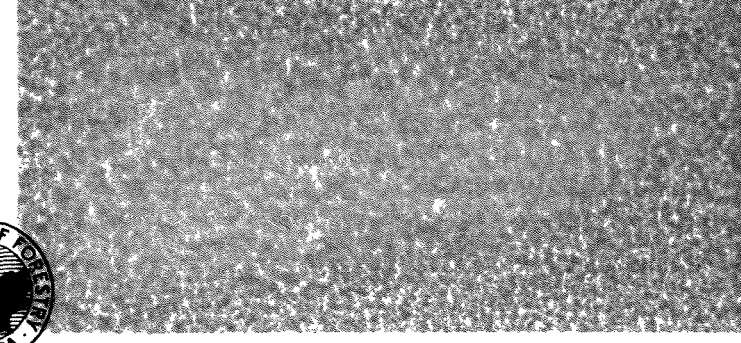

THINNING ASPEN RIDING MOUNTAIN

Project MS-146

by

G. A. Steneker

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INTRODUCTION

Trembling aspen[1] is one of the most abundant commercial tree species in Manitoba and Saskatchewan, occupying respectively about one-tenth and one-third of the productive forest land in the two provinces (Gill 1960 and Anon. 1959). As aspen is highly susceptible to infection by pathogens, it must be cut before reaching maturity in order to minimize volume losses due to decay (Gill 1960 and Kirby et al 1957). Cutting of aspen before maturity, however, will curtail greatly the production of large-sized material suitable for veneer and lumber, unless the growth rate of individual trees can be increased by thinning.

Since 1926 the Department of Forestry has conducted thinning experiments in pure aspen stands in Manitoba and Saskatchewan to determine the stocking levels (= basal area per acre) required for maximum diameter increment and volume production. This report presents 15-year results of a thinning experiment, carried out in 1950 in 14- and 23-year-old aspen stands[2]. Results to 1960 have been reported previously (Steneker 1964).

LOCATION AND DESCRIPTION OF STUDY AREA

The experimental areas are within the Riding Mountain National Park, which is located in the southeastern extremity of the B18[a] Forest Section (Rowe 1959). A description of the selected stands, based on observations in 1950, is presented in Table 1.

METHODS

Within each stand permanent sample plots (with 30-foot surrounds) were laid out and thinned to spacings of 8-by 8-, 10-by 10-, and 12-by 12-feet. Treatments were replicated once in the 23-year-old stand, but not

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[1] For botanical names of plants, see the appendix.

[2] A 19-year-old stand was also thinned in 1950, but sample plots were unavoidably destroyed in 1961.

TABLE 1

DESCRIPTION OF STANDS BASED ON OBSERVATIONS IN 1950

Factor	Stand I	Stand II
Age	14 years	23 years
Stand origin	clear cutting	clear cutting
No. trees/acre	6,000	2,200
Av. d.b.h.	1.4 inches	2.9 inches
Av. dom. ht.	22 feet	42 feet
Aspect	south	north
Slope	2 %	2 %
Soil texture	clay loam	clay loam
Moisture *	fresh to mod. fresh	mod. moist to moist
Tree species	pure aspen	aspen and 8% burr oak, green ash and balsam poplar by no. of trees.
Underbrush	hazelnut, cherry	hazelnut, cherry
Ground flora	dewberry, wild strawberry, rose	sarsparilla, northern bedstraw, snakeroot

* After Hill's classification, 1952.

in the 14-year-old stand. Control plots, which received no treatment, were established as well in each stand. Trees were tallied by one-inch diameter classes before thinning. Malformed and suppressed trees and species other than aspen were removed in thinning, along with sufficient intermediate trees to provide the prescribed spacings. Residual trees were tagged and breast-height diameters were measured to the nearest one-tenth-inch; trees were remeasured in 1960 and 1965. Heights of all trees on the thinned plots and on about 10 per cent of the trees on the control plots were measured to the nearest foot in 1950, 1960 and 1965. Height/diameter curves were constructed for each plot in 1950, 1960 and 1965. Table 2 presents stand statistics for all plots in 1950, 1960 and 1965.

RESULTS

Diameter and Height Increment

Figure 1 shows that periodic diameter increment by one-inch diameter classes was directly related to thinning intensity and that all size classes benefitted from the thinning. Diameter increment decreased substantially after 1960, particularly on the plots thinned to 8- by 8- and 10- by 10-foot spacing and among the smaller diameter classes on all plots (Table 3).

The average diameter of the 200 largest trees per acre on each plot in 1950, 1960 and 1965 has been used as a basis to study the effect of thinning on the size of potential crop trees. Up to 1960 and 1965 the thinned plots supported greater sized crop trees than the controls (Table 4). The average diameter in 1965 of the 200 largest trees on the 8- by 8-foot thinned plot in the younger stand seemed to be a reflection of the above average tree size on this plot in 1950. Periodic increment between 1950 and 1960 on the thinned plots in the younger stand was 42 per cent greater than that on the control. In the older stand periodic increment on the thinned plots was between 20 and 40 per cent greater than that on the controls. Increment between 1960 and 1965 on the thinned and unthinned plots was on the average only 50 per cent of that between 1950 and 1960.

Based on the height of the 20 tallest trees per plot (100 per acre) in 1950 and 1965, thinning did not seem to have had any influence on height increment. Dominant heights between plots in 1950 in the 14-year-old stand varied from 19 to 26 feet and in 1965 from 35 to 42 feet, giving an average increment of 16 feet for all plots. In the 23-year-old stand dominant heights in 1950 averaged 42 feet and in 1965 they averaged 59 feet, giving a periodic increment of 17 feet.

Basal Area and Volume Increment

Basal area and total volume increment per acre to 1960 was greatest on those plots thinned to an 8- by 8-foot spacing and decreased with lighter and heavier thinning (Table 5). Losses at the lower densities are attributed to inadequate stocking and at the higher density levels (controls) to mortality resulting from overstocking.

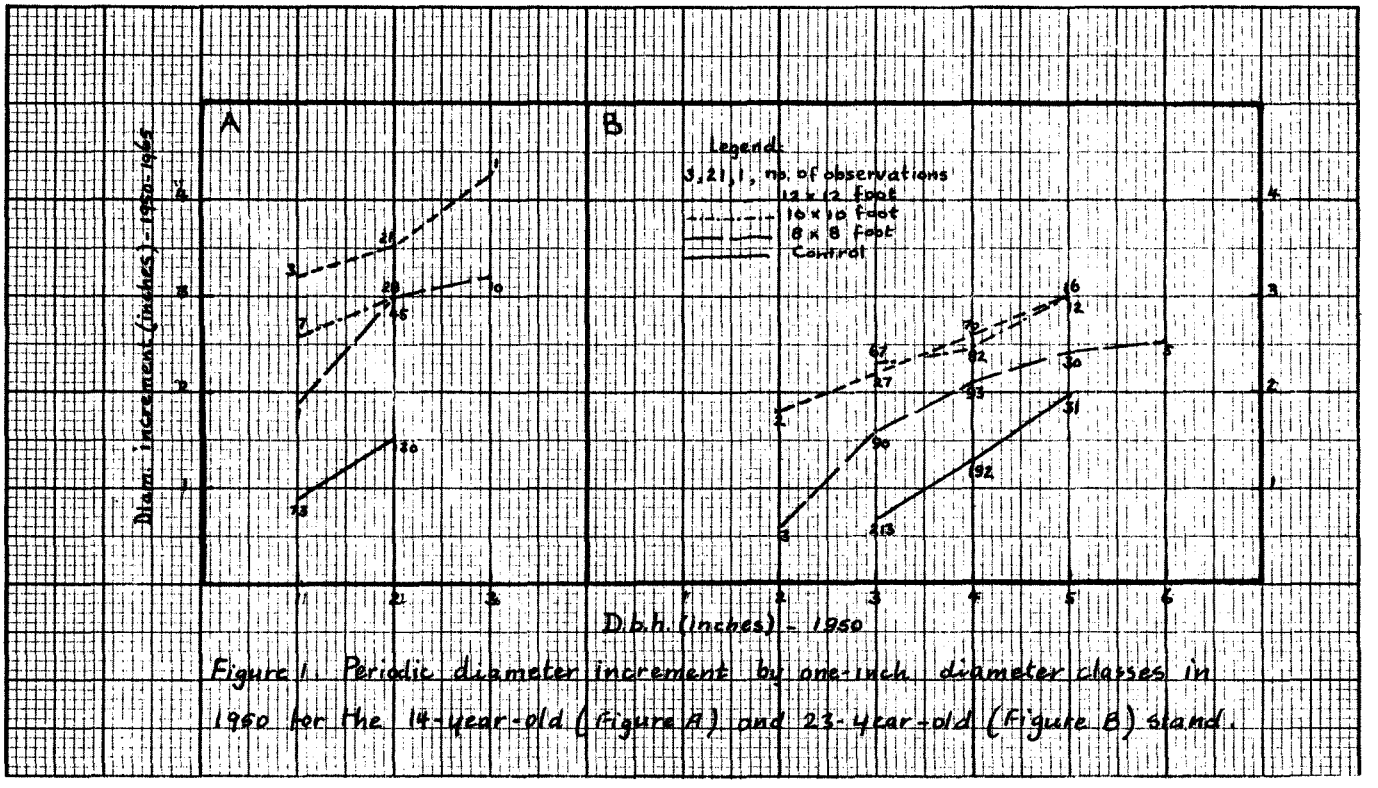

Figure 1. Periodic diameter increment by one-inch diameter classes in 1960 for the 14-year-old (Figure A) and 23-year-old (Figure B) stand.

TABLE 2. STAND DATA PER ACRE FOR ALL PLOTS IN 1950, 1960 AND 1965.

Treatment	Age 1950	No. of plots	No. of trees				Basal area (sq.ft.)				Total volume (cu.ft.)[1]				Volume (cords)[2]				Volume (bd.ft.)[3]		
			1950		1960	1965	1950		1960	1965	1950		1960	1965	1950		1960	1965	1950	1960	1965
			BT.	AT.			BT.	AT.			BT.	AT.			BT.	AT.					
12 x 12	23	1	2365	300	300	290	97	26	71	87	1986	580	1873	2455	8.5	5.6	23	31	-	803	3613
12 x 12	"	1	1965	300	295	280	95	28	69	80	1895	593	1801	2141	9.0	5.5	22	26	-	1071	3282
10 x 10	"	1	2645	435	425	405	106	36	93	105	2065	765	2408	2861	7.1	6.3	28	36	-	325	3268
10 x 10	"	1	2250	435	420	395	75	33	84	95	1796	693	2160	2511	5.3	4.9	25	31	-	306	1369
8 x 8	"	1	1700	680	615	530	92	56	114	114	1793	1132	2964	3087	8.9	8.2	36	38	-	1062	2281
8 x 8	"	1	1665	680	640	575	92	53	115	119	1792	1087	2974	3175	9.1	8.4	35	39	-	580	1944
Control	"	1	2490	-	1470	1090	127	-	159	164	2706	-	4069	4562	16	-	40	59	-	270	2076
Control	"	1	2730	-	1650	1115	131	-	166	159	2631	-	4214	4259	14	-	40	49	-	0	945
12 x 12	14	1	5970	300	260	250	70	6.5	29	40	907	83	459	729	-	-	3.7	7.3	-	-	-
10 x 10	"	1	6670	440	410	350	55	9.4	40	46	714	119	640	803	-	-	4.5	7.7	-	-	-
8 x 8	"	1	5270	680	630	560	71	20	75	85	990	296	1424	1767	-	-	13	19	-	-	-
Control	"	1	6050	-	3060	2030	55	-	103	103	712	-	1685	1900	-	-	3.8	5.7	-	-	-

1 Interpolated volume tables.Canada,Dept.Mines and Resources,Dom.For.Ser.Misc.Ser.No.3.1944
2 Peeled 1' stump,3" top diam.ib.Volume,yoeld and stand tables for tree species in the Lake
3 States.1934.Univ.Minn.Tech.Bull.No.39,Page 30.
1' stump;log length 12.6' and 16.8';top diam. 6.5" Int.log rule(1/4) (7.5"dbh). Form class volume tables (sec.ed.) 1948. Canada Dept. Mines and Resources, Dom.For.Ser. Table 203

TABLE 3

ANNUAL PERIODIC DIAMETER INCREMENT DURING 1960-1965 AS A PER CENT OF THAT DURING 1950-1960 BY TREATMENT AND ONE-INCH DBH CLASSES

Treatment	Age in 1950	No. of plots	Dbh. class (inches) m 1950						Weighted average
			1	2	3	4	5	6	
12 x 12	14 - years	1	67	69	69				69
10 x 10		1	60	50					52
8 x 8		1	53	40	46				41
Control		1	59	50					53
12 x 12	23 - years	2		44	54	62	60		60
10 x 10		2			26	48	50		39
8 x 8		2		10	25	38	42	48	33
Control		2		22	57	77	80		67

TABLE 4

AVERAGE BREAST HEIGHT DIAMETER OF THE 200 LARGEST TREES IN 1950, 1960 AND 1965, AVERAGE ANNUAL INCREMENT 1950-1960 AND 1960-1965 AND THE AVERAGE ANNUAL INCREMENT 1960-1965 AS A PERCENT OF THAT DURING 1950-1960.

Treatment	Age in 1950	No. of plots	Av. dbh. (inches)			Annual increment Period		Per cent II/I x 100
			1950	1960	1965	I 1950-1960	II 1960-1965	
12 x 12	14 - years	1	2.0	4.7	5.7	.27	.20	74
10 x 10		1	2.1	4.8	5.3	.27	.10	37
8 x 8		1	2.6	5.3	6.0	.27	.14	52
Control		1	2.1	4.0	4.5	.19	.10	52
12 x 12	23 - years	2	4.3	7.1	7.8	.28	.14	50
10 x 10		2	4.2	6.9	7.6	.27	.14	52
8 x 8		2	4.6	7.0	7.4	.24	.08	33
Control		2	4.5	6.5	7.0	.20	.10	50

TABLE 5

NET PERIODIC BASAL AREA AND TOTAL VOLUME INCREMENT PER ACRE

Treatment	Age in 1950	No. of plots	Basal area sq. ft.					Total volume cu. ft.				
			Standing			Increment		Standing			Increment	
			1950	1960	1965	50-60	60-65	1950	1960	1965	50-60	60-65
12 x 12	14 - years	1	6.5	29	40	22.5	11	83	459	729	376	270
10 x 10		1	9.4	40	46	30.6	6	119	640	803	521	163
8 x 8		1	20	75	85	55	10	296	1424	1767	1128	343
Control		1	55	103	103	48	0	712	1685	1900	973	215
12 x 12	23 - years	2	27	70	84	43	14	586	1837	2298	1251	461
10 x 10		2	34	88	100	54	12	729	2284	2686	1555	402
8 x 8		2	54	114	116	60	2	1110	2969	3131	1859	162
Control		2	129	162	162	33	0	2668	4142	4410	1474	268

By 1960 basal area levels in the older stand were such that subsequent increment was highest on the 12- by 12-foot thinned plots. These plots still supported the smallest basal area in 1960 and 1965. A decrease in basal area increment occurred between 1960 and 1965 with increasing densities. These data indicate that the basal area per acre in 1960 required for maximum periodic increment was at or below 70 sq. ft. In the younger stand increment trends were not clear, as the 12- by 12- and 8- by 8-foot thinned plots had almost similar basal area increments and the 10- by 10-foot thinned plot had an unexpectedly low increment. Consequently, the basal area required in 1960 for maximum periodic increment in the younger stand could not be determined from the available data. The increment pattern of the older stand corresponds with that found by Steneker and Jarvis (1966) in other aspen stands. They concluded that maximum periodic increment at age 33 (stand age in 1960) will be reached with a basal area of about 70 sq. ft. For the younger stand they predict a basal area of 55 sq. ft.

Volume Production to 1960 and 1965

Total volume and cordwood production per acre to 1960 and 1965 (Table 6) on the control plots in the older stand are reflections of stand conditions in 1950 before thinning, when the control plots supported by far the largest growing stock (Table 2). If volumes had been more comparable the 8- by 8-foot spacing would probably have given the highest production as it did in the younger stand. Board foot production to 1960 and 1965 was increased by thinning, and in 1965 on the heaviest-thinned plots was more than twice that on the control plots.

Mortality

Mortality between 1950 and 1965 was directly related to stand density (Table 7). Hypoxylon pruinatum caused much mortality among all size classes. No trends could be detected between stocking and losses due to this canker.

DISCUSSION AND RECOMMENDATIONS

In all instances thinning resulted in an increase in the diameter increment of residual trees. With thinning to 10- by 10- and 12- by 12-foot spacings, this increase occurred at the expense of basal area and total volume increment per acre, as these light stockings prevented the complete utilization of the available growing space by the residual trees. By 1960 stocking, at least on the heaviest thinned plots in the older stand, had increased sufficiently to attain a greater periodic basal area and volume increment to 1965 than the lighter thinned plots and controls.

Maximum basal area and total volume increment will be achieved when stands are sufficiently stocked so as to use all available growing space, but stocking is light enough to keep mortality, as a result of natural thinning, to a minimum. Based on findings by Steneker and Jarvis (1966) the required stocking level to achieve maximum per acre periodic increment in the 14-year-old stand in 1950 would have been about 35 sq. ft. per acre

TABLE 6

TOTAL VOLUME PRODUCTION PER ACRE TO 1965

Age in 1950	No. of plots	Treatment	Total volume cu. ft. Thinning in 1950	To 1960	To 1965	Cordwood volume Thinning in 1950	To 1960	To 1965	Bd. ft. volume To 1960	To 1965
14 - years	1	12 x 12	824	1283	1553	0	3.7	7.3	0	0
	1	10 x 10	595	1235	1398	0	4.5	7.7	0	0
	1	8 x 8	694	2118	2461	0	13	19	0	0
	1	Control	0	1685	1900	0	3.8	5.7	0	0
23 - years	2	12 x 12	1354	3191	3652	3.2	26	32	937	3448
	2	10 x 10	1202	3486	3888	.6	27	34	316	2318
	2	8 x 8	683	3652	3814	0.7	36	39	821	2112
	2	Control	0	4142	4410	0	40	54	135	1510

TABLE 7

MORTALITY PER ACRE 1950 - 1965

Treatment	Age in 1950	No. of plots	No. of trees	Basal area sq. ft.	Total volume cu. ft.
12 x 12	14 - years	1	50	4.1	63
10 x 10		1	110	9.4	163
8 x 8		1	120	10.8	215
Control		1	4020	36.4	491
12 x 12	23 - years	2	15	3.5	143
10 x 10		2	35	6.2	145
8 x 8		2	126	16.9	412
Control		2	1508	48.5	998

and for the 23-year-old stand about 55 sq. ft. per acre. In 1960 these levels would have been about 55 sq. ft. and 70 sq. ft. respectively, and in 1965 about 65 and 80 sq. ft. respectively.

It is recommended that an additional thinning is carried out in the summer of 1966 to maintain the high diameter increment of individual trees on the thinned plots and to prevent plots from becoming overstocked. Based on the results of this study and the findings by Steneker and Jarvis (1966) the 12- by 12-foot thinned plots in the older stand will be thinned to a residual basal area of about 65 sq. ft., the 10- by 10-foot thinned plots to 80 sq. ft., and the 8- by 8-foot thinned plots to 95 sq. ft. Controls will not be thinned. In the younger stand the 8- by 8-foot thinned plot will be thinned to a residual basal area of 65 sq. ft.

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APPENDIX

Common and botanical names of plants mentioned in text.

Ash, green	-	Fraxinus pennsylvanica Marsh. var. subintegerrina (Vahl.) Fern.
Aspen, trembling	-	Populus tremuloides Michx.
Cherry	-	Prunus sp.
Oak, burr	-	Quercus macrocarpa Michx.
Poplar, balsam	-	Populus balsamifera L.
Dewberry	-	Rubus pubescens Raf.
Hazelnut	-	Corylus cornuta Marsh.
Northern bedstraw	-	Galium boreale L.
Rose	-	Rosa sp.
Sarsaparilla	-	Aralia nudicaulis L.
Snake root	-	Samcula marilandica L.
Wild strawberry	-	Fragaria virginiana Duchesne.