

# Protect Your Pine Plantation Investment by Thinning



Thinning at the proper time is one of the best strategies for protecting your pine plantation investment and increasing the value of that investment. Thinning is a silvicultural treatment used to reduce stand density, which improves tree growth, enhances forest health, and can help recover the value of trees that otherwise might die.

The establishment of a pine plantation requires planting more trees per acre than desired for final harvest at the end of the rotation or growing cycle. This is primarily to control the form and value of the timber produced. Planting too few trees will cause large persistent limbs within the first log section, which will greatly reduce the value of the future timber harvest.

Increasing the planting density will control limb production by “shading” the lower limbs. The tree will then naturally prune the limbs over time. However, as the stand ages and trees grow in size, there will not be enough space for all the trees. Eventually the trees will begin to compete with one another for space, water, and nutrients. This competition will slow the trees’ growth.<sup>1</sup> The objective of thinning at the proper time is to reduce the number of trees in the pine plantation before the stand becomes too dense and tree growth begins to slow.

It is not uncommon for timber landowners to neglect timely thinning of pine plantations. In some cases, thinning is intentionally delayed in hopes of receiving a higher price for pulpwood, which is a lower-valued product primarily harvested at thinning. However, the practice of delaying thinning is not a sound strategy to maximize the wealth of a long-term pine plantation investment. Delaying a thinning introduces an increased risk of density-related mortality from direct competition between trees and can increase the probability of a southern pine beetle infestation.

Also, there is no certainty of seeing a pulpwood price increase if thinning is delayed. However, if prices do increase, any short-term gain associated with delaying the thinning will most likely result in a long-term loss. Delaying thinning slows the growth of the remaining trees, resulting in longer rotations and reduced value for the pine plantation.

To demonstrate the value of thinning, a typical pine plantation was modeled using a computer growth and yield simulator.<sup>2</sup> Timber growth over time was projected along with future timber volumes from thinnings and final harvest. The pine plantation scenarios included three different sites that are capable of producing a dominant tree height of 60 feet, 70 feet, and 80 feet in 25 years. Dominant tree height in feet produced by a given timberland site is referred to as site index (SI). For each of the three site indices, an initial planting density of 681 trees per acre (TPA) was used. The year of thinning and number of trees to remove during each thinning were determined using stand density index (SDI) criteria (a measure of site occupancy). Research suggests thinning a stand when SDI is 55 percent of maximum, and leaving a residual number of trees that is equal to 35 percent of maximum SDI.<sup>3</sup> The maximum SDI for loblolly pine is 450. The formula for SDI is:

$$\text{Stand Density Index} = \text{TPA}(\text{DIA}/10)^{1.605}$$

Where: TPA = trees per acre

DIA = quadratic mean diameter

Ideally, trees are thinned before the point of density related mortality (SDI = 55 percent of max), and the number of trees retained in the stand after thinning (SDI = 35 percent of max) should ensure adequate site occupancy (no growing space is wasted). This is illustrated in **Figure 1**.

The thinning regimes for each of the three sites are listed in **Table 1**. A management regime refers to the specific combination of thinnings and final harvest age for a site.

For each of the three scenarios, the timing of the final harvest was based on maximizing land expectation value (LEV). The financial formula used to calculate LEV is:

$$\text{LEV} = [\text{Net Value in Year } n] \div [(1+i)^n - 1]$$

Where: *i* = interest rate in decimal percent

*n* = the rotation age in years

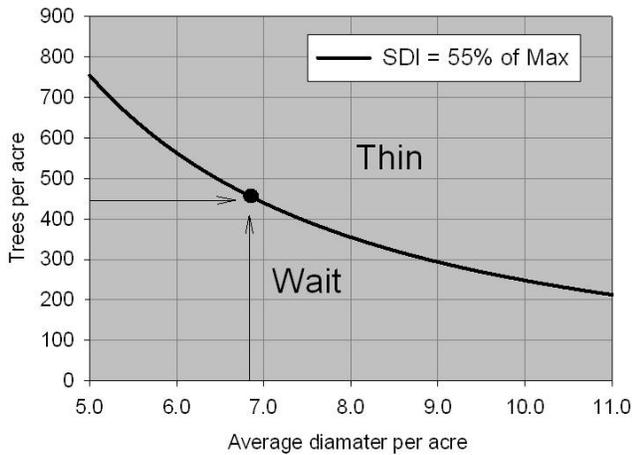


Figure 1. Thinning graph showing the “thin or wait” decision based on stand density measured by the combination of trees per acre and tree diameter.

LEV can be thought of as the value of land for growing trees for a specific management regime. LEV is equal to the net present worth of all future expected cash flows discounted by some minimum acceptable rate of return or discount rate.<sup>4</sup> The management regime with the highest LEV is considered to be financially optimal. For the three scenarios considered, a discount rate of 5 percent was used, and stand establishment cost (tree planting and site preparation) was estimated at \$191.49 per acre. Product volumes from

thinnings and final harvest were valued using the following product prices<sup>5</sup>: \$37.73 per ton for sawtimber, \$21.19 per ton for chip-n-saw, and \$8.20 per ton for pulpwood.

Using SDI criteria to determine biologically optimal thinning ages and LEV criteria to determine financially optimal final harvest ages produces the following management regimes and associated revenues by site index for each thinning and final harvest (Figure 2).

Consider the financial implications of delaying a first thinning treatment. As previously mentioned, the financially optimal management regimes for each of the three site indices were determined using LEV criteria. The final harvest age that results in the greatest LEV is the financially optimal harvest age. If first thinning was delayed 1 or 2 years, how much would pulpwood prices have to increase in those years to justify that decision based on LEV criteria? The required increase in pulpwood prices does not include compensation for the increased risk a delayed thinning can introduce. For each of the three site indices, the pulpwood price was increased until the LEV was greater than or equal to the LEV of the previously identified financially optimal management regime. See Tables 2 and 3.

Thinning “on time” results in higher LEVs than management regimes where the first thinning is delayed for 1 or 2 years. For all three site indices, the

**Table 1. Ideal first and second thinning timing and intensity for three pine plantation scenarios of SI 60, 70, and 80 (base age 25) using an initial planting density of 681 TPA. For this example, when the number of trees per acre and average diameter indicated the stand reached 55 percent of maximum SDI (SDI = 248), a thinning was applied and trees per acre was reduced to SDI 35 percent of maximum (SDI = 158).**

First thinning					
Site index		Current (before thinning)		Residual (after thinning)	
Base age 25	Age	TPA	Average stand diameter	TPA	Average stand diameter
60	17	565	6.4	274	7.1
70	14	561	6.3	287	6.9
80	13	550	6.5	268	7.2
Second thinning					
Site index		Current (before thinning)		Residual (after thinning)	
Base age 25		TPA	Average stand diameter	TPA	Average stand diameter
60	30	260	10.1	142	10.7
70	22	278	9.5	158	10.0
80	21	257	10.2	138	10.9

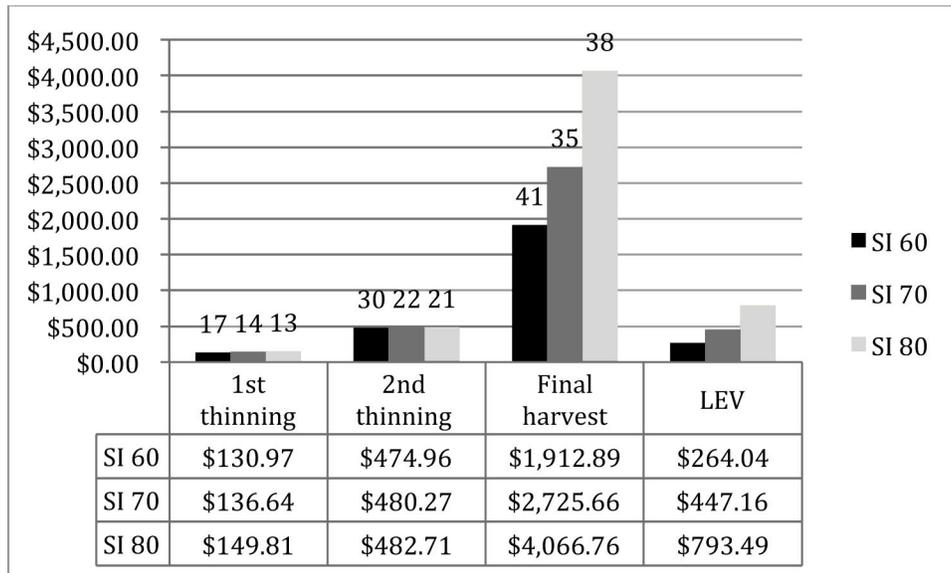


Figure 2. Per-acre harvest revenues and LEVs for site index 60, 70, and 80 using a planting at 681 TPA, using a 5 percent discount rate, and indicating year of each management activity.

LEV continually declined as thinning was delayed for both 1 and 2 years. The assumption here is that first-thinning pulpwood prices did not increase or decrease. Recall that the rationale for some landowners delaying a first thinning is the expectation (or hope) of higher pulpwood prices.

In the case of the SI 60 site, pulpwood prices from a first thinning would have to be at least 8 percent higher, or 66 cents per ton, to result in a comparable LEV. If the thinning is delayed 2 years, then the pulpwood price would have to be 11 percent higher, or 90

cents per ton. For more productive timberland, the pulpwood price increase required to justify delaying thinning is even greater. Site index 70 requires first-thinning pulpwood prices to be 15 percent higher, or \$1.23 per ton, to justify a 1-year delay in thinning and 18 percent higher, or \$1.48, to justify a 2-year delay. The required pulpwood price increase is even more extreme for site index 80, where pulpwood prices would have to increase 20 percent, or \$1.64 per ton, to justify a 1-year delay and 27 percent, or \$2.21 per ton, to justify a 2-year delay.

**Table 2. Estimated loss in LEV caused by a 1-year delay in first thinning and the pulpwood price increase needed to avoid a loss in the investment value of the pine plantation.**

Site index	LEV (\$/acre)	LEV loss by 1-year delay (\$/acre)	Increase in pulpwood price needed to avoid loss (%)	Increase in pulpwood price needed to avoid loss (\$/ton)
60	264.04	5.65	8	0.66
70	447.16	15.23	15	1.23
80	793.49	22.19	20	1.64

**Table 3. Estimated loss in LEV caused by a 2-year delay in first thinning and the pulpwood price increase needed to avoid a loss in the investment value of the pine plantation.**

Site index	LEV (\$/acre)	LEV loss by 2-year delay (\$/acre)	Increase in pulpwood price needed to avoid loss (%)	Increase in pulpwood price needed to avoid loss (\$/ton)
60	264.04	7.75	11	0.90
70	447.16	19.35	18	1.48
80	793.49	30.50	27	2.21

The values described above are only examples and will vary with establishment costs, number of trees planted, current market conditions, product values, etc. However, as this example demonstrates, the better the site, the more costly the delay. Slow-growing pine plantations on poorer sites (SI 60 or lower) may be able to afford a temporary delay in thinning, but this is not the case for fast-growing plantations on good sites (SI 70 or higher). Pine plantations on good sites lose too much money with a thinning delay. The pulpwood prices necessary to avoid investment value losses can be very high, and there is no certainty that those prices will be realized.

## Conclusion

Thinning at the proper time not only improves the overall health of your pine plantation, but also sets the stage for future higher valued products such as chip-n-saw and sawtimber. Unfortunately, many landowners will choose to wait to conduct the first thinning in hopes of securing higher stumpage prices for pulpwood, but delaying a thinning treatment brings increased risk of tree mortality and the chance of a pine beetle outbreak as the growth rates slow and trees become more stressed. Thinning “on time” is one of the best strategies to reduce the risk of southern pine beetle attack.

As shown here, the required stumpage prices for landowners to break even after delaying thinning are extremely high and unrealistic, particularly for more productive timberland (higher site indices). Delaying thinning with the expectation of increased pulpwood prices is not a sound strategy to maximize the wealth of a long-term pine plantation investment.

## References

- <sup>1</sup> For a more detailed explanation, see: Traugott, T.A., and S. Dicke. 2007. Are My Pines Ready to Thin? Mississippi State University Extension Publication 2260.
- <sup>2</sup> North Carolina State University Managed Pine Plantation Growth and Yield Simulator. Version 3.1.
- <sup>3</sup> Dean, T.J., and S.J. Chang. 2002. Using simple marginal analysis and density management diagrams for prescribing density management. *Southern Journal of Applied Forestry* 26: 85-92.
- <sup>4</sup> For a more detailed explanation of the LEV formula, see: Measells, M.K., and J.E. Henderson. 2009. Financial considerations. Pages 55-59 in M.J. Wallace and A.J. Londo, editors, *Managing the Family Forest in Mississippi*. Mississippi State University Extension Service Publication 2470.
- <sup>5</sup> Product prices are averages for Mississippi over the period from 2001 to 2012.

---

Publication 2732 (POD-09-19)

By **James E. Henderson**, PhD, Extension Professor and Head, Coastal Research and Extension Center, and Andrew J. Londo, PhD, former Extension/Research Professor, Forestry.



*Copyright 2019 by Mississippi State University. All rights reserved. This publication may be copied and distributed without alteration for nonprofit educational purposes provided that credit is given to the Mississippi State University Extension Service.*

Produced by Agricultural Communications.

Mississippi State University is an equal opportunity institution. Discrimination in university employment, programs, or activities based on race, color, ethnicity, sex, pregnancy, religion, national origin, disability, age, sexual orientation, genetic information, status as a U.S. veteran, or any other status protected by applicable law is prohibited. Questions about equal opportunity programs or compliance should be directed to the Office of Compliance and Integrity, 56 Morgan Avenue, P.O. 6044, Mississippi State, MS 39762, (662) 325-5839.

Extension Service of Mississippi State University, cooperating with U.S. Department of Agriculture. Published in furtherance of Acts of Congress, May 8 and June 30, 1914. GARY B. JACKSON, Director