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## Pine Plantation Thinning Practices

*by L. V. Pienaar, R. L. Bailey and M. L. Clutter*



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## *About The Authors*



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## ABSTRACT

In a sample of 39 plantations selected throughout the state, age at thinning ranged from 13 to 27 years with an average of 22 years. The typical thinning was a selective thinning in a previously unthinned plantation at age 22 years that removed about 36% of the merchantable volume, 41% of the basal area, and consisted of trees with an average dbh of about 8 inches. Most operators used shortwood systems, paid an average stumpage price of \$19 per cord, and realized a net profit of about 3 dollars per cord.



*Most of the thinning operations were in small old-field plantations in the 20 to 40-acre range.*

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## Objectives of the Survey

In recent years thinning of southern pine plantations has become a more common timber management practice in the southeast. During 1982 an attempt was made to obtain information from active thinning operations in pine plantations in Georgia. The purpose was to obtain information on the methods of thinning being employed, the types of equipment being used, and associated costs and revenues. We hoped to gain information on the economic feasibility of thinning from the logging contractor's point of view as well as the plantation owner. This type of information is helpful in evaluating different thinning strategies with the aid of newly developed plantation growth and yield models.

## Survey Procedure

A questionnaire was prepared, and, with the assistance of personnel from the Forestry Commission, data were obtained

from 39 thinning operations in pine plantations throughout the State, 20 in the coastal plain and flatwoods and the remainder in the piedmont. The following information was obtained at each location:

### A. Plantation and thinning operation information

1. Species
2. Age
3. Average height of dominants and codominants
4. Acres in plantation
5. Number of previous thinnings
6. Trees per acre before and after thinning
7. Basal area per acre before and after thinning
9. Thinning method--row, selective, combination
10. Type of thinning operation--shortwood, tree-length
11. Stand damage--percent remaining trees with scarred boles

12. Average skidding distance
13. Hauling distance

### B. Production rate, cost and revenue information

1. Total number of cords removed in thinning
2. Stumpage cost per cord
3. Price per cord at the woodyard
4. Total number of work days on site
5. Number of people involved in operation
6. Labor cost per day
7. Price and type of felling, skidding, loading and hauling equipment
8. Total equipment operating cost per day

Stand information was obtained from cruises performed before and after the thinning. Cost information was supplied by the logging contractors.

## Summary of Survey Results

Plantation and thinning operation information is summarized in Table 1 for all 39 plantations and thinning operations.

The mean thinning age of 22 years was older than expected, and can be attributed to the fact that 13 of the 39 plantations had been thinned at least once previously. Measures of stand density and volume showed that the average thinning operation removed roughly 50% of the trees, 40% of the basal area, and 36% of the merchantable volume. A majority of the operations were in small old-field plantations in the 20 to 40 acre range.

The plantation and thinning information is summarized separately for each of 3 thinning methods in Table 2.

Of the 39 plantations, 4 were thinned using row thinning, 21 were selectively thinned, and 14 with a combination of row and selective thinning. Selection thinning as well as combination of row and selection thinning were generally made in plantations with lower than average densities and volumes, largely due to the fact that many of these plantations had been thinned previously, whereas row thinning was used exclusively for first thinnings. This fact also largely accounts for the higher wood costs and operating costs associated with selection and combination of row and selection thinning. First thinnings were exclusively row thinnings which removed about 30% of the volume, while combination of row and selection thinning was often used as first thinnings in less dense stands. Selection thinning was used mainly in plantations that had been thinned previously. In selectively thinned plantations the quadratic average dbh before and after thinning was about 8.0" and 8.5" respectively, indicating that such thinnings, in general, were from below or selective for smaller trees.

In Table 3 the plantation and thinning information is summarized separately for plantations thinned for the first time, and plantations that had been thinned once, and twice before.

Of the 39 thinning operations surveyed, 25 were in plantations that had not been thinned before, 12 had been thinned once, and 2 had been thinned twice before. The average age increased as the number of previous thinnings increased, while the stand density and stand volume before thinning decreased. Both plantations which had been thinned twice before were thinned by whole-tree operators, as well as 3 of the 12 stands that had been thinned once before. This fact possibly accounts for the higher equipment costs per day for second and third thinnings. Plantations which had not been thinned previously were thinned exclusively by shortwood operators who have a much lower equipment cost and capital investment, but a higher labor cost per cord. Both the stumpage price per cord



*Whole-tree operators had a much higher harvesting rate, used larger crews, and had much more expensive equipment than did short-wood operators.*

Table 1.--Summary of plantation and thinning information.

	Mean	Min.	Max.
Age	22	13	27
Average height--dominants & codominants	61	38	74
Trees per acre before thinning	399	160	1210
Trees per acre thinned	196	56	616
Basal area per acre before thinning (sq. ft.)	121	50	230
Basal area per acre thinned (sq. ft.)	50	7	104
Cords per acre before thinning	30	17	45
Cords per acre thinned	11	3	19
Acres	34	4	334

Table 2.--Plantation and thinning information by thinning method.

	Row	Mean Values for	
		Selection	Combination
Number of stands	4	21	14
Age when thinned	22	23	22
Stems per acre before thinning	756	328	403
Stems per acre thinned	257	159	218
Basal area before thinning	164	111	124
Basal area thinned	48	46	51
Cords per acre before thinning	32	27	34
Cords per acre thinned	10	10	13
Quadratic mean dbh before thinning	6.3	7.9	7.5
Quadratic mean dbh after thinning	6.3	8.4	8.5
Stumpage cost per cord (\$)	14	21	18
Labor cost per day (\$)	137	149	131
Equipment cost per day (\$)	30	108	98
Price per cord at woodyard (\$)	35	42	43

and delivered price per cord were highest where plantations had been thinned once before.

Production rates, costs and revenues for all thinning operations are summarized in Table 4.

The average thinning operation removed 242 cords and harvested 11 cords per acre; it lasted 25 days and removed 10 cords per day. Stumpage costs and prices received reflect the value of both pulpwood and higher valued products. Labor and equipment costs varied widely among different types of operators. The minimum labor cost of zero dollars was recorded by a one-man shortwood logger who did not pay himself a wage. In this case the opportunity cost of his labor would have been an appropriate labor cost.

Several "types" of logging operators were encountered in the survey and production rates, costs and revenues are summarized by type of logging operation in Table 5.

A total of 33 plantations were thinned by shortwood operators, 5 by tree-length operators, and in one case by a whole-tree chipper. The average capital investment by the loggers was \$56,760, but the amount varied widely due to the age and type of equipment. Much of the equipment used by shortwood loggers was either home-made or second-hand equipment. Whole-tree operators had a much higher production rate, used larger crews, and much more expensive equipment. The average shortwood operator had \$22,750 invested in equipment, while the whole-tree operators had \$188,500 invested. Shortwood operators paid less for stumpage and received a lower price per cord than whole-tree operators. In all cases the gross profit before labor and equipment (including hauling) costs was about \$22 per cord. The average shortwood operator had a net operating profit of \$3 per cord compared to a \$4 net profit per cord for whole-tree operators. Whole-tree operators caused significantly more tree and site damage than shortwood operators.

Nineteen of the 39 thinned plantations were loblolly, and the remainder slash pine. Production rates, costs and revenues are summarized by species in Table 6.

The average plantation age in both cases was about 22 years, and the average site index about 67 ft. (base age 25 years). Slash pine plantations averaged about 20 acres larger, but there were no obvious differences in "type" of thinning, logging conditions, and tree or site damage. Slash pine plantations had a slightly larger average dbh before thinning (7.8") than loblolly plantations (7.2"). The loblolly plantations had more trees per acre, 498 vs. 305, more basal area per acre, 143 vs. 100 sq. ft., more volume per acre, 36 vs. 25 cords, and more volume removed in thinning, 13 vs. 9 cords. An average of 12.5 cords per day was produced in slash

Table 3--Plantation and thinning information by number of previous thinnings.

	Number of Previous Thinnings		
	0	1	2
Number of stands in sample	25	12	2
Age when thinned	22	23	25
Trees per acre before thinning	452	326	168
Trees per acre thinned	115	175	92
Basal area per acre before thinning	131	110	60
Basal area per acre thinned	53	46	28
Cords per acre before thinning	33	27	18
Cords per acre thinned	12	10	8
Total cords harvested	205	304	344
Cords per acre	11.5	4.8	5.4
Stumpage cost per cord (\$)	17	25	18
Labor cost per day (\$)	128	171	134
Equipment cost per day (\$)	75	102	325
Price per cord at woodyard (\$)	37	50	42

Table 4.--Production rates, costs and revenues

	Mean	Min.	Max.
Total cords thinned	242	30	921
Cords per acre thinned	11	3	19
Stumpage cost per cord (\$)	19	10	45
Days on site	25	2	120
Labor cost per day (\$)	141	0	645
Equipment cost per day (\$)	96	15	600
Price per cord at woodyard (\$)	42	18	70

Table 5.--Mean production rates, costs and revenues by thinning operation

	Type of Operation		
	Shortwood	Tree-length	Whole-tree Chip
Number of operators	33	5	1
Cords thinned per day	9	30.5	50
Stumpage cost per cord (\$)	18	30	25
Labor cost per day (\$)	109	342	198
Equipment cost per day (\$)	64	211	600
Price per cord at woodyard (\$)	40	53	47

pine plantations compared to 8 cords per day for loblolly. Both stumpage costs and delivered prices were significantly higher for slash pine, mainly because slash pine is concentrated in an area of higher competition, and the average tree size was larger.

As far as the timber owner is concerned, thinning seemed to be used as an in-

strument in controlling the timing of the cash flows rather than a means of maximizing the present value of cash flows. The average stumpage price was \$19 per cord, site damage was low, and less than 5% of the remaining trees had scarred boles. Shortwood operators caused significantly less site and tree damage than whole-tree operators.

Table 6.--Mean production rates, costs and revenues by species

	Loblolly Mean	Slash Mean
Number of stands in sample	19	20
Total cords thinned	254	231
Cords per acre thinned	13	9
Stumpage cost per cord (\$)	14	24
Days on site	32	18
Labor cost per day (\$)	151	132
Equipment cost per day (\$)	97	96
Price per cord at woodyard (\$)	35	48



*Using a short-wood operation, loggers thinned out the smaller trees and culls while providing growing room for the higher quality trees.*



John W. Mixon, Director  
J. Fred Allen, Chief of Research

Cost	\$28.00
Quantity	311