All costs and returns are in real (today's) dollars.

### **Two thinning types:**

Scenario 1: A row + 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<sup>2</sup> basal area/acre and 34.3 tons/acre removed) while leaving 157 TPA (65 ft<sup>2</sup> basal area/acre and 36.1 tons/acre).

Scenario 2: A row + even thinning removing 75% of the pulpwood or suppressed trees and 40% of the good crop trees/acre-1 (20% in the thinned rows and 20% in the stand). A total of 245 TPA are removed in this thinning operation (74 ft<sup>2</sup> basal area/acre and 36.0 tons/acre) while leaving 195 TPA (65 ft<sup>2</sup> basal area/acre and 34.4 tons/acre).

**Table 1. Pine stumpage prices (TM-S 1<sup>st</sup> Qtr 2005)**

Product class (abbreviation, dbh, form specs)	Price per ton	Price per cord
Pulpwood (PW: 4.6 – 7.5” dbh, with or without defects)	\$7	\$18
<sup>1</sup> Superpulp (SP: 7.6 – 9.5” dbh, with minor form defects)	\$12	\$32
Chip-n-saw (CNS: 9.6 – 12.5” dbh, good form)	\$25	\$68
Sawtimber (ST: > 12.5” dbh, good form)	\$43	\$115

<sup>1</sup>Superpulp price was not available in TM-S. It’s value was estimated to be 70% greater than PW.

Winyield (version 1.11 Hepp 2001) is the model used for this paper to estimate trees per acre by diameter class and product class (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 wood (tons per acre, Figure 6), value by product class (Figure 7 for 3 product classes), and dollar value per acre from the clear-cut at age 27-years (Figure 8).

### **Diameter distributions and wood production using three and four product classes**

#### **Thinning @ 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). Thirty-four and 36 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+ mark and row + even thinning (Figure 2).

Note that the economic gain in selling approximately 50 extra good crop trees per acre (inventory with potential for the highest value with time) at age 16-years with the row + even thinning 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 1<sup>st</sup> thinning than is needed?” 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. The row + even thin scenario had \$26 and \$76 greater per acre thinning at age 16-years revenue than the row + low thin using 3 or 4 product classes (Table 2).

#### **Clear-cut at age 27-years**

By age 27-years (11 years post-thinning) the loblolly pine diameter distribution tends to favor 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). The row + even thin produced more SP and PW volume (the low valued inventory; 37.5 tons per acre) than the row + low thin (21.2 tons per acre, Figure 7).

### **Three Product Prices**

The clear-cut revenue generated from the row + low thin is \$2597 per acre at age 27-years (Table 2). 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 the thinning scenarios came from the CNS and ST sized trees (Table 2).

### **Four Product Prices**

Selling pine stumpage using four product prices increased revenues from the thinning by \$61 and \$111 per are (21% and 35%) for the row + low thin and row + even thin, respectively (Table 2). Selling pine stumpage using four product prices did not increase revenues from the clear-cut for the row + low thin due to all trees being in the CNS or ST diameter classes. Selling pine stumpage using four product prices increased revenues from the clear-cut for the row + even thin due by \$71 per acre, a modest 3% gain (Table 2). There was a revenue gain of 21% to 35% realized in the thinning at age 16-years selling wood using the four product class prices over the three product class prices.

Table 2. Loblolly pine stumpage revenues realized with a thinning at age 16-years and a clear-cut at age 27-years by thinning type using three<sup>1</sup> and four<sup>2</sup> product classes.

Harvest age (years)	Thinning type	PW (\$/acre)	SP (\$/acre)	CNS <sup>3</sup> (\$/acre)	ST <sup>3</sup> (\$/acre)	Total \$ revenue/acre
-----Three products-----						
16	row+low	248	0	40	0	288
	row+even	234	0	80	0	314
27	row+low	0	0	1002	1595	2597
	row+even	92	0	878	1072	2042
-----Four products-----						
16	row+low	169	140	40	0	349
	row+even	92	253	80	0	425
27	row+low	0	0	1002	1595	2597
	row+even	0	163	878	1072	2113

<sup>1</sup>Three product classes = pulpwood (PW: 4.6–9.5” dbh to a 3” top), chip-n-saw (CNS: 9.6-12.5” dbh to a 6” top), and sawtimber (ST > 12.5” dbh to an 8” top).

<sup>2</sup>Four product classes = pulpwood (PW: 4.6–7.5” dbh to a 4” top), superpulp (SP: 7.6-9.5” dbh to a 5” top), chip-n-saw (CNS: 9.6-12.5” dbh to a 6” top), and sawtimber (ST > 12.5” dbh to an 8” top).

<sup>3</sup>All CNS and ST stems’ wood above the minimum top diameter (6” and 8”, respectively) is sold at PW price.

## Scenario #1 vs Scenario #2:

### **Three Product Classes**

- ▶ 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 1<sup>st</sup> thinning @ age 16-years,
- ▶ BUT **loses \$555/acre** (\$2501/acre - \$1969/acre) in final harvest value @ age 27-years (Table 2).
- ▶ Scenario #1's (row + low thin) financial measures were all greater than scenario #2 (row + even thin). Scenario #1 NPV and AEV were more than double than scenario #2 (Table 3). Scenario #1 IRR and CRR were 1.34% and 1.16% greater than scenario #2, respectively (Table 3).

Scenario #, thin type	NPV (\$/ac)	AEV (\$/ac/yr)	IRR (%)	CRR (%)
1, row + low thin	274	21	8.67	8.16
2, row + even thin	114	9	7.33	6.92

### **Four Product Classes**

- ▶ Total revenue generated by thinning type: \$2946 per acre (\$349 + \$2597) for the row + low thinning and \$2538 per acre (\$425 + \$2113) for the row + even thinning.
- ▶ Landowner **gains \$76/acre** in revenues due to selling some of his/her best trees as chip-n-saw in 1<sup>st</sup> thinning @ age 16-years,
- ▶ BUT **loses \$484/acre** (\$2597/acre - \$2113/acre) in final harvest value @ age 27-years (Table 2).
- ▶ Scenario #1's (row + low thin) financial measures were all greater than scenario #2 (row + even thin), but the differences were less than when using three product classes (Table 2 and 3). Scenario #1 NPV was \$71/acre greater than scenario #2 (Table 4). Scenario #1 AEV was \$6/ac/yr greater than scenario #2 (Table 4). Scenario #1 IRR and CRR were 0.44% greater than scenario #2 (Table 4).

Scenario #, thin type	NPV (\$/ac)	AEV (\$/ac/yr)	IRR (%)	CRR (%)
1, row + low thin	298	23	8.88	8.31
2, row + even thin	227	17	8.44	7.87

## SUMMARY

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 crop trees (future high valued inventory) in the first thinning 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 a low appreciation rate), leaving the best trees to grow at a faster rate to the higher valued product classes? Does selling wood using four product class prices get better

financial returns than three product class prices?

▶ In these cases, the landowner is best off harvesting primarily the defective trees (low valued inventory), removing very little of the good quality large trees (future high valued inventory) and saving them for the clear-cut. In these cases, thinning + clear-cut revenues were well over \$400 to \$550+ per acre greater with the more selective thinning method.

▶ Selling wood using four product class prices does improve first thinning revenues by getting more dollars per unit of wood for some smaller diameter sized trees that would have been sold as pulpwood.

## 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 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 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 3<sup>rd</sup>, 4<sup>th</sup> or 5<sup>th</sup> row + selection thinning practices. Each of these thinning types has their advantages and disadvantages. For more information on 3<sup>rd</sup>, 4<sup>th</sup> 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/quality financial differences and a lower residual basal area

can increase thinning type/quality financial differences), (3) current and future stumpage prices, and (3) first thinning timing to a lesser extent.

### **Literature Cited**

Timber Mart South<sup>®</sup> (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<sup>®</sup> v 1.1. Forest Growth, Yield, and Financial Analysis Tool for Southern Forests. Tennessee Valley Authority, Norris, TN.

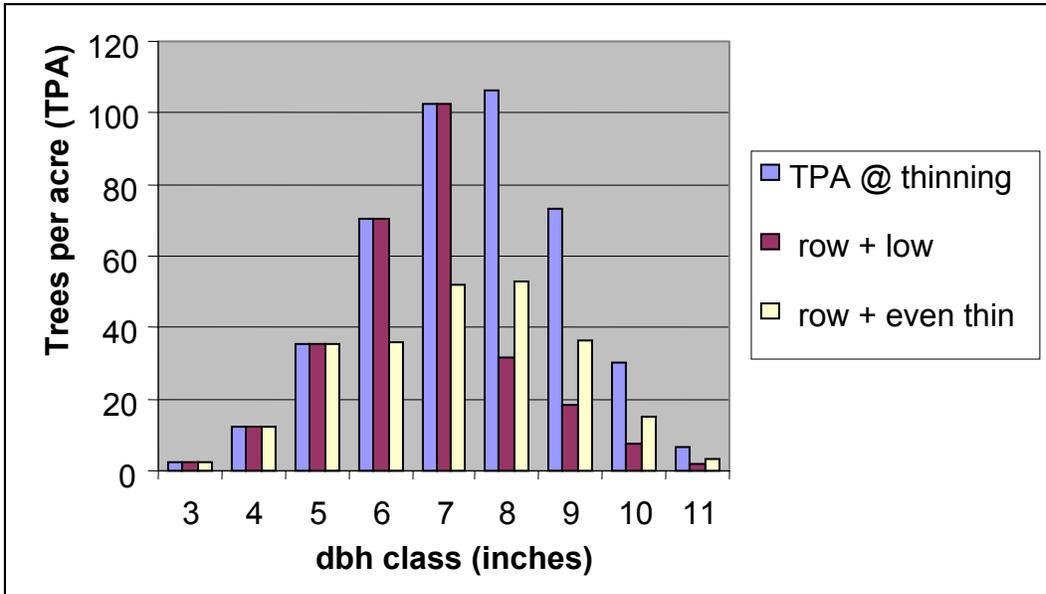


Figure 1. Harvested loblolly pine trees per acre @ age 16-years based on thinning type and trees per acre (TPA) just prior to thinning.

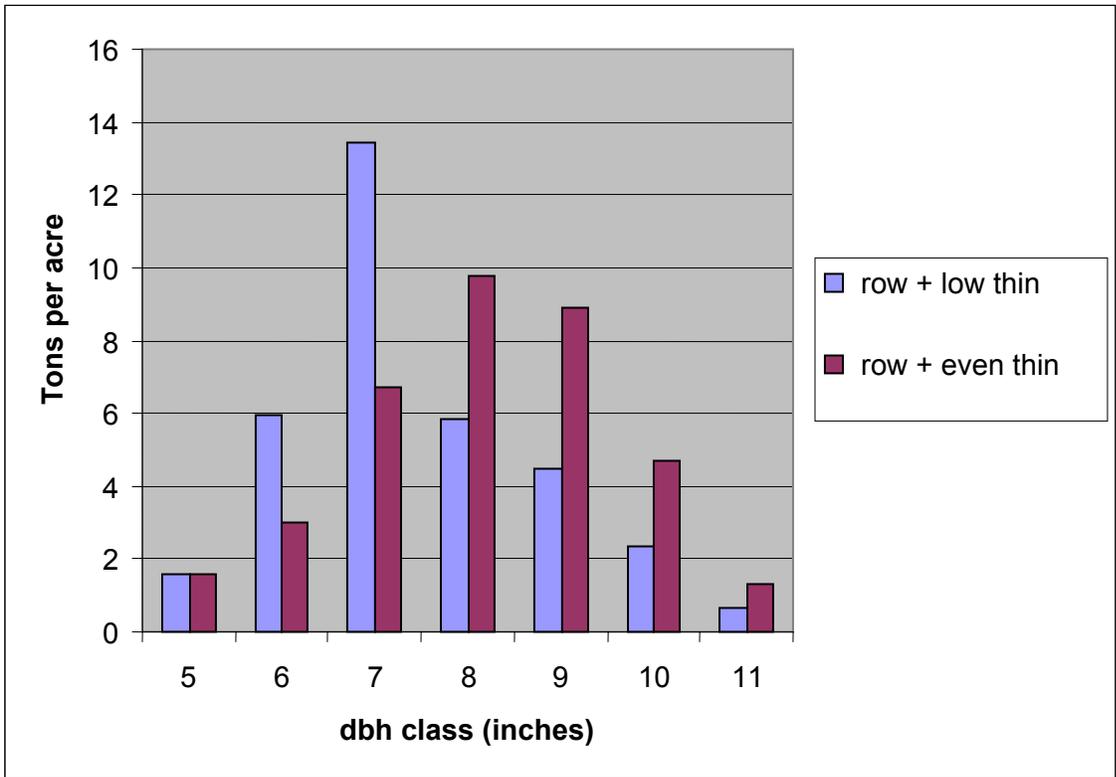


Figure 2. Harvested loblolly pine merchantable wood @ age 16-years based on thinning type.

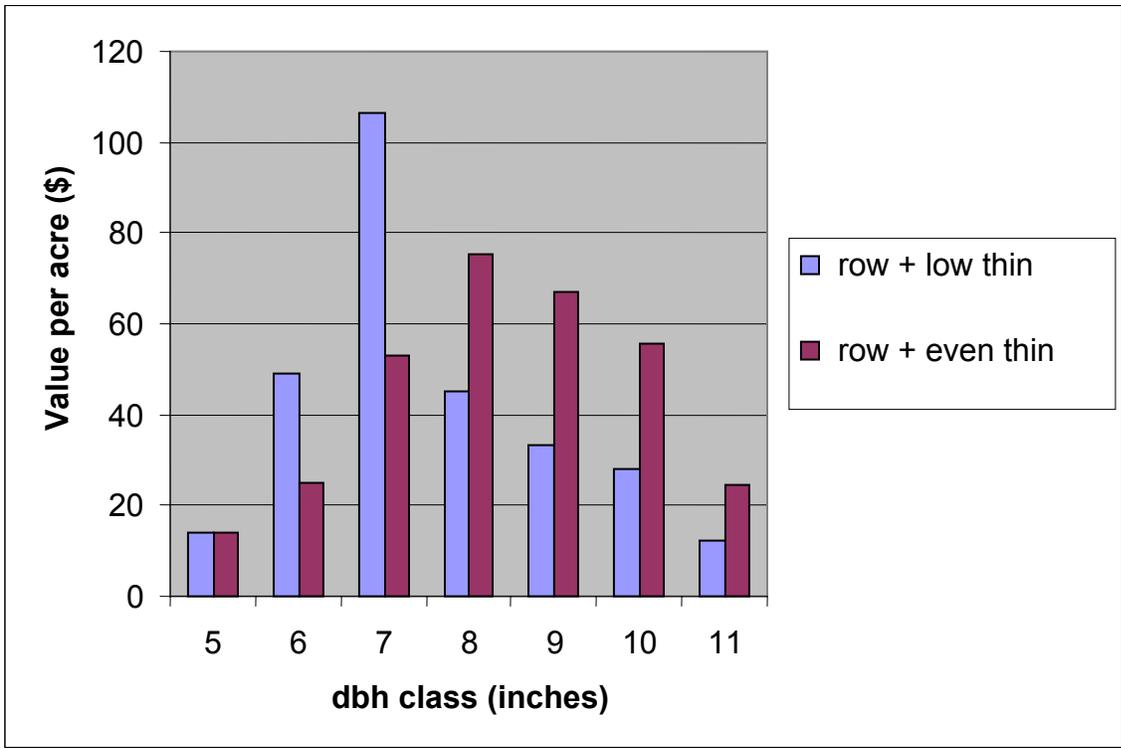


Figure 3. Harvested loblolly pine wood value @ age 16-years based on thinning type.

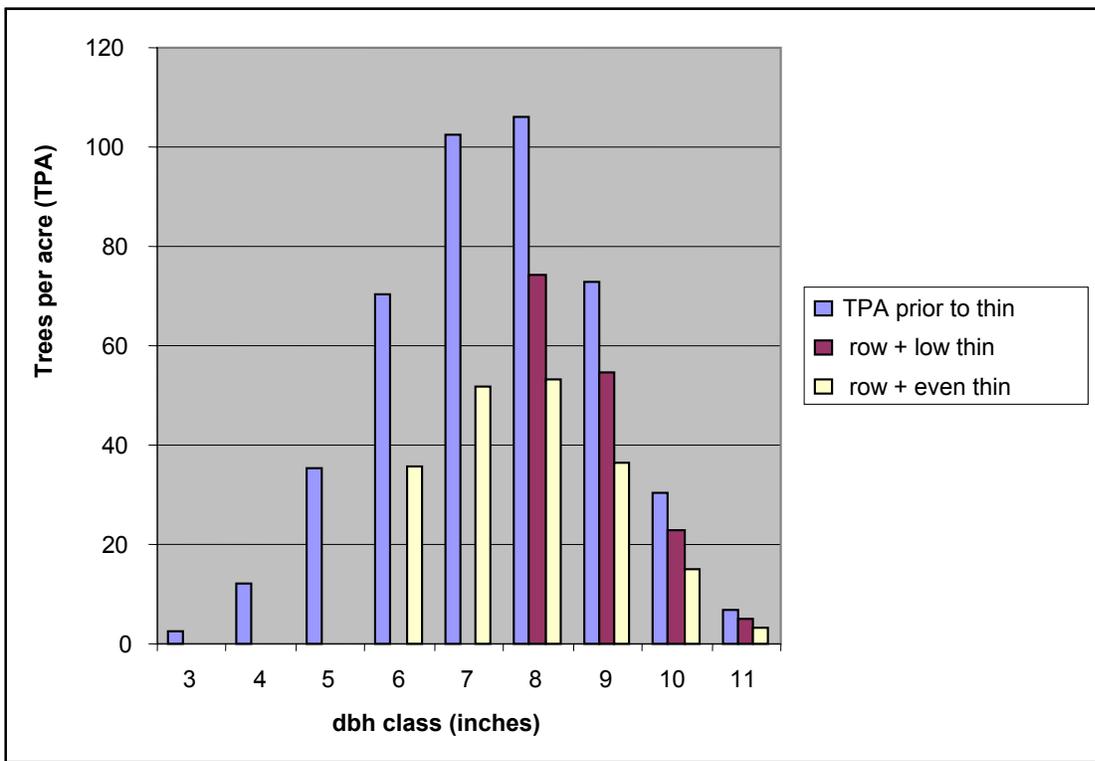


Figure 4. Residual loblolly pine trees per acre after the thinning @ age 16-years by dbh class and thinning type and trees per acre prior to the thinning.

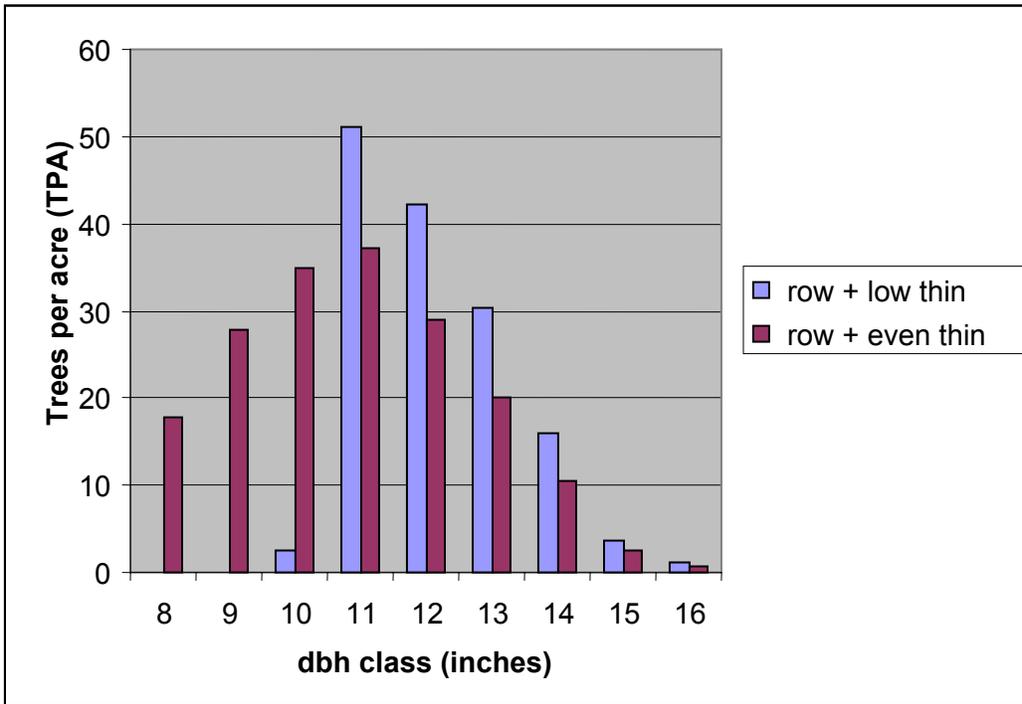


Figure 5. Loblolly pine diameter distribution @ age 27-years by dbh class and thinning type (11 years after 1<sup>st</sup> thinning).

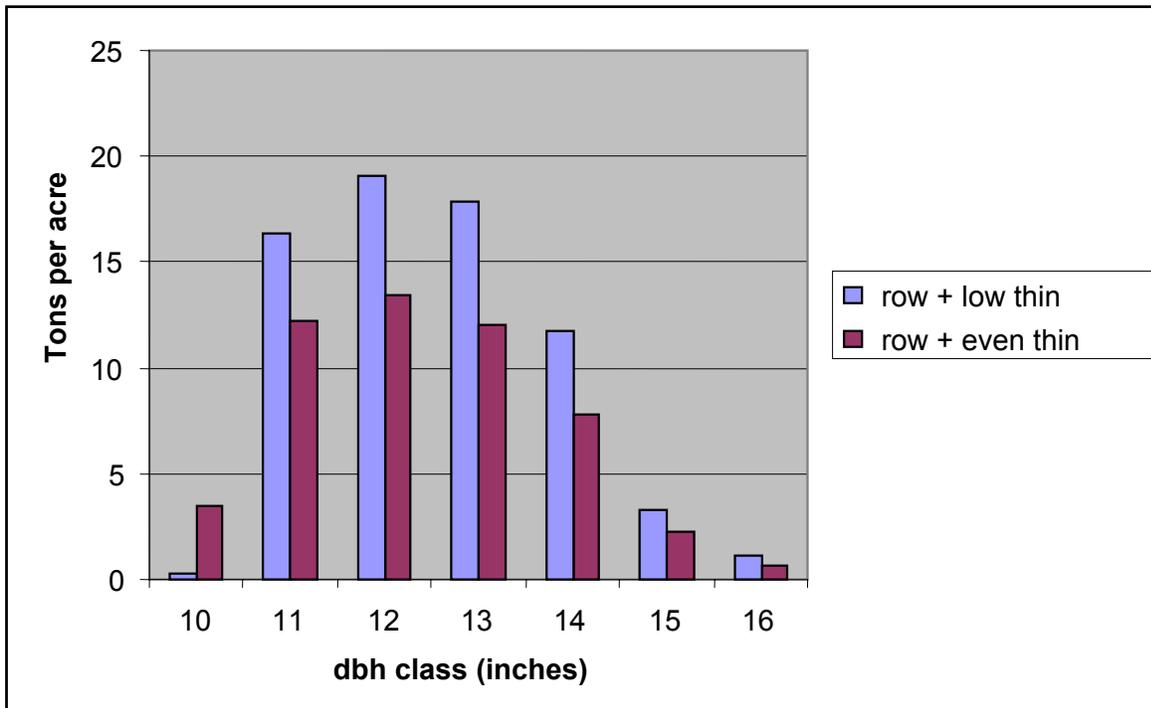


Figure 6. Loblolly pine chip-n-saw and sawtimber production at age 27-years by dbh class and thinning type (11 years after 1<sup>st</sup> thinning).

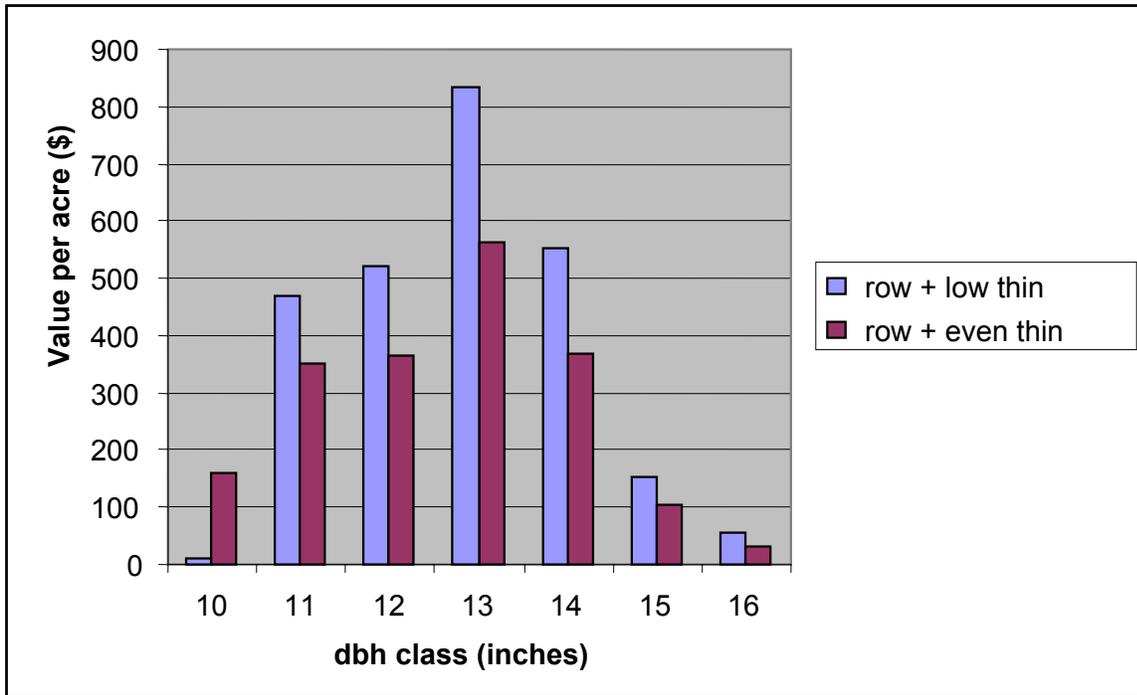


Figure 7. Loblolly pine chip-n-saw and sawtimber value by dbh class and thinning type at age 27-years (11 years after 1<sup>st</sup> thinning).

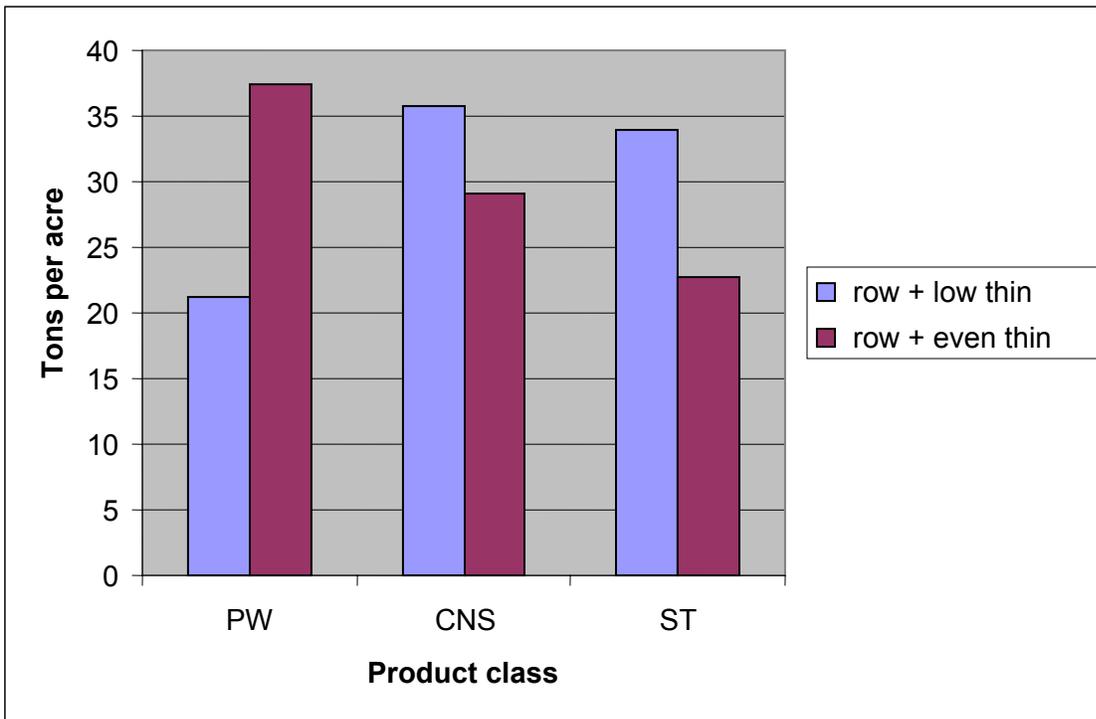


Figure 8. Loblolly pine three product class distribution by thinning type at age 27-years (11 years after 1<sup>st</sup> thinning). PW=pulpwood, CNS=chip-n-saw, ST=sawtimber.