Forest Research Branch

TEN-YEAR RESULTS OF THINNING 14-, 19- AND 23-YEAR-OLD ASPEN TO DIFFERENT SPACINGS

by

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Sommaire en français

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ABSTRACT

Ten-year results of thinning 14-, 19- and 23-year-old aspen stands to spacings of 8′ × 8′, 10′ × 10′ and 12′ × 12′ in the Riding Mountain National Park, Manitoba indicate that, with thinning to a 12 × 12-foot spacing, the rotation necessary for the production of veneer bolts will be shortened by about 10 years. Thinning to a 12 × 12-foot spacing resulted in the greatest board-foot volume.

Ten-Year Results of Thinning 14-, 19-, and 23-Year-Old Aspen to Different Spacings[1]

by

G. A. Steneker[2]

INTRODUCTION

Aspen[3], present over large areas of Manitoba and Saskatchewan, is increasingly affected by decay organisms as it gets older, and its commercial value is greatly reduced by the resulting high proportion of defect in mature stands. Kirby, Bailey and Gilmour (1957) concluded from cull studies in Saskatchewan that aspen should be cut on a pathological rotation of 80 years. As untended stands of this age are normally deficient in sizes suitable for saw and veneer logs, thinning to increase the growth rate of individual trees has been suggested as a means of increasing saw and veneer log production.

Since the 1920's numerous thinning experiments in aspen have been conducted in the Lake States and in Canada. In some instances thinning showed promise, and in others it did not (Bickerstaff 1946, Zehngraff 1946 and 1949, Pike 1953, and Day 1958). Some of the less favourable results might be attributed to such causes as: thinning too lightly; thinning stands too old to respond; thinning stands on sites unfavourable for aspen; using thinning methods unsuitable to aspen.

A thinning experiment established in western Manitoba in 1950 would appear to have avoided most of the factors referred to above. Fourteen-, 19-, and 23-year-old aspen stands were thinned to spacings of 8′ × 8′, 10′ × 10′ and 12′ × 12′ on what may be considered good sites for aspen (Figures 1 and 2).

This report presents growth results to 1960.

LOCATION AND DESCRIPTION OF EXPERIMENTAL AREA

The experimental area is within the Riding Mountain National Park, which is located in the southeastern extremity of the B. 18a Forest Section (Rowe 1959).

A description of the selected stands, based on observations in 1950, is presented in Table 1.

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[3]For botanical names of plants mentioned, see Appendix 1.

FIGURE 1. Thirty-three-year-old aspen, 1960. It was thinned to 12 × 12-foot spacing in 1950.

FIGURE 2. Thirty-three-year-old aspen, 1960—undisturbed.

TABLE 1. DESCRIPTION OF SELECTED STANDS—BASED ON OBSERVATIONS IN 1950

Factor	Stand description		
	Stand I	Stand II	Stand III
Age	14 years	19 years	23 years
Stand origin	clear cutting	burn	clear cutting
No. of trees per acre	6,000	2,400	2,200
Av. d.b.h.	1.4″	2.4″	2.9″
Av. dom. ht.	16′	25′	35′
Aspect	south	northwest	north
Slope	2%	2%	2%
Soil texture*	clay loam	clay loam	clay loam
Moisture**	fresh to mod. moist (3)	mod. fresh (2)	mod. moist to moist (4–5)
Tree species (Stand Composition based on number of trees)	pure apsen	aspen and 13% burr oak, green ash and balsam poplar	aspen and 8% burr oak, green ash and balsam poplar
Underbrush	hazelnut, cherry	hazelnut, cherry	hazelnut, cherry
Ground flora	dewberry wild strawberry rose	kidneyleaf violet wild strawberry rose	sarsparilla northern bedstraw snake root

*Detailed soil profile descriptions are given in Appendices II, III and IV.
**After Hills' classification, 1952.

METHODS

Within each stand permanent sample plots (with 30-foot surrounds) were laid out and thinned to spacings of 8′ × 8′, 10′ × 10′ and 12′ × 12′. Table 2 gives a summary of plots and treatments.

TABLE 2. SUMMARY OF PLOTS AND TREATMENTS

Treatment and Spacing	Number of plots		
	1/10-acre plots	1/5-acre plots	
	14-year-old	19-year-old	23-year-old
12′ × 12′	1	2	2
10′ × 10′	1	2	2
8′ × 8′	1	2	2
Control	1	2	2

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 spacing. Trees remaining after thinning were mapped and numbered, and diameter-at-breast-height was measured to the nearest one-tenth-inch; they were remeasured to the same accuracy in 1960. All trees on the thinned plots and about 10 per cent of all trees on the control plots were measured for height to the nearest foot in 1950 and 1960. Height diameter curves were constructed for each plot from both measurements. Stand tables for all plots before and after thinning in 1950 and in 1960 are given in Appendix IV.

Growth data for the replications in the 19- and 23-year-old stands have, because of their similarity, been grouped together.

Following an unavoidable destruction of plots in the 19-year-old stand in 1961, detailed growth analyses were made on some of the sample trees remaining on the various plots. Of the 1950 inch-class diameter groupings only the 3-inch class had sufficient residuals to give an adequate sample for analysis. Discs were cut from sample trees at breast height. At the radius of average diameter the yearly ring width over the last 20 years was measured with the aid of a vernier microscope.

RESULTS

Production of Large Trees

The various spacings had by 1960 not greatly influenced the production of large sized trees, although some trends were apparent (Table 3). In all stands in 1960 the number of trees in the two largest diameter classes was, with two exceptions, greater on thinned than on control plots. Number of trees 5 inches and over in the 14- and 19-year-old stands, and 7 inches and over in the 23-year-old stand, was greatest on plots thinned to an 8 × 8-foot spacing. However, initial differences in 1950 in diameter distribution between sample plots within the various stands may have favoured the 8 × 8-foot spacings to 1960. In the 19-year-old stand the number of trees 6 inches and over was greatest on plots thinned to a 12 × 12-foot spacing.

Diameter and Height Increment

Average diameters of the 200, 50 and 25 largest trees per acre in 1960 by treatment and stand, and their 10-year diameter increment (1950-1960), were computed (Table 4). Diameters in 1960 were, except in the 19-year-old stand, greater on the thinned than on the control plots, but differed little between thinned plots. However, 1950-1960 diameter increment, except for two instances, tended to be directly related to intensity of thinning. The effect of thinning was almost as evident on the 25 largest trees as on the 50 or 200 largest trees.

The large 1960 diameters on some of the plots could be attributed to diameter distribution before thinning.

TABLE 3. CUMULATIVE FREQUENCY DISTRIBUTION IN 1960 BY DIAMETER CLASSES, STANDS AND TREATMENTS

Treatment	Number of trees per acre											
	14-year-old (1950)				19-year-old (1950)				23-year-old (1950)			
	12′ × 12′	10′ × 10′	8′ × 8′	Control	12′ × 12′	10′ × 10′	8 × 8′	Control	12′ × 12	10′ × 10′	8′ × 8′	Control
D.b.h. class												
1	—	—	—	3,060	—	—	—	—	—	—	—	—
2	260	—	—	2,600	—	—	655	1,085	—	—	—	1,557
3	240	410	630	1,200	—	427	650	998	—	—	628	1,487
4	130	340	610	230	287	420	573	660	298	422	610	985
5	10	120	340	10	237	253	302	267	290	403	515	562
6	0	10	30	0	80	40	58	55	250	307	332	230
7	—	0	0	—	10	2	2	5	145	120	147	67
8	—	—	—	—	0	0	0	0	37	37	33	5
9	—	—	—	—	—	—	—	—	5	5	2	0
10	—	—	—	—	—	—	—	—	0	0	0	—

TABLE 4. AVERAGE D.B.H. OF 1960'S TWO HUNDRED, FIFTY AND TWENTY-FIVE LARGEST TREES PER ACRE IN 1950 AND 1960 AND DIAMETER INCREMENT, BY TREATMENT AND STANDS

Age in 1950	Treat-ment	Number of largest trees per acre: 200 D.b.h. 1960	200 D.b.h. 1950	200 Incr.	50 D.b.h. 1960	50 D.b.h. 1950	50 Incr.	25 D.b.h. 1960	25 D.b.h. 1950	25 Incr.	200 (Incr. treatm. -Incr. control × 100 / Incr. control)	50	25
	12′ × 12′	4.7	2.0	2.7	5.3	2.3	3.0	—*	—	—	42%	30%	—
14 years	10′ × 10′	4.8	2.1	2.7	5.3	2.4	2.9	—*	—	—	42%	26%	—
	8′ × 8′	5.3	2.6	2.7	5.6	2.7	2.9	—*	—	—	42%	26%	—
	Control	4.0	2.1	1.9	4.6	2.3	2.3	—*	—	—	—	—	—
	12′ × 12′	5.5	3.0	2.5	6.1	3.3	2.8	6.4	3.6	2.8	56%	47%	40%
19 years	10′ × 10′	5.3	3.2	2.1	5.8	3.5	2.3	6.0	3.6	2.4	31%	21%	20%
	8′ × 8′	5.4	3.5	1.9	6.0	3.9	2.1	6.3	4.1	2.2	19%	10%	10%
	Control	5.4	3.8	1.6	6.1	4.2	1.9	6.3	4.3	2.0	—	—	—
	12′ × 12′	7.1	4.3	2.8	7.9	4.9	3.0	8.3	5.2	3.1	40%	30%	35%
23 years	10′ × 10′	6.9	4.2	2.7	7.9	4.8	3.1	8.3	5.0	3.3	35%	35%	43%
	8′ × 8′	7.0	4.6	2.4	7.8	5.3	2.5	8.2	5.5	2.7	20%	9%	17%
	Control	6.5	4.5	2.0	7.3	5.0	2.3	7.5	5.2	2.3	—	—	—

*Sample plots in the 14-year-old stand are $\frac{1}{10}$-acre in size. Analysis of the largest 25 trees per acre would therefore involve 2 or 3 trees. This number was considered too small for analysis. Sample plots in other stands are $\frac{1}{5}$-acre in size.

Figure 3 shows diameter increment (1950-1960) of all trees by treatments and 1-inch diameter classes. In all stands diameter increment rose with increased thinning intensity. Effect of thinning was most evident on trees in the smaller size classes. Little difference existed in diameter increment of trees in the largest diameter classes in the 23-year-old stand.

Yearly diameter increment of a number of sample trees in the 19-year-old stand is shown by treatment over a 20-year-period in Figure 4. After 1950, diameter increment for all treatments increased, the 12 × 12-foot spacing showing the most noticeable increase. By 1953 maximum rate of increment had been reached by all trees and a general decline occurred. However, trees on the thinned plots maintained a higher growth rate than those on the controls. Regression lines of diameter increment on years since thinning for trees on the heaviest thinned and control plots for the period 1953-1961 (1953 is year in which full effect of thinning was reached), have been superimposed on the graphs in Figure 4. The regression lines show that, although absolute difference in growth rate between thinned and control plots decreased somewhat, percentage difference increased from 1953 to 1961.

Height increment of dominant trees was not influenced by thinning.

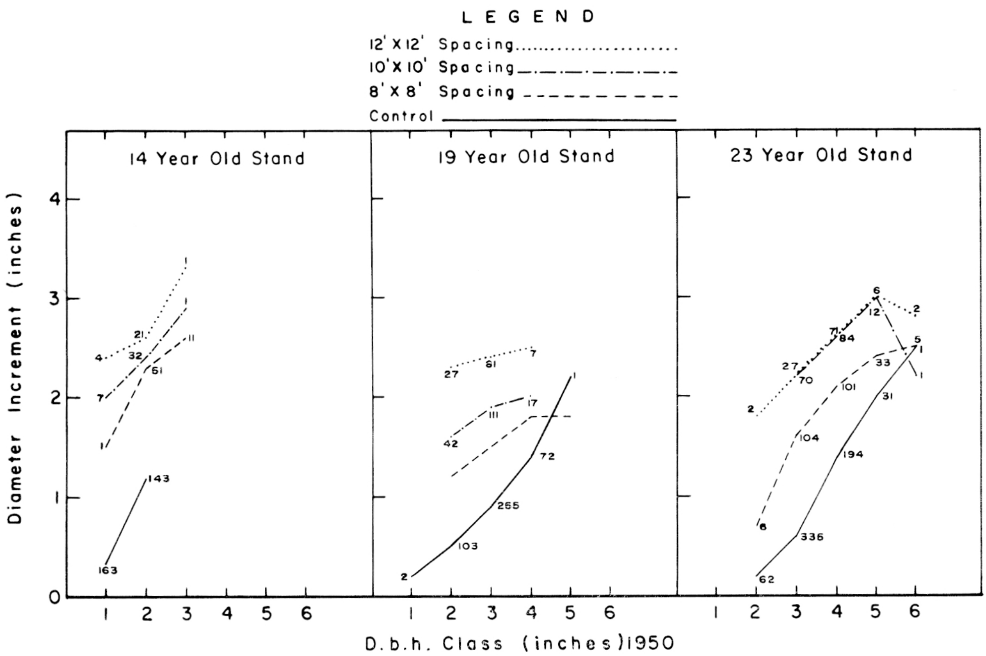

FIGURE 3. Periodic diameter increment by treatment and stands 1950-1960

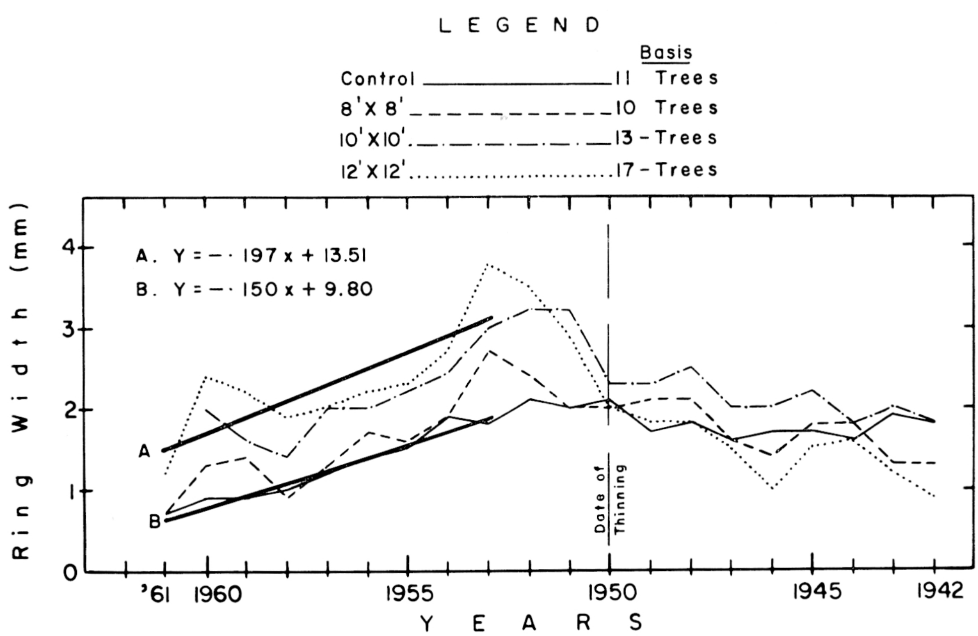

FIGURE 4. Yearly ring width at breast height from 1942 to 1961 by treatment of 3″ trees (dominant and codominant in 1950) from the 19-year-old stand.

TABLE 5. STAND STATISTICS PER ACRE, 1950 AND 1960

Age in 1950	Treatment	No. of plots	No. of trees			Basal area (sq. ft.)			Total volume (cu. ft.)*			Merchantable volume (cords)**			Merchantable volume (bd. ft.)†		
			1950 B.T.	1950 A.T.	1960	1950 B.T.	1950 A.T.	1960	1950 B.T.	1950 A.T.	1960	1950 B.T.	1950 A.T.	1960	1950 B.T.	1950 A.T.	1960
14 years	12′ × 12′	1	5,970	300	260	70	6	29	907	83	459	0	0	3.7	0	0	0
	10′ × 10′	1	6,670	440	410	55	9	40	714	119	640	0	0	4.5	0	0	0
	8′ × 8′	1	5,270	680	630	71	20	75	988	296	1,424	0	0	13.4	0	0	0
	Control	1	6,050	—	3060	55	—	103	712	—	1,685	0	—	3.8	0	—	0
19 years	12′ × 12′	2	2,458	300	288	74	14	42	1,099	230	768	1.0	.2	8.0	0	0	0
	10′ × 10′	2	2,785	435	428	76	21	53	1,232	360	1,012	1.0	.6	10.0	0	0	0
	8′ × 8′	2	2,138	680	655	72	35	74	1,104	542	1,346	1.4	1.2	12.1	0	0	0
	Control	2	2,475	—	1,085	94	—	94	1,524	—	1,847	3.2	—	13.2	0	—	0
23 years	12′ × 12′	2	2,165	300	298	96	27	70	1,940	586	1,837	8.8	5.6	22.1	0	0	937
	10′ × 10′	2	2,448	435	422	90	34	88	1,930	729	2,284	6.2	5.6	26.8	0	0	870
	8′ × 8′	2	1,682	680	628	92	54	114	1,792	1110	2,969	9.0	8.3	35.5	0	0	821
	Control	2	2,610	—	1,557	129	—	162	2,668	—	4,142	15.1	—	40.4	0	—	135

*Interpolated volume tables. Canada, Department of Mines and Resources, Dom. For. Serv. Misc. Ser. No. 3. 1944.

**Peeled, 1-foot stump, 3-inch top diameter i.b. Volume, yield and stand tables for tree species in the Lake States. 1934. Univ. of Minn. A.E.S. Tech. Bull. No. 39. Page 30.

†1-foot stump; log length 12.6′ and 16.8′; top diameter 6.5″. Int. log rule (¼) (> 7.5″ d.b.h.) Form class volume tables (sec. ed.) 1948. Canada Dep't. of Mines and Resources, Dom. For. Serv. Table 203.

Stand in 1960

Stand statistics for 1950 before and after thinning and for 1960 are presented in Table 5. In 1960 only the 23-year-old stand supported trees sufficiently large (larger than 7.5 inches) to produce a board-foot volume. Thinning to a 12 × 12-foot spacing produced the greatest volume (937 bd. ft.) and no thinning produced the least (135 bd. ft.).

Basal area, total volume (cu. ft.) and cordwood volume in 1960 were, except in the 14-year-old stand, inversely related to intensity of thinning.

Nett and Gross Volume Increment and Mortality

Nett board-foot volume increment was greatest on plots thinned to a 12 × 12-foot spacing and least on the controls (Table 6). Net total volume (cu. ft.) and cordwood volume increment were for all stands greatest with an 8 × 8-foot spacing and, except for the 19-year-old stand, least with a 12 × 12-foot spacing.

TABLE 6. PERIODIC NETT AND GROSS VOLUME INCREMENT AND MORTALITY PER ACRE, 1950–1960.

Age in 1950	Treatment	Total volume (cu. ft.)			Merchantable volume (cords)			Merchantable volume (bd. ft.)		
		Nett inc.	Mort.	Gross inc.	Nett inc.	Mort.	Gross inc.	Nett inc.	Mort.	Gross inc.
14 years	12′ × 12′	376	49	425	3.7	.2	3.9	0	0	0
	10′ × 10′	521	24	545	4.5	.1	4.6	0	0	0
	8′ × 8′	1,128	36	1,164	13.4	.1	13.5	0	0	0
	Control	973	221	1,194	3.8	0	3.8	0	0	0
19 years	12′ × 12′	538	28	566	7.8	.3	8.1	0	0	0
	10′ × 10′	652	6	658	9.4	.02	9.4	0	0	0
	8′ × 8′	804	34	838	10.9	.2	11.1	0	0	0
	Control	323	357	680	10.0	.2	10.2	0	0	0
23 years	12′ × 12′	1,251	7	1,258	16.5	.07	16.6	937	0	937
	10′ × 10′	1,555	42	1,597	21.2	.5	21.7	870	0	870
	8′ × 8′	1,859	153	2,012	27.2	1.6	28.8	821	0	821
	Control	1,474	524	1,998	25.3	.8	26.1	135	0	135

Gross total volume increment showed a marked drop on those plots thinned to a spacing wider than 8 × 8 feet.

Mortality over the 10-year period on the control plots, especially among the smaller diameter classes, was in some instances as high as 50% by number of trees. Most trees on the thinned plots had their crowns relatively free from competition, and mortality was consequently greatly reduced.

DISCUSSION AND CONCLUSIONS

Results of aspen thinnings in Manitoba and Saskatchewan will most likely be evaluated in terms of increased production of material suitable for the manufacture of lumber and veneer for which certain size and quality standards must be met. Ten-year results of this experiment have shown that thinning produced a greater number of large sized trees to 1960 than no thinning. Furthermore the largest trees on the thinned plots were growing at a faster rate than the largest trees on the control plots. It is therefore likely that as a result of thinning veneer size material (minimum size: 11 inches d.b.h.) will be produced at an earlier age than would be the case with no thinning.

In order to make a conservative estimate of the rotation age at which veneer size material will be produced on the plots thinned to a 12 × 12-foot spacing in the 19-year-old stand, the assumptions are made that (1) Kirby's et al. (1957) projected growth rates for aspen apply to the growth rate of the largest trees on the controls and (2) a constant per cent difference (rather than slightly increasing difference as in Figure 4) in growth rate between the 12 × 12-foot thinned plots and control plots will be maintained in the future. Projected growth rate calculations for the 200, 50 and 25 largest trees on the 12 × 12-foot thinned plots revealed that these trees may produce veneer size material at an age of 48 years. On the control plots this material may be produced at an age of 58 years. Thinning to a 12 × 12-foot spacing will therefore have shortened the rotation by 10 years. If the same assumptions are made in the calculation of the projected growth rate of the largest trees in the other two stands, the rotation of these trees will also be shortened by about 10 years.

The three ages of stand in this study showed no difference in response to thinning. Where one non-commercial thinning is possible, early and heavy thinning would seem most advantageous. It would probably be cheaper, and also the growth advantage resulting from thinning would be better utilized, than if thinning were to be deferred. Thinning a 14-year-old stand to a 12 × 12-foot spacing will likely maintain the diameter increment at a high level for a long period of time, and a subsequent thinning can be delayed until such an operation will be commercial.

Greatest board-foot volume to 1960 was produced on plots thinned to a 12 × 12-foot spacing. However, volume differed little from that on plots thinned to a 10 × 10- and an 8 × 8-foot spacing. It cannot therefore be safely assumed that the widest spacing will continue to produce the greatest board-foot volume.

SUMMARY

In 1950, 14-, 19- and 23-year-old aspen stands were thinned to spacings of 8′ × 8′, 10′ × 10′ and 12′ × 12′ in the Riding Mountain National Park, Manitoba. An analysis of the growth to 1960 of 1960's 200, 50 and 25 largest trees per acre, by treatment and stand, showed that on plots thinned to a 12 × 12-foot spacing diameter increment of the largest trees was between 30 and 56 per cent greater than that of the largest trees on the controls. It was concluded that with thinning to a 12 × 12-foot spacing, the rotation necessary for the production of veneer bolts (assuming a minimum utilizable size of 11 inches d.b.h.) will be shortened by about 10 years.

Thinning to a 12 × 12-foot spacing resulted in the greatest board-foot volume; no thinning resulted in the greatest basal area and total volume (cu. ft.); and thinning to an 8 × 8-foot spacing resulted in the greatest cordwood volume.

Gross total volume increment dropped markedly at spacings wider than 8 × 8 feet. Mortality was noticeably reduced by thinning.

SOMMAIRE

En 1950, des peuplements de peupliers de 14, 19 et 23 ans ont été éclaircis à intervalles de 8 pieds sur 8, de 10 pieds sur 10 et 12 pieds sur 12 dans le parc national Riding Mountain, au Manitoba. Une analyse de la croissance, jusqu'en 1960, des 200, 50 et 25 plus gros arbres à l'acre en 1960, d'après le traitement reçu et le type de peuplement, a révélé que dans les places éclaircies à intervalles de 12 pieds sur 12, l'accroissement en diamètre des arbres les plus gros était de 30 à 56 p. 100 supérieur à celui des plus gros arbres des places témoins. L'auteur conclut que grâce aux coupes d'éclaircie à intervalles de 12 pieds sur 12, la rotation nécessaire pour la production de billes de placage, si l'on présume que les dimensions minima des billes utilisables sont de 11 pouces de diamètre à hauteur de poitrine, sera raccourcie d'environ dix ans.

Les coupes d'éclaircie à intervalles de 12 pieds sur 12 ont donné le plus fort volume de pieds mesure de planche, mais n'ont provoqué aucun accroissement de la surface terrière et du volume global (en pi. cu.); par ailleurs, les coupes d'éclaircie à intervalles de 8 pieds sur 8 ont donné le plus fort volume de bois de chauffage.

L'accroissement du volume global brut a sensiblement diminué à la suite des éclaircies à intervalles de plus de 8 pieds sur 8. De plus, les éclaircies ont enrayé notablement la mortalité.

APPENDIX I

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* spp.
Oak, burr	*Quercus macrocarpa* Michx.
Poplar, balsam	*Populus balsamifera* L.
Dewberry	*Rubus pubescens* Raf.
Hazelnut	*Corylus cornuta* Marsh.
Kidneyleaf violet	*Viola renifolia* Gray (incl. var. *brainerdii* (Green) Fenn.)
Northern bedstraw	*Galium boreale* L.
Rose	*Rosa* sp.
Sarsaparilla	*Aralia nudicaulis* L.
Snake root	*Sanicula marilandica* L.
Wild strawberry	*Fragaria virginiana* Duchesne.

APPENDIX II

Soil Profile Description, 14-Year-Old Stand, Plots 9-12

Moisture regime 3, fresh.

		Accumulative depth
organic layers	L Depth ½″ F " 2″ H " 1″	3½″
Ahe horizon	Depth —3″ Texture —clay loam Structure—granular pH —6.5 Colour —very dark grey (10YR3/1)*	6½″
Bt horizon	Depth —11″ Texture —heavy clay Structure—blocky pH —6.7 Colour —dark brown (10YR3/3)	17½″
Bm horizon	Depth —6″ Texture —clay loam Structure—granular pH —7.4 Colour —grey brown (2.5Y 5/2) Free Ca present.	23½″
C horizon	Depth —8″+ Texture —clay loam Structure—granular pH —7.4+ Colour —grey brown (2.5Y 5/2) Water table below 31½″	31½″+

*Munsell Soil Color Charts, 1954 ed.
Munsell Color Company, Inc.
Baltimore 2, Maryland, U.S.A.

APPENDIX III

Soil Profile Description, 19-Year-Old Stand, Plots 13-20

Moisture regime 2, moderately fresh.

		Accumulative depth
organic layers	L Depth ¼″ F " 1″ H " ¾″	2″
Ahe horizon	Depth —4″ Texture —loamy sand Structure—single grained to slightly granular pH —6.8 Colour —dark grey to reddish brown (5YR 3/1)	6″
Bt horizon	Depth —7″ Texture —clay loam Structure—single grained to slightly granular pH —6.7 Colour —reddish brown (5YR 5/4)	13″
Bm horizon	Depth —9″ Texture —silty clay loam Structure—single grained to slightly blocky pH —7.3 Colour —yellow brown (10YR 5/6) Free Ca present	22″
C horizon	Depth —7½″ Texture —silty clay loam Structure—single grained to slightly blocky pH —7.4 Colour —yellow brown (10YR 5/6) Water table below 29½″	29½″

APPENDIX IV

Soil Profile Description, 23-Year-Old Stand, Plots 1-8

Moisture regime 4-5, moderately moist to moist

		Accumulative depth
organic layers	L Depth ¼″ F " 1″ H " 1″	2¼″
Ah horizon	Depth —2½″ Texture —loamy fine sand Structure—single grained slightly platy pH —6.8 Colour —dark grey to black (10YR 3/1)	4¾″
Ae horizon	Depth —3½″ Texture —loamy fine sand Structure—single grained slightly platy pH —6.8 Colour —grey brown (2.5 YR 5/2)	8¼″
Btg horizon	Depth —7″ Texture —heavy clay Structure—granular to slightly blocky pH —6.8 Colour —grey brown (2.5 YR 5/2) Occurrence of gleying	15¼″
Cg horizon	Depth —15″ Texture —alternate bands of silt and fine sand Structure—single grained to slightly granular pH —7.4 Colour —yellow brown (10YR 5/6) Occurrence of gleying Water table in June below 30″	30¼″

APPENDIX V

STAND TABLE, 1950 AND 1960

(number of trees per acre)

	14 years (1950)										
Treatment	12′ × 12′			10′ × 10′			8′ × 8′			Control	
Plot number	10			11			12			9	
D.b.h. class	1950 B.T.	1950 A.T.	1960	1950 B.T.	1950 A.T.	1960	1950 B.T.	1950 A.T.	1960	1950	1960
1	3,630	20		5,400	30		3,050	490		4,580	460
2	2,330	270	20	1,250	400		1,980	190		1,470	1,400
3	10	10	110	20	10	70	240		20	—	970
4	—	—	120	—	—	220	—	—	270	—	220
5	—	—	10	—	—	110	—	—	310	—	10
6	—	—	—	—	—	10	—	—	30	—	—
7	—	—	—	—	—	—	—	—	—	—	—
8	—	—	—	—	—	—	—	—	—	—	—
9	—	—	—	—	—	—	—	—	—	—	—
Total	5,970	300	260	6,670	440	410	5,270	680	630	6,050	3,060

APPENDIX V

STAND TABLE, 1950 AND 1960

(number of trees per acre)—continued

	19 years (1950)																					
Treatment	12′ × 12′						10′ × 10′						8′ × 8′						Control			
Plot number	13			14			17			18			15			16			19		20	
D.b.h. class	1950 B.T.	1950 A.T.	1960	1950 B.T.	1950 A.T.	1960	1950 B.T.	1950 A.T.	1960	1950 B.T.	1950 A.T.	1960	1950 B.T.	1950 A.T.	1960	1950 B.T.	1950 A.T.	1960	1950	1960	1950	1960
1	335	—	—	280	—	—	735	—	—	375	—	—	320	—	—	205	—	—	260	—	310	—
2	1,530	55	—	1,215	55	—	1,785	70	—	1,170	105	—	1,090	155	—	865	60	10	925	105	1,055	70
3	650	230	—	720	210	—	675	320	5	630	260	10	705	445	80	825	475	75	910	325	895	350
4	70	15	60	105	35	40	70	45	165	130	70	170	150	80	325	100	135	215	245	395	325	390
5	10	—	145	—	—	170	—	—	215	—	—	210	5	—	190	10	10	300	5	210	15	215
6	—	—	70	—	—	70	—	—	40	—	—	35	—	—	65	—	—	45	—	45	5	55
7	—	—	10	—	—	10	—	—	—	—	—	5	—	—	—	—	—	5	—	—	—	10
8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	2,595	300	285	2,320	300	290	3,265	435	425	2,305	435	430	2,270	680	660	2,005	680	650	2,345	1,080	2,605	1,090

APPENDIX V

STAND TABLE, 1950 AND 1960

(number of trees per acre)—concluded

	23 years (1950)																					
Treatment	12′ × 12′						10′ × 10′						8′ × 8′						Control			
Plot number	1			2			3			4			5			6			7		8	
D.b.h. class	1950 B.T.	1950 A.T.	1960	1950 B.T.	1950 A.T.	1960	1950 B.T.	1950 A.T.	1960	1950 B.T.	1950 A.T.	1960	1950 B.T.	1950 A.T.	1960	1950 B.T.	1950 A.T.	1960	1950	1960	1950	1960
1	260	—	—	95	—	—	170	—	—	75	—	—	75	—	—	70	—	—	145	—	165	—
2	910	—	—	675	—	—	1,190	—	—	960	—	—	495	15	—	415	—	—	765	50	865	90
3	810	55	—	790	75	—	950	140	—	920	165	—	655	240	25	750	280	10	925	460	1,070	545
4	340	205	—	300	140	15	265	225	25	260	240	15	345	295	70	305	285	120	530	390	545	455
5	40	35	35	95	75	45	70	70	70	30	25	120	120	120	170	105	100	195	110	330	85	335
6	5	5	120	10	10	90	—	—	200	5	5	175	10	10	205	20	15	165	15	155	—	170
7	—	—	115	—	—	100	—	—	60	—	—	105	—	—	100	—	—	130	—	70	—	55
8	—	—	20	—	—	45	—	—	60	—	—	5	—	—	45	—	—	15	—	10	—	—
9	—	—	10	—	—	—	—	—	10	—	—	—	—	—	—	—	—	5	—	—	—	—
Total	2,365	300	300	1,965	300	295	2,645	435	425	2,250	435	420	1,700	680	615	1,665	680	640	2,490	1,465	2,730	1,650

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