The Place of Thinning in
Southern Forestry

—an overview—

by

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Background

Southern Forestry has experienced a number of changes in recent years. The South's second forest has supported increasing lumber production since the early 1960's and the advent and tremendous growth of the southern pine plywood industry. These two products alone required some 7.9 billion board feet of logs in 1976, and consumption is still increasing. The demand for Southern pine pulpwood was approximately 38.9 million cords in 1976, up 20 percent since 1970. All this and still the growth to harvest ratios for both softwood sawtimber and growing stock remain favorable, southwide. This remarkable resource is and will provide the foundation for one of (if not) the South's largest manufacturing industries. Southern forests are the source of products, jobs, recreation, range, quality water and many other resources.

Further, the role of the southern forest resource is projected to become increasingly important. Removals from the softwood growing stock inventory are forecast to rise by 31 percent nationwide from 1970 to 2000(1). The comparable figure for the South is 57 percent. As much as 5.6 billion cubic feet or 51 percent of nation's softwood roundwood production will come from the South in 2000. Roundwood removals from the southern hardwood resource are forecast to increase even faster.
Much of the South's future softwood supplies will come from plantation stands. A great deal is said today about the failure to assure adequate pine regeneration on harvested acres, and this is, without question, a serious matter. However, perhaps too little is said about the tremendous number of acres of pine plantations that are being established annually in the South.

During the last 15 years, southern forest industry has planted over 6.5 billion seedlings on its own lands and distributed another 1.4 billion to other landowners. Using 800 trees per acre to account for the close spacings typical in the early part of this period, this 6.5 billion figure translates into some 8.2 million acres of pine plantations. It is these plantations that are the subject of this workshop.

It is also apparent that the rate of plantation establishment is increasing (Figure 1). Again, this represents only forest industry lands and means that the industry has artificially regenerated some 23 percent (of 35 MM acres) of its holdings in the past 15 years. Interestingly, approximately three percent of industry holdings were planted in 1978-79, implying a 33 year rotation.

Appreciable plantation acreage is now being established on nonindustrial private lands often with the aid of state and/or federal funds (Forestry Incentives Program, FIP). Early indications are that
Figure 1. Number of Seedlings Planted on Southern Industrial
Ownership. (Southern Forest Institute)
Table 1. Yields for a 30 Year Old Loblolly Plantation with an Original Planting of 600 Trees Per Acre on Site 60 (25 year base) Lands.

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(similar to a row thinning), the volume removed would be 480 cubic feet per acre or some 6.4 cords. With thinning, the stand would arrive at age 30 with 217 stems and, allowing for some additional mortality, the stand might contain 200 stems per acre.

Not accidentally, this same publication has projected yields for a loblolly pine plantation at age 30, on site 60 lands and containing only 200 stems per acre (Table 2). This stand has 2,531 cubic feet of volume per acre or 76 percent of its total volume in the 10 inch and greater diameter classes and has an average stand diameter of 9.7 inches.

The simulation therefore results in:

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<tr>
<th>Stems per Acre</th>
<th>Cubic Feet Per Acre</th>
<th>Thinned Volume</th>
<th>Volume &lt; 10''</th>
<th>Volume ≥ 10''</th>
<th>Total Volume</th>
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<td>&quot;Thinned&quot;</td>
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Obviously, the difference between the two stands has been maximized. The stand with 317 stems (unthinned) occurred with ideal survival. The yield for the 200 stem, "thinned" stand is not that of a fast growing stand which was thinned at age 15 but rather a stand that potentially has had competition or insect/disease problems over its entire development. The complexities and tradeoffs can be
Table 2. Yields for a 30 Year Old Loblolly Plantation on Site 60 (25 year base) Lands and Containing 200 Stems Per Acre.

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\frac{200}{3,330}
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80-85 percent of FIP funds spent in the South are for pine plantation establishment (2,3). Subsequent speakers will no doubt further detail the number of plantation acres. Suffice it to say there are millions of southern acres awaiting a thinning regime, if it is deemed appropriate.

Thinning - few forest management topics arouse more debate and few management practices are more complex in terms of tradeoffs. Many southern foresters have gone full cycle with regard to the merits of thinning. This reflects, perhaps, not so much a change of mind but rather a truly dynamic operating environment. Central to the current interest in thinning has been the changing price of pulpwood and sawtimber-sized material relative to each other (Figure 2). During the past few years the real price of southern pine pulpwood has actually declined while sawtimber stumpage has increased significantly both in current and real terms. To the extent that thinning can shift more volume to fewer stems and raise sawtimber volume, any landowner would be interested in better understanding the practice.

Tradeoffs

Total cubic foot volume yield in slash pine or loblolly pine plantations typically increases with trees planted through any reasonable planting spacing. Planting 900 trees per acre will provide more volume in fiber terms than 800 trees per acre for example (4,5). Pienaar (1977) has suggested maximum stems per acre given various site indicies that are well above reasonable planting spacings.
Figure 2. Stumpage Prices by Product, Southern Pine (Timber Mart - South)
Similarly, it is generally agreed that thinning cannot increase total cubic foot yields over the rotation.

There is certainly no question that the primary purpose of thinning is to distribute future growth on fewer residual stems. Average stand diameter increases of 20 to 30 percent are typical with early thinning of loblolly pine plantations (7). As mentioned above, the practice of thinning is almost solely an effort to capitalize on the growing price differential depicted in Figure 2.

The merits of thinning pine plantations truely represent the integration of biology and economics. If you will allow me substantial liberty with respect to use of some just released yields for unthinned loblolly pine plantations, perhaps I can demonstrate the implied tradeoffs. Table 1 provides yield estimates for a loblolly pine plantation at age 30 (8). This plantation is the result of planting 600 seedlings on site 60 lands (25 year base) and has had "ideal survival". ("Ideal survival" because plots were established in stands so as to avoid poor survival and heavy damage from insects and disease). The average stand diameter is 9.0 inches and the stand contains 2,808 cubic feet of volume per acre or 64 percent of total volume in stems 10 inches and greater at DBH.

At age 30, 317 stems remain (Table 1). At age 15, however, this same stand contained 449 stems per acre and had an average diameter of 6.6 inches. Suppose we simulate a thinning at age 15 and remove 100 stems. If volume is removed uniformly across diameter classes
demonstrated with this illustration, however. The diameter distributions for the two stands are shown in Figure 3. The distribution of the "thinned" stand has been shifted to the right, but there is still more volume in the 10 inch and greater diameter classes than in the unthinned stand. Do the results suggest that no thinning should be carried out?

Even though the goal of increasing sawtimber-sized volume does not seem to have been attained, the answer is not apparent. The unthinned (317 stems) stand has the equivalent of 23,083 square feet of veneer while the "thinned" (200 stems) stand contains 23,858 square feet or nearly 800 square feet more (3/8 inch basis)(9). Also, harvesting costs are very sensitive to average stand diameter and number of stems per acre. The cost per cord equivalent loaded on a truck at the harvest site would be approximately $14.00 for the unthinned stand and $10.50 for the "thinned" stand (assumes 90 cubic feet per cord (10)). This assumes a rather small harvesting system composed of a feller-buncher with accumulating shear, grapple skidder and knuckleboom loader. The result is that it costs some $685 to harvest an acre of the unthinned stand and $388 to harvest an acre of the "thinned" stand. The unthinned stand has 32 percent more volume but requires a 77 percent increase in harvesting costs. The thinning job at age 15 would cost $27.50 or more per cord loaded on the truck or $147 per acre. Such a high cost explains some of the reluctance to thin, especially in young, small diameter stands.
Figure 3. Diameter Distributions Associated with Two Stands at Age 30 and Site Index 60_{25}.

317 stems/acre

200 stems/acre

DBH Class (in.)

Stems per Acre

3 4 5 6 7 8 9 10 11 12 13 14 15 16
Perhaps now it seems that thinning is worthwhile based on higher solid-wood product yield, harvesting efficiency gains and/or early returns. However, recall that the unthinned stand produced 25 percent more pulp-wood volume (1,600 cubic feet vs. 1,279 cubic feet) over the 30 year rotation. A yield difference of this magnitude is quite significant and would have an important implication with regard to a firm's back-up ratio for fiber. Would practicing thinning require a larger land base with its attendant costs?

Hopefully this rather contrived example has been sufficient to demonstrate the numerous biologic/economic tradeoffs entailed in the thinning decision. Additionally, we have not even considered the role of thinnings in the industries dynamic energy situation, nor have we considered the problems, handling and otherwise, associated with use of this low density raw material. Especially a raw material with high bark content and packaged as many small pieces. Mill managers would say that our problems have just begun once this material reaches the manufacturing site or concentration point. These ramifications are very real also. We have reached no globals solution to the thinning question ourselves with respect to this myriad of tradeoffs and implications and would appreciate comment from those who have.

Beyond the Woods

For those who decide that thinning should be a part of southern pine management, financial considerations become paramount. A good deal of forward planning is required because of the high level of capital investment required to perform the thinning operations.
Capital funds, realistically, must be obtained in a competitive environment given the no doubt numerous alternative investment opportunities. Justification is complicated by the fact that the benefits from thinning will be realized some years in the future and thinned volumes removed will be delivered at very high cost.

Earlier, 8.2 million acres of southern pine plantations in the one to 15 year age classes were identified. A single thinning in these stands implies that 547,000 acres will be thinned per year. Multiple thinnings would mean a higher annual acreage figure in as few as five years. Assuming for simplicity, however, that 8 to 10 cords of pulpwood are removed at first thinning, the single-thinning, minimum acreage figure means that from 4.4 to 5.5 million cords would be removed annually as thinnings. This is perhaps 12 percent of current softwood pulpwood demands, southwide.

A full 80 percent of the producers in this region deliver less than 50 cords of pulpwood per week (11). Therefore, assuming a very efficient 75 cords per week per operator, the above volumes imply the need for from 1,128 to 1,410 producers and equipment sets for thinning plantations. This is a quantum change from the current number of operators thinning plantations. All these need not be new operations but many new producers and equipment sets will be required. The productivity of most current operations would be significantly reduced if they were moved to thinning plantations full time. Thus, there will be a need for many new thinning operations to keep overall total pulpwood production at sufficient levels.
It is difficult to visualize a new equipment set, skidder, loader, etc., costing less than $150M and of course, a system using a whole-tree chipper could cost as much as $500M. The total initial investment in thinning equipment could therefore be $300MM southwide and would have a useful life of only 3 to 5 years. Additional expenditures would, without question, be required at mill sites also. The magnitude of this added investment simply further demonstrates the need for careful planning to align systems and production with future wood needs.

There are related questions concerning labor supply and labor skill levels, impact on water and wildlife resources and aesthetics, but I have raised sufficient issues. The topic of this workshop is indeed timely. Thinning southern pine plantations is not a simple, inconsequential, inexpensive, independent decision. It is a complex, costly, all encompassing decision with significant impact on the future character of southern forestry, resources and industry. In all likelihood we will not reach a consensus on the issue of thinning at this meeting. Thinning decisions will probably have to be tailored to individual landowner objectives, but I hope we can make significant gains in our understanding of the tradeoffs implied. I look forward to an educational day-and a-half.


