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Improve Your Pine Stand by Thinning

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Thinning pine plantations is a common and necessary practice that can help landowners achieve their management objectives. Appropriately timed thinnings can help private forest landowners capture the financial value of merchantable timber, improve existing stands and alter wildlife habitat. However, thinning practices in the past have often focused on removing the larger, more valuable material and leaving smaller, low vigor residual trees. This practice, called "high grading," usually involves removing all timber above a given diameter limit (e.g., 12 inches). A diameter limit cut generally reduces stand productivity and value by leaving a large component of slow growing, low vigor residual trees. A properly planned thinning operation, on the other hand, can increase stand quality and economic potential, while providing income at the same time.

What Is Thinning?

Some 30 to 50 years are required to grow a stand of pine sawtimber to economic maturity. In any forest stand, trees compete with each other for light, soil moisture and nutrients. The more crowded the trees are, the more intense the competition. In a very crowded stand, the individual tree growth rate is reduced and eventually, the weaker trees die. This competition can be reduced by cutting some of the trees before the stand reaches maturity. Generally speaking, the volume of wood produced by a timber stand of a certain age on a particular site is about the same over a wide range of stand densities. This means that if the number of trees in a stand is reduced, a similar volume of wood can be produced with fewer trees while maintaining a good rate of growth. Foresters can, therefore, cut or thin a stand without damaging the site's productivity. Cuttings made in immature stands to reduce competition and improve stand quality are called thinnings.

The main objectives of thinnings are: (1) to redistribute the growth potential of the stand to the well-formed, high-quality trees, (2) to maintain a sustainable stand growth rate, (3) to capture the economic value of all merchantable timber produced by the stand and (4) to produce merchantable timber or specific products in a shorter period of time.

Pine Trees Increase in Value Quickly

Most pine stands are even-aged. That is, all of the trees are within a few years of being the same age. If all trees are about the same age, then the larger trees must have been growing

Table 1. Growth in volume and economic value of an example tree.

	Tree Age (years)					
	14	**21**	**28**	**35**	**42**	**49**
Diameter of tree (inches)	6	10	12	15	19	20
Height of tree (feet)	41	54	64	72	78	83
Pulpwood volume of tree (cords)	0.04	0.12	0.23	0.39	0.61	0.84
Sawlog volume of tree (board feet Doyle scale)	----	36	48	121	215	322
Pulpwood value of tree (@18.00 per cord)	$0.72	$2.16	$4.14	$7.02	$10.98	$15.12
Sawlog value of tree (@ $350 per 1,000 board feet)	----	$12.60	$16.80	$42.35	$75.25	$112.70

Note: Tree sizes are an illustrative example of what could be expected on many southern pine sites. Prices are based on a ten-year average and are useful only to compare the value of different tree sizes.

at a faster rate. Landowners can optimize growth by managing their forest stand. The combination of a productive site and proper management practices can result in growth rates of up to 10 percent per year (Table 1). The timber products produced by a stand can be an important factor in determining when to cut a pine stand. Trees in the 6-9-inch diameter range are normally sold as pulpwood. When they reach the 10-inch diameter size or larger they can be sold as sawlogs at a significantly higher value than pulpwood. The example in Table 1 illustrates a large increase in value as a tree grows from a 6-inch pulpwood tree (worth $0.72) at age 14 to a 10-inch sawtimber tree (worth $12.60) at age 21. Thinning operations provide growing conditions that allow trees to reach larger diameters and higher values in less time.

Always Leave the Best Trees for Future Growth

The purpose of any thinning operation should be to provide more growing space for the well-formed, fast-growing trees while harvesting the trees that are diseased, damaged or poorly formed and those that will not live until the next scheduled harvest. The following types of trees should be included in the harvest during thinning: (1) overtopped trees, (2) forked trees, (3) trees with broken tops, (4) trees with one-sided crowns, (5) trees with crooked stems, (6) trees with trunk swellings (cankers) caused by fusiform rust disease and (7) trees damaged by insects, fire or weather (Figure 1).

When to Thin

The first commercial thinning in a pine stand is normally made when the trees reach pulpwood size, about 6 to 9 inches in diameter. In a plantation, the trees will normally be between 12 and 18 years old when they reach this size. In a natural stand, the trees will probably not reach this size until they are several years older.

Within a few years, after the diseased, damaged, poorly formed and weak trees are removed by thinning, the branches and roots of the remaining trees will grow to fill in the gaps. A similar crowded condition that existed before thinning will redevelop. Before the trees get so crowded that the growth rate slows down, thin the stand again.

A good way to determine when a pine plantation should be thinned is to look at the live crown ratio. The live crown ratio equals the length of the live

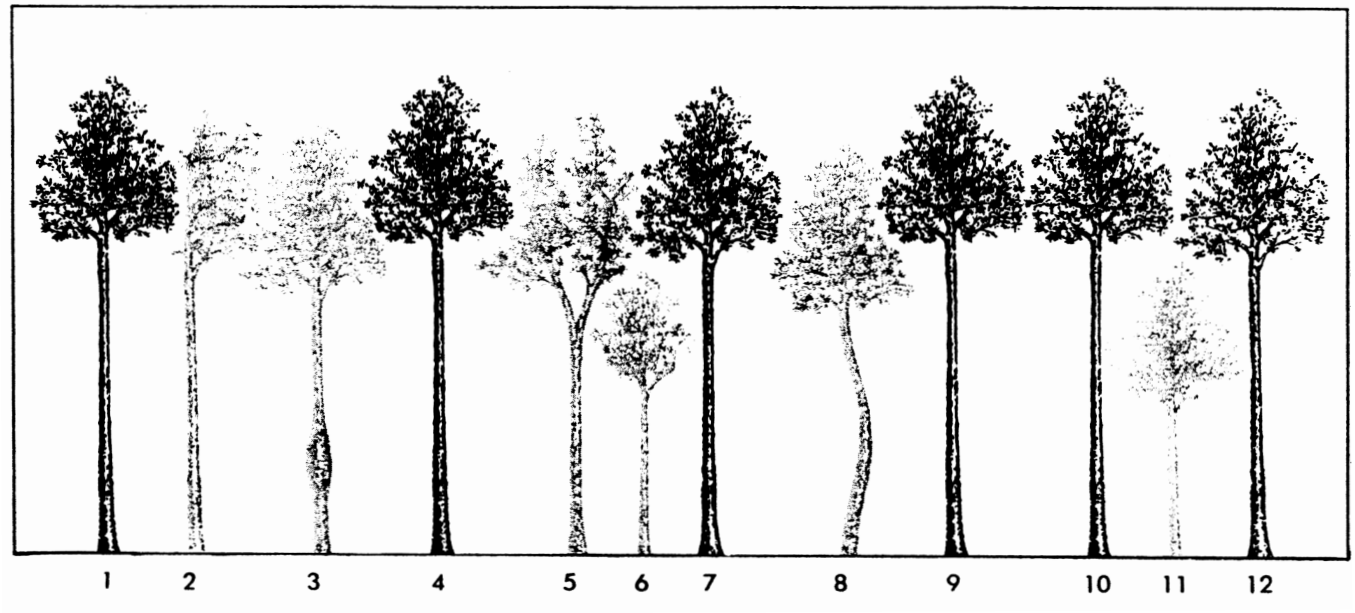

Figure 1. The trees above removed by thinning are (2) one-sided crown, (3) fusiform canker, (5) forked stem, (6) overtopped tree, (8) crooked stem and (11) small tree too close to larger neighbors.

crown (the length of the stem that has live branches) divided by total tree height multiplied by 100. When the average live crown ratio of the dominant trees in the stand drops to near 30 percent, it is time for another thinning (Figure 2). If the live crown ratios drop below 30 percent, the growth of the trees will be reduced; and even after thinning, trees with very small crowns will not resume rapid growth until the sizes of the crowns increase.

Perhaps the simplest method of determining when a stand should be thinned is when the crowns start touching one another. In most cases, a reduction in live crown ratio and annual growth rate (a good growth rate is between 5 percent and 15 percent) will coincide with the point at which the tree crowns begin to touch. This method may be easier to visualize than the live crown ratio especially in a denser stand, where seeing the side view of trees may be difficult.

How to Thin

There are several thinning methods that can be employed in pine stands. One of the primary factors that help determine which method to use is whether the pine stand is a natural stand or a plantation. Another factor that affects the thinning method is the level of diseased or damaged trees present in a pine stand.

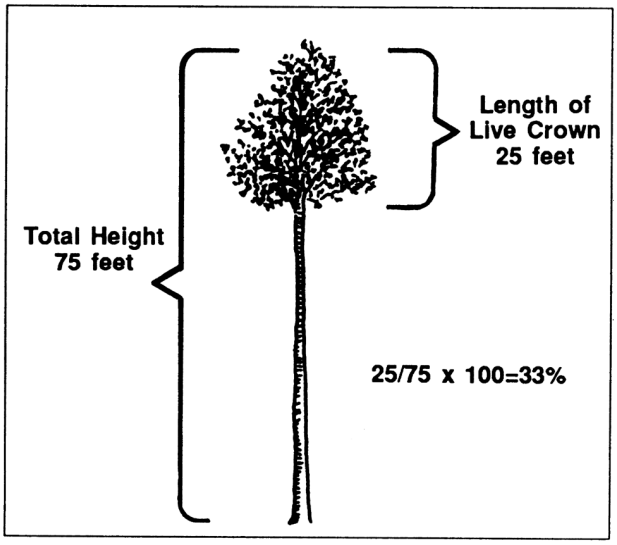

Figure 2. An illustration of live crown ratio. When live crown ratios drop near or below 30 percent, it is time to conduct a thin.

Natural Pine Stands

In natural pine stands, thinnings can be accomplished by individual tree selection (also known as “free thinning”). Using a “free thinning,” any tree can be selected and marked for harvest, which allows for the removal of more undesirable stems and focuses growth on the best trees or “crop trees.” Due to the removal of lower-value, undesirable stems, the free thinning method will not bring the top price for the wood sold. But remember, the objective is to favor the best trees for future growth, not to produce maximum income from the thinning operation.

With the free thinning method, provisions should be made in the logging contract for damage to unmarked trees. Often, these provisions include a penalty for damaging unmarked trees during the logging operation.

Natural pine stands differ from plantations in that tree spacing is not uniform. This irregular spacing can create access problems for the large harvesting equipment used by many contractors. Therefore, a series of corridors are often harvested in natural stands to provide equipment access. This operation is similar to row thinning in pine plantations. After the corridors or access openings are established, free thinning can be used in the remaining trees.

Pine Plantations

Individual tree selection or "free thinning" is also an effective way to thin pine plantations. However, the row thinning operation (also known as "mechanical thinning") has become preferred to the initial thinning of pine plantations because it is generally quick, economical and allows harvesters to utilize larger equipment. Row thinning, as the name implies, involves removing entire rows within a plantation. Row thinning involves removing every second to seventh row, depending on the intensity of the thinning operation. However, since row thinning removes trees without regard to tree size or vigor, it does not improve the quality of the stand.

A common method for the initial thinning (stand age 12-18 years) is a combination of row thinning and free thinning. The row thinning is the first part of the operation and is commonly employed on every third or fourth row. In areas where storm damage (e.g., ice storm, wind throw and others) is a concern, or if the landowner desires more control over which trees are removed, the row thinning may only remove every fourth or fifth row. The row thinning provides better access for harvesting equipment. After the row thinning, individual trees are selected for harvest between the thinned rows. In thinning operations beyond the initial thinning, the free thinning method alone will probably be the method of choice.

Diseased or Damaged Stands

Diseases such as fusiform rust are seldom a significant problem in Arkansas pine plantations, especially if local, naturally resistant seed sources have been used. However, an emphasis should be placed on removing diseased trees in thinning operations. If a pine stand contains a significant level of diseased and/or damaged trees, a landowner may decide to perform a light row thinning (e.g., every fifth row). The light row thinning would be followed by a more intense free thinning, designed to focus on the removal of diseased stems.

How Much to Thin

Most pine stands that are in need of thinning maintain a basal area near or greater than 100 square feet per acre. Thinning operations in pine stands should always leave an optimum stocking level of residual trees. The optimum stocking level after a thinning will differ depending on the productivity of a forest site. However, a residual basal area of 60 to 70 square feet per acre is often desirable in stands that contain primarily pulpwood size material. A residual basal area of 70 square feet per acre is often desired if a pine stand contains primarily sawtimber size material.

Table 2. Approximate number of TPA for the desired residual BA/A.

Average Diameter	Basal Area (acre)	Trees Per Acre
6	60	306
8	60	172
10	60	110
12	70	89
14	70	65
16	70	50
18	70	40
20	70	32

Table 2 illustrates the number of trees per acre required for a stand to maintain the desired pulpwood or sawtimber basal areas after a thinning. An important factor in determining the trees per acre to retain is the size or diameter of the trees present. For example, if the average diameter in your pine

stand is 8 inches, approximately 172 trees would be necessary for the stand to have a basal area of 60 square feet per acre. If your stand contained primarily sawtimber size trees with an average diameter of 14 inches, approximately 65 trees per acre would be necessary to establish a basal area of 70 square feet per acre.

Key Points to Remember

1. Thinnings are cuttings made in immature stands to stimulate the growth of the remaining trees and improve the yield of the stand.

2. Trees compete for light, moisture and nutrients. If they become too crowded, individual tree growth slows and they may eventually die.

3. Pines grow rapidly, and trees grown for sawlogs are worth far more than trees grown for pulpwood.

4. The purpose of a thinning operation should be to provide more growing space for the best trees while primarily harvesting the diseased, damaged, poorly formed or dying trees.

5. The first commercial thinning in a pine stand is usually made between ages 12 and 18 when the trees reach pulpwood size.

6. Subsequent thinnings should be made before the live crown ratios drop below 30 percent or when the crowns begin to touch (generally every 5 or 6 years).

7. In natural stands, thinning is best accomplished by individual tree selection (known as “free thinning”) where each tree to be cut is marked.

8. A modified row thinning is acceptable as the first thinning in pine plantations. Every third to fifth row can be removed and intermediate rows thinned by free thinning.

9. Subsequent thinnings in pine plantations are often best accomplished by free thinnings.

References

Timbermart South, timber price report, online available www.tmart-south.com.

Smith, D.M., B.C. Larson, M.J. Kelty, and P.M.S. Ashton. 1996. *The Practice of Silviculture: Applied Forest Ecology*. Ninth Edition. 537 p.

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