EFFECT OF THINNING ON THE GROWTH AND YIELD OF RED PINE *(PINUS RESINOSA)*

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ABSTRACT

A study was conducted at the West Virginia University Forest, U. S. A. on the effect of thinning on growth and yield of red pine during Spring, 1986. It was done by comparing two different stands, one thinned and the other unthinned. The thinned plantations received three commercial crown thinnings.

The sawtimber volumes in each stand were estimated through a cruise. Sawtimber volume estimates per hectare in the thinned stand were found slightly lower than in the unthinned stand. Volumes for both the stands were then projected for next 10 years. Future sawtimber volumes were also predicted and found to be slightly higher in the thinned stand than in the unthinned one. These results were believed to have occurred because the thinning intensities were too light to prompt a better growth response at the early stage.

Data obtained from increment cores of 40 trees in each stand were analysed by a paired t-test. It was found that the growth rate in the thinned stand was significantly higher than in the unthinned stand. It means, the thinned stand would show better growth performance if both were left for another 10 years.

সারসংক্ষেপ

১৯৮৬ সালের বসন্তকালে যুক্তরাষ্ট্রের ওয়েষ্ট ভার্জিনিয়া বিশ্ববিদ্যালয়ের গবেষণামূলক বন বাগানে একটি নিরীক্ষা চালানো হয়। এতে রেড পাইন গাছের বৃদ্ধি ও কাঠ উৎপাদনের উপর থিনিং এর ফলাফল দেখা হয়। এ কাজে এমন দু'টো বাগানের তুলনা করা হয় যাদের একটিতে কোন থিনিং করা হয়নি এবং অপরটিতে তিনটি বাণিজ্যিক থিনিং করা হয়।

নিরীক্ষায় প্রাপ্ত উপাত্ত থেকে উভয় বাগানের চেরাই কাঠের পরিমাণ নিরূপণ করা হয়। দেখা যায় যে, অথিনিংকৃত বাগানে প্রতি হেক্টর জমিতে উৎপাদিত কাঠের পরিমাণ থিনিংকৃত বাগানের চেয়ে কিছুটা বেশী। অতঃপর বাগানদ্বয়ের কাঠের পরিমাণ পরবর্তী ১০ বছরের জন্য অভিক্ষেপণ করা হয়। কিন্তু এতে থিনিংকৃত বাগানেই অধিক ফল পাওয়া যায়। অনুমিত হয় যে, অপর্যাপ্ত থিনিং এর কারণেই প্রাথমিক পর্যায়ে গাছের যথাযথ বর্ধন সাধিত হয় নাই।

প্রত্যেকটি বাগান থেকে সংগৃহীত ৪০টি গাছের বর্ধনশীল শাঁস নিয়ে জোড়া টি-টেষ্ট করা হয়। এতেও দেখা যায়, পরবর্তী বছরসমূহে গাছের বার্ষিক বর্ধনহার থিনিংকৃত বাগানেই উল্লেখযোগ্যভাবে অধিক। অর্থাৎ, আরো ১০ বছর পরে থিনিংকৃত বাগান থেকেই অধিকতর কাঠ লাভ করা সম্ভব।

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INTRODUCTION

Thinning has significant effect on the growth and yield of red pine. Eyre and Zehngraff (1948) indicated that thinnings have considerably stimulated diameter growth, and the trees appeared not to suffer growth loss when the initial thinning is heavy. Buchman (1962) and Schantz-Hansen (1956) also agreed that red pine appeared not to suffer growth loss when the first thinning was heavy. Lundgren (1981) recommended that thinning red pine could increase net productivity, specially late in the rotation. Lundgren and Wambach (1963) mentioned that tree diameters and number of trees per acre greatly influenced the value and kind of products produced from red pine stands. It was also added that in low-density stands on site index 60, diameter growth was rapid, with maximum 10 annual rings per inch after age 45. At the other extreme, in the high density stands on site index 50, growth rates were very low at older ages, with minimum 40 annual rings per inch after age 95. Thus it was inferred that the combined effect of stand density and site on diameter growth was high.

Artificial prunning in red pine plantations has also become a regular practice in any managed forest to produce clear lumber from trees which are to be harvested within a period from 50 to 80 years after planting (Bramble and Schmidt 1951). Cooley (1969) concluded that thinning to about 60 cu.ft./acre of basal area would be profitable to most owners, because it shortens the rotation as much as possible without seriously reducing the volume yield.

The objectives of the study were to see the effect of thinning on the growth and yield of red pine and also to make financial analysis of red pine plantation management in the West Virginia University Forest. The present paper deals with the first objective only.

MATERIALS AND METHOD

Study area : The study was made in the West Virginia University Forest, where there were 17 different plantations of red pine, established between 1941 and 1960. From these plantations, two red pine stands (plantations 11 and 12), established in 1941, were selected for the study. Plantation 11 (thinned stand) was consisted of two portions, one received single commercial crown thinning which removed 36% of the basal area, while the other had three thinnings and removed approximately 35% of the basal area (Witt 1981). Both the portions of plantation 11 also received two to three Prunnings. On the other hand, Plantation 12 received three different prunnings, but was not thinned.

The areas of the thinned and the unthinned stands were 4.48 ha. and 1.56 ha respectively. A 1.8m x 1.8m spacing was generally used for both the plantations, but in some portions of these stands, a much closure spacing, approaching 1.5m x 1.5m was also obtained (Witt 1981).

Sampling design, study time and analysis of data : Twenty circular sample plots, each having an area of 0.02 ha were established in both the thinned and unthinned stands. The plots were laid on

a systematic square grid pattern. The study was conducted during spring (March-May), 1986.

For the thinned stand data on dbh and merchantable height to the minimum 10-15 cm top diameter were taken for all merchantable trees. Increment cores were taken on two dominant or codominant trees nearest to the plot centre, along with dbh to the nearest 0.25 cm on the trees bored for growth analysis. It is noted here that in portions of the thinned stand, a number of trees were found dead. For the unthinned stand, data on merchantable height and increment cores in each plot were taken only from three dominant or codominant trees nearest to the plot centre, while dbh was measured for all the merchantable trees as before.

The sawtimber volume in the thinned stand was estimated from the cruise data using the International 1/4" log rule. Pulpwood volumes (upto 10 cm top diameter) was estimated from the equation, $Y=3.142+0.00236\ D^2\ H$ where, Y is the pulpwood volume, D is the diameter at breast height (dbh), and H is the merchantable pulpwood height to the 10 cm top diameter (Bernard *et al.* 1973). The present stand-stock table for the thinned stand was then prepared. For the unthinned stand, linear regression equations were run for the data obtained from each of the three trees in predicting mean sawtimber and pulpwood volumes per tree in each dbh class.

The equations for predicting mean sawtimber and pulpwood volumes per tree in each dbh class for the unthinned stand were found to be :

i) $Y\ (\text{sawtimber}) = -32.108 + 1.097\ D^2 \quad (r^2 = 0.9643)$

ii) $Y\ (\text{pulpwood}) = -1.301 + 0.193\ D^2 \quad (r^2 = 0.9823)$

where, D is the diameter at breast height (dbh).

The relationships were then used for estimating the sawtimber and pulpwood volumes for all the trees of the stand. The stand-stock table for the unthinned area was prepared from this sample data summary. Scatter diagram of the growth data collected from the increment borings for both the thinned and unthinned stands were used to prepare the growth projection tables, which were used to predict tree movement by dbh classes in the next 10 years.

The present stand-stock tables for both the stands were projected at the end of next 10 years (1996) by using the stand-table projection method presented in Table 1 (Spurr 1952). The future sawtimber volumes in both the stands were predicted, the future stand-stock tables were then prepared.

Paired t-test was made to compare the growth rates on both the stands using the data of increment cores obtained from 10 sample trees in each stand.

RESULTS AND DISCUSSION

The present stand-stock tables (Table 2) for both the thinned and unthinned stands show that the per hectare sawtimber volumes in the thinned stand were lower than those in the unthinned stand. The sawtimber volume estimates in the thinned stand was 297 cu m per hectare. The mean dbh was found to be 28 cm with a total of 596 trees per hectare. The estimate for the sawtimber volumes per hectare in the unthinned stand was 311 cu m, while the mean dbh was found to be 24 cm with a total of 899 trees per hectare.

On the contrary, the growth projection table (Table 1) as well as the future stand-stock table (Table 2) indicate that the thinned stand would perform better growth response than the unthinned stand if both are left to grow another 10 years. Paired t-test showed that the growth rate in the thinned stand was significantly higher than that in the unthinned stand (t=9.19 at *P.* 05).

Thinning red pine is an economically profitable practice. It has a significant effect on diameter growth and overall timber production in the United States and Canada. The review of the literature cited earlier strongly support this fact. It may, therefore, be concluded that the lower yields in the thinned stands of the present study are probably due to light thinning as well as mortality of trees in some portions of the stand. However, the thinned stand would perform significantly higher yield if both were left to grow for another 10 years.

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Table 1. Growth projection tables based on scatter diagram of the growth data for the thinned and the unthinned stands in next 10 years.

Present dbh	Percent of trees moving to dbh classes		
(cm)	0	+1	+2
Unthinned stand			
15	50	50	
18	20	80	
20	30	70	
23	25	75	
25	28	58	14
28	29	71	
30	33.3	66.7	
33	50	50	
36	50	50	
Thinned stand			
15		100	
18		100	
20		100	
23		100	
25		87.5	12.5
28	14.4	42.8	42.8
30		40	60
33		66.7	33.3
36		100	

Table 2. Summary of the present and future stand-stocks for both the thinned and unthinned stands.

dbh (cm)	No. of trees		Present sawtimber volume (cu m)		Future sawtimber volume (cu m)	
	Thinned	Unthinned	Thinned	Unthinned	Thinned	Unthinned
15	100	131	—	—	—	—
18	66	208	—	—	—	—
20	221	173	—	—	—	—
23	266	204	102	81	84	69
25	532	254	213	124	108	109
28	499	246	277	144	296	126
30	476	108	310	73	187	168
33	222	58	169	45	305	78
36	233	11	205	10	382	30
38	55	8	55	8	365	15
Total	2670	1401	1331	485	1727	595
Tree/ha	596	899	297	311	385	381
% S. E. (plot totals)	—	—	6%	6%	—	—
C. V. % (plot totals)	—	—	28%	26%	—	—

Note : Sawtimbers were calculated upto 20 cm top diameter of the trees.