




STRIP AND SPACED THINNING IN OVERSTOCKED JACK PINE AND BLACK SPRUCE STANDS

Project MS-134

**by
G. A. Steneker**

**FOREST RESEARCH LABORATORY
WINNIPEG, MANITOBA
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**FORESTRY BRANCH
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INTRODUCTION

Overstocked jack pine (*Pinus banksiana* Lamb.) and black spruce (*Picea mariana* (Mill.) B.S.P.) stands, showing signs of stagnation are common in many parts of Canada.

Thinning of young jack pine stands has been given considerable attention particularly in the Lake States (Anon. 1940, Schantz-Hansen 1931, Wilson 1952). Although young stands generally tend to respond favourably to thinning, there is evidence that with increasing age response diminishes rapidly (Hansen and Brown 1929).

Although the growth of residual trees might be stimulated by thinning, the undertaking may be uneconomical because:

- (i) high levels of stocking make thinning difficult and costly, and
- (ii) the cut material is small and may produce little or no revenue.

Attempts to overcome these economic disadvantages led to manual row thinning, which has given favorable results (Bornebusch 1933, Spurr 1947), and later to mechanical strip thinning (Fixmer 1950, Anon. 1953).

In 1949 a thinning trial, including the use of power equipment for strip thinning, was established by the Forestry Branch of the former Department of Northern Affairs and National Resources in co-operation with the Saskatchewan Department of Natural Resources.

Permanent 1-acre sample plots were established in three dense, even-aged jack pine stands in the Nisbet Forest Reserve west of Prince Albert, Saskatchewan and in a dense even-aged black spruce stand near Montreal Lake north of Prince Albert.

Results to 1954 were summarized by Jameson (1956) and Cayford et al (1967). This report summarizes results up to 1964.

LOCATION AND DESCRIPTION OF EXPERIMENT AREAS

One jack pine stand, adjacent to the Shellbrook highway, is located in Sec. 12 and 13, Twp. 49, Rge. 28, W 2. It originated following a fire in 1919. The number of trees per acre in 1949 at age 30 ranged from 3,200 to 3,700 with d.b.h. ranging from 1 to 5 inches, 95 per cent of the trees being in the 1- and 2-inch class.

A second jack pine stand, located near Holbein in Sec. 14, Twp. 49, Rge. 2, W 3, was also of fire origin and was 40 years old in 1949. The number of trees per acre in 1949 ranged from 2,400 to 2,500 and d.b.h. from 1 to 7 inches.

A third stand, located at Crutwell in Sec. 15, Twp. 49, Rge. 1, W 3, was 60 years old in 1949. The number of trees per acre ranged from 600 to 800 and d.b.h. from 1 to 10 inches.

The stands are located on sand deposits from the post-glacial Saskatchewan River. Reworking of the deposits by wind is evident. The sites are dry to moderately dry (Hills 1952). Drainage is excessive due to the coarse soil texture. Ground vegetation consisted principally of Cladonia spp., Arctostaphylos uva-ursi and Thermopsis rhombifolia.

The black spruce stand is located near Bittern Creek in Twp. 58, Rge. 26, W 2. In 1949 at age 58, it contained about 11,000 trees per acre. Diameters at breast height ranged from 1 to 3 inches with more than 80 per cent of the trees in the 1-inch class. This stand is also of fire origin.

Topography is flat to gently undulating. Soil material is greyish brown, gritty loam till. The site is moderately moist. Ground vegetation consists principally of moss species of Calliergon, Hylocomium, Dicranium and Hypnum.

METHODS

In each of the four stands three 1-acre permanent sample plots were established; one plot was strip thinned, the second was thinned to a specific spacing and the third was left as an unthinned control. Table 1 summarizes the treatments given in 1949.

Trees removed in strip thinning were uprooted in groups by a D4 tractor with winch and cable. In the black spruce stand at Bittern Creek it was possible to pull out as many as 40 trees at one time while in the oldest jack pine stand trees had to be pulled out individually because of their size and spacing. Uprooting the trees resulted in extensive scarification in the cleared strips. Thinning to square spacing was done manually.

RESULTS

Stand data for all sample plots in 1949 and 1964 are presented in Table 2. Between 1954 and 1964 unavoidable cutting was carried out on the three sample plots in the jack pine stand at Holbein. Some of the plot data for this stand are therefore presented to 1954.

Diameter and Height Increment

Thinning to spacing

The data in Figure 1 indicate that thinning to specific spacing increased the diameter increment of all d.b.h. classes in the two jack pine stands. Even the 60-year jack pine stand at Crutwell responded to such release. Increment in the smaller diameter classes was about doubled in this stand, while in the larger classes increases amounted to about 50 per cent. Diameter increment was stimulated even more in the jack pine stand at Shellbrook, thinned at the age of 30.

Greatest stimulation of diameter increment occurred in the black spruce stand: after thinning to 7 x 7 feet it had increased on the average over the 15 year period from 0.5 inches to 1.8 inches.

Strip thinning

Diameter increment in the 60-year-old jack pine stand after strip thinning compared favorably with that in the plot thinned to 9 x 9 feet. In the 30-year-old jack pine stand strip thinning resulted in diameter increment intermediate between the control and the thinning to 7 x 7 foot spacing. In the black spruce stand strip thinning did not stimulate diameter increment greatly except in the 3-inch d.b.h. class. The reason for the high increment of the seven trees sampled in this class compared to that in the other classes is not clear since in the other two plots increment in all d.b.h. classes is nearly similar. Possibly the trees are favorably located within the stand in relation to the cleared strips and thus the growth increment is biased.

Strip thinning has stimulated the diameter increment of residual trees, especially of those along the cleared strips. Figure 2 indicates the relationship between diameter increment and distance from the cleared strips. In one of the jack pine stands diameter increment was stimulated at least up to 5 feet away from the cleared strips. Trees along the edge did not necessarily perform best, which could be due to overexposure on the dry jack pine sites or possibly to root damage following the uprooting of trees in the strips. The influence of strip thinning in the black spruce stand is discernible over only 1 to 2 feet into the uncut strips. The great density in stocking in the uncut strips is probably the reason for this.

The stimulating effect of thinning on diameter increment is reflected in the production of large-sized trees to 1954 and 1964 (Table 3). In 1954 and 1964 the thinned plots contained a greater number of large-sized trees than the control plots. The only exception is the oldest jack pine stand. The greater number of large-sized trees on the control plot compared to the strip thinned plot in 1964 is probably a reflection of stand conditions before thinning. It is evident from average d.b.h. and stocking data in Table 2 for this stand that the control plot in 1949 supported a greater number of large-sized trees than the strip-thinned plot.

No trend in height increment in relation to treatment was apparent. It would seem that thinning did not influence height growth.

Basal Area and Volume Increment to 1964

Table 4 summarized periodic basal area and volume increment over the period 1949 to 1964. Only in the two older jack pine stands was increment on the spaced-thinned plots greater than on the controls and strip-thinned plots. Increment on the spaced-thinned plot in the black spruce stand was considerably below that of the other two plots, while the youngest jack pine stand showed only small differences between all plots.

Total Production to 1964

Total volume production to 1964 and 1954 (Table 5) was greater on the control plots than on the plots thinned to a fixed spacing, except in the oldest jack pine stand. In this stand production to 1964 on the spaced-thinned plot was about 30 per cent greater than on the control plot while strip thinning showed an increase in production of about 15 per cent. Total volume production on control and strip-thinned plots was quite similar in the other three stands.

Merchantable volume production reflects the stimulating effect of thinning on diameter increment. For all stands to 1964 merchantable cubic foot and board foot production was greater on the spaced thinned than control plots. Cubic foot merchantable volume production was also greater on the strip-thinned plots than on the controls.

Production on the strip-thinned plots tended to be higher than on the plots thinned to a fixed spacing, except in the oldest jack pine stand where the reverse was the case. In the oldest jack pine stand and the black spruce stand merchantable cubic foot production on the strip-thinned plots although greater than on the controls, was less than that on the plots thinned to a fixed spacing. In the youngest jack pine stand strip thinning gave the highest merchantable cubic foot production while in the oldest jack pine stand it gave the lowest board foot production.

DISCUSSION OF RESULTS AND CONCLUSIONS

Since the results are based on data sampled from four stands of different age and two species, while treatment within stands was not replicated conclusions based on the results must be tentative. An additional factor making evaluation of the results to 1964 difficult is the fact that initial tree size distribution in 1949 before thinning was still evident in the stand data in 1964. However, some observations can be made, based on stand data to 1964. Even at age 60 jack pine showed a response to thinning in all diameter classes. Of the two species black spruce showed the greatest response to release, diameter increment being more than tripled by thinning to a 7 x 7 foot spacing.

Total volume production in the youngest jack pine stand and the black spruce stand was less on the plots thinned to a fixed spacing than on the control plots. Apparently the 1949 thinning in these stands resulted in a level of stocking below that needed for full utilization of the site. Any loss in volume production on the strip-thinned plots was apparently made up by the increased diameter increment of the residual trees, since production on the strip-thinned and control plots was quite similar for all stands, except the oldest jack pine stand.

The stimulus to diameter increment subsequent to thinning resulted in a greater production of large-sized trees. Consequently merchantable volume production was in general greater on the thinned than on the control plots. However, it is doubtful whether these differences will be maintained in future, especially in the black spruce and youngest jack pine stand. It is possible that once the majority of trees in these stands reach merchantable size, production on the unthinned plots will surpass in particular that on the spaced-thinned plots, since the level of stocking on the latter is low.

The profitability of the thinnings in terms of thinning cost and revenue in 1949 and potential revenue in 1964 is difficult to assess, since required operating costs for a 1964 commercial cut are not known. Presumably such costs will be different for the strip-thinned, spaced-thinned and unthinned stands. Nevertheless an evaluation of the commercial standing material in 1964, using a price of \$22.00 per cord (Anon. 1964) from which operating costs must be subtracted, indicates that thinning in the black spruce and youngest jack pine stand was not economical in light of the thinning costs in 1949 and the absence of any returns in that year (Table 6). Thinning to a 9 x 9 foot spacing in the 60-year-old jack pine stand seems to have been profitable, considering that extraction costs in 1964 in the thinned stand would probably have been lower than those in the unthinned stand. The merit of the strip thinning is debatable since the value of merchantable material in 1964 in this stand was less than that in the unthinned stand. In evaluating the material cut in 1949 in the 60-year-old stand a pulpwood price of \$10.80 was used (Anon. 1949).

SUMMARY

Fifteen-year results of strip and spaced thinning in 1949 in dense 30-, 40- and 60-year-old jack pine stands and a dense 58-year-old black spruce stand have shown that jack pine responded to thinning at all ages tested. Black spruce showed a markedly greater response to thinning than even the youngest jack pine stand.

Thinning to a 7 x 7 foot spacing in the youngest jack pine stand and the black spruce stand resulted in a loss in total volume production, probably as a result of inadequate utilization of the site. Thinning to a 9 x 9 foot spacing in the 60-year-old stand increased total volume production by about 30 per cent. Production on the strip-thinned plots was quite similar to that on the unthinned plots in all stands. Merchantable volume production on thinned plots was higher than on unthinned plots in all stands.

An evaluation of thinning costs and revenues in 1949 and potential revenues in 1964 indicated that only thinning the 60-year-old jack pine stand to a 9 x 9 foot spacing was a profitable undertaking.

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Table 1
Methods

Species	Age in 1949	Location	Plot No.	Treatment in 1949
jP	30	Shell- brooke	1	Alternate strip cutting; 10' wide cut, 20' wide uncut strips Thinned to 7' x 7' spacing Control - no thinning
			2	
			3	
jP	60	Crutwell	8	Alternate strip cutting; 20' wide cut, 40' wide uncut strips Thinned to 9' x 9' spacing Control - no thinning
			7	
			9	
bS	58	Bittern Creek	12	Alternate strip cutting; 10' wide cut, 20' wide uncut strips Thinned to 7' x 7' spacing Control - no thinning
			10	
			11	
jP	40	Holbein	5	Alternate strip cutting; 15' wide cut, 30' wide uncut strips Thinned to 7' x 7' spacing Control - no thinning
			4	
			6	

Table 2
Stand Statistics per Acre
1949, 1954, and 1964

Species	Age in 1949	Treatment	D.b.h. (")			Height (')		No. of Trees			Basal Area			Total Volume (cuft.)*			Merchantable Volume	
			1949		1964	1949	1964	1949		1964	1949		1964	1949		1964	cuft.**	bdf,***
			BT	AT				BT	AT		BT	AT		BT	AT		1964	1964
jP	30	Strip Spacing Control	1.7	1.7	2.7	26	32	3174	2255	1420	50	35	56	521	369	743	94	—
			1.6	2.0	3.2	26	30	3427	1058	706	48	24	40	492	252	528	68	—
			1.6	1.6	2.2	25	30	3714	3714	2610	52	52	70	521	521	855	27	—
jP	60	Strip Spacing Control	5.0	5.0	6.2	55	61	936	612	458	128	82	96	2884	1847	2252	1922	3061
			5.3	5.6	6.5	55	64	810	573	516	126	97	124	2883	2238	3086	2831	5142
			5.4	5.4	6.4	55	60	666	666	554	107	107	122	2435	2435	2857	2467	4043
bS	58	Strip Spacing Control	1.3	1.3	1.8	24	28	11872	7512	8021	110	72	128	892	592	1278	113	—
			1.2	1.7	3.4	25	30	10684	833	686	82	12	42	600	107	459	210	—
			1.2	1.2	1.6	26	29	11588	11588	11300	95	95	173	718	718	1683	177	—
jP	40	Strip Spacing Control			1954		1954			1954			1954			1954	1954	1954
			2.9	2.9	3.2	38	42	2409	1496	1373	111	67	75	1780	1077	1291	—	—
			2.7	3.2	3.6	35	39	2391	965	945	93	55	68	1383	844	1151	—	—
			2.8	2.8	3.0	39	42	2497	2497	2289	103	103	110	1736	1736	1907	—	—

* FC-65, Interpolated Form-Class Volume Tables, Can. Dept. Mines & Resources, Misc. Series #3, 1949.

** FC-65, Stump ht. 1.0 foot, Top diam. 3 inches. Form-Class Volume Tables, Can. Dept. Mines & Resources, 1948.

*** FC-65, Stump ht. 1.5 foot, Log length 16.3 feet, Int-(1/4) log rule, Form-Class Volume Tables, Can. Dept. Mines & Resources, 1948.

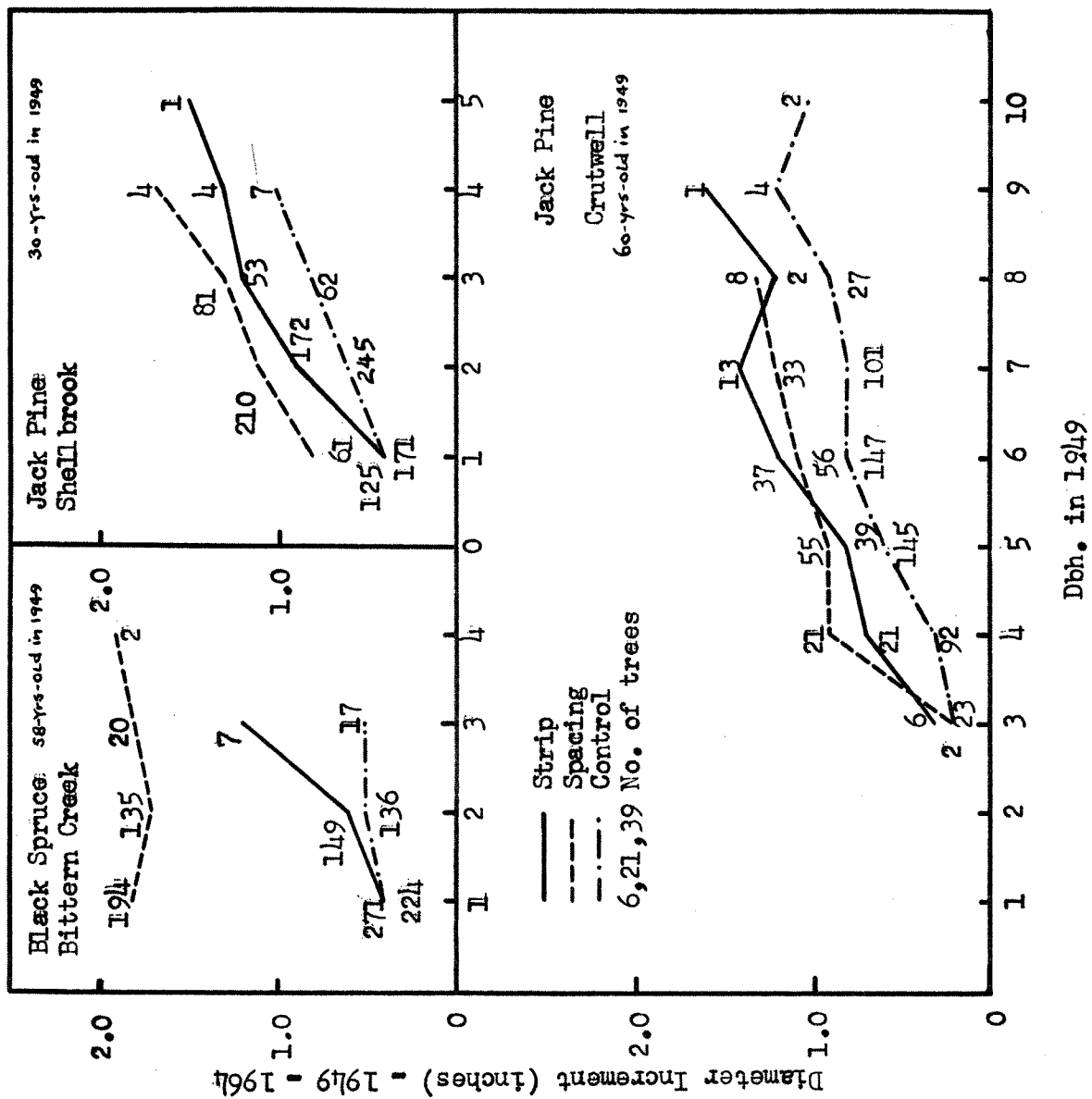


Figure 1. Diameter Increment by One-inch Dbh. Classes

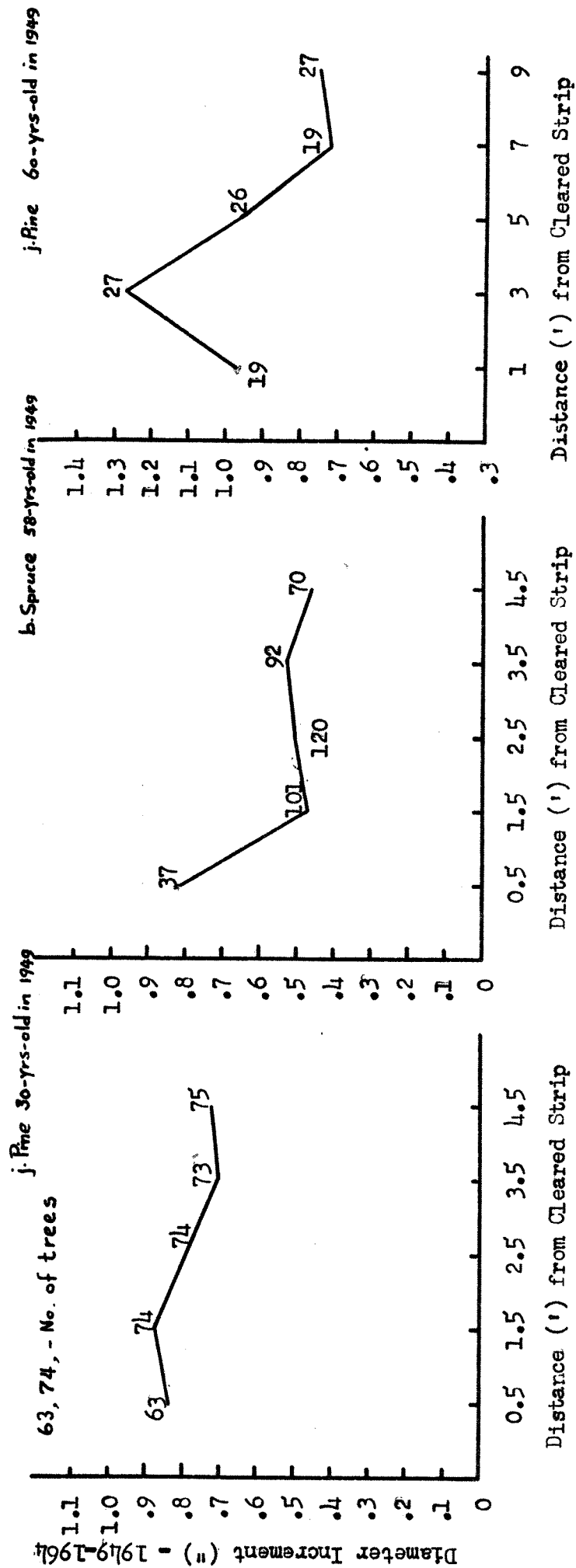


Figure 2. Diameter Increment in Relation to Proximity of Cleared Strip

Table 3
Size Distribution of Trees in 1954 and 1964, by Treatment

Location	Species	Age	Treatment	No. of Trees per Acre in 1964 above:										
				1"	2"	3"	4"	5"	6"	7"	8"	9"	10"	11"
Shell- brooke	jP	30	Strip Spacing Control	1420	1064	697	245	47	5					
				706	681	555	211	38	2					
				2610	1976	697	99	13						
Crutwell	jP	60	Strip Spacing Control			458	431	376	279	170	80	27	3	1
						516	505	464	395	256	124	42	12	
						554	532	469	369	233	108	34	8	1
Bittern Creek	bS	58	Strip Spacing Control	8021	4241	1189	128	1	3					
				686	685	608	214	39						
				11300	4350	1150	200							
Holbein	jP	40	Strip Spacing Control	No. of Trees per Acre in 1954 above:										
				1373	1257	857	419	126	23	1	1			
				945	936	801	453	133	27	3				
				2289	2037	1286	572	146	13					

Table 4
 Net Basal Area and Volume Increment
 (1949-1964)
 per acre

Location	Species	Age 1949	Treatment	Increment (1949-1964)	
				Basal Area (sq. ft.)	Total Volume(cuft.)
Shell- brooke	jP	30	Strip Spacing Control	21	374
				16	276
				18	334
Crutwell	jP	60	Strip Spacing Control	14	405
				27	848
				15	422
Bittern Creek	bS	58	Strip Spacing Control	56	686
				30	356
				78	965
Holbein	jP	40	Strip Spacing Control	Increment (1949-1954)	
				8	214
				13	307
				7	171

Table 5.
Total and Merchantable Volume Production to 1964, per acre

Location	Species	Age in 1949	Treatment	Total Volume (cuft.)			Merchantable*	
				Thinning 1949	Stand 1964	Thinning and Stand	Volume 1964	
							cu. ft.	bd. ft.
Shell- brooke	jP	30	Strip Spacing Control	152	743	895	94	—
				240	528	768	68	—
				—	855	855	27	—
Crutwell	jP	60	Strip Spacing Control	1037	2252	3289	2710	3061
				645	3086	3731	3303	5142
				—	2857	2857	2467	4043
Bittern Creek	bS	58	Strip Spacing Control	300	1278	1578	113	—
				493	459	952	210	—
				—	1683	1683	53	—
Holbein	jP	40	Strip Spacing Control	703 539 —	Total to 1954			
					1291	1994	—	—
					1151	1690	—	—
					1907	1907	—	—

* No merchantable material was taken out in the 1949 thinning except for the Crutwell stand

Table 6
Cost and Revenue per Acre

Species	Age in 1949	Treatment	Cost of thinning 1949	Value of thinning 1949	Cost at 5% to 1964	Revenue at 5% to 1964	Value of stand in 1964
jP	30	Strip	\$ 40.00	- -	\$ 83.16	- -	\$ 24.00
		Spacing	\$ 58.00	- -	\$ 120.58	- -	\$ 18.00
		Control	- -	- -	- -	- -	\$ 7.00
jP	60	Strip	\$ 37.00	\$ 100.00	- -	\$ 130.98	\$ 497.00
		Spacing	\$ 44.00	\$ 60.00	- -	\$ 33.26	\$ 733.00
		Control	- -	- -	- -	- -	\$ 638.00
bS	58	Strip	\$ 49.00	- -	\$ 101.87	- -	\$ 29.00
		Spacing	\$ 105.00	- -	\$ 218.30	- -	\$ 54.00
		Control	- -	- -	- -	- -	\$ 14.00