

CANADA
Department of Northern Affairs and National Resources
FORESTRY BRANCH

**SEEDING JACK PINE ON THE
SANDILANDS FOREST RESERVE, MANITOBA
1925 TO 1955**

by
J. H. Cayford

**Forest Research Division
Technical Note No. 79
1959**

Issued under the authority of
The Honourable Alvin Hamilton, P.C., M.P.,
Minister of Northern Affairs and National Resources
Ottawa, 1959

THE QUEEN'S PRINTER AND CONTROLLER OF STATIONERY
OTTAWA, 1959

Cat. No. R47-79

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ACKNOWLEDGEMENT

The author wishes to express his gratitude to the Manitoba Forest Service for permission to use their records pertaining to the seeding. Foresters M. Kaye and A. Kotowycz provided considerable assistance in planning and carrying out the field examination.

Seeding Jack Pine on the Sandilands Forest Reserve, Manitoba, 1925 to 1955

by
J. H. Cayford¹

INTRODUCTION

Direct seeding with jack pine² has been carried out sporadically on the Sandilands Forest Reserve in southeastern Manitoba since 1925 as a method of restocking open areas of potentially productive forest land. Between 1925 and 1928 a number of small plots were experimentally seeded by the Dominion Forest Service, Canada Department of the Interior. Seeding was undertaken on a small operational scale by the Manitoba Forest Service during the 1940's and since 1950 their program has been greatly expanded. In 1958 many of the seeded plots were examined to determine the degree of success of direct seeding on the reserve and to investigate some of the factors which affected the results.

DESCRIPTION OF PLOTS SEEDED

Jack pine stands originally covered most of the plots but had been destroyed by fire or cutting. The soils, which show little profile development, have been described as sandy podzolics developed on sandy textured deposits of outwash and moraine (Ehrlich *et al*, 1953). Topography varies from flat to gently undulating. In 1958 the lesser vegetation consisted of ericaceous and grass communities. The former were characterized by bearberry, wintergreen, and blueberry and the latter by various grasses including big blue-stem, mountain-rice, sheep's-fescue, June-grass, hair-grass, and poverty oat-grass.

SEEDING METHODS

The 1925 to 1928 seeding was carried out experimentally on 26 one-quarter-acre plots, eight of which were seed spotted and the remainder broadcast seeded. Seed spots, spaced at four-foot intervals, were prepared with a hoe and seeds sown by hand; one plot had been disked prior to the preparation of the seed spots.

The broadcast-seeded plots were disked four times and usually thoroughly harrowed before seeding. Seeding was done either by hand or with a hand-operated Cyclone seeder. A few plots were again harrowed after seeding.

Later seeding techniques, with the exception of limited seeding in ploughed furrows, were fairly uniform. Before seeding plots were scarified, either completely or in strips which covered one half of the plot area. An Athens or similar type of disk plough was used to prepare a mineral-soil seedbed and an uneven surface of furrows and ridges was created (Figure 1). The proportion of mineral soil exposed varied from less than half to almost complete exposure. Seed in quantities varying from 3.5 to 32 ounces per acre was scattered with a Cyclone seeder. On four plots cones instead of seed were scattered and on another, cone-bearing branches were spread. Seeding was carried out in the spring, summer, and autumn of different years. The April seeding in 1953 and 1954 was done while snow remained on the ground.

¹Forestry Officer, Forest Research Division, Forestry Branch, Manitoba-Saskatchewan District Office, Winnipeg, Manitoba.

²For a list of scientific names of all species mentioned in the text, see Appendix.



Figure 1. A seedbed prepared by scarifying sandy soil with a disk plough. (Photo by R. A. Haig.)

On two small plots seeding was done in ploughed furrows spaced from 6 to 9 feet apart. A few jack pine seeds were dropped at four-foot intervals along the furrows.

Seeding from 1943 to 1955 is summarized in Table 1.

SAMPLING METHODS

Sampling, with the exception of that for the 1943 seeding and the furrow seeding, was based on instructions prepared by the Forestry Branch for the study of reproduction on cut-over and burned-over land in Canada (Candy, 1951).

Each seeded plot was sampled with milacre quadrats using the continuous strip method and the number of quadrats examined usually varied between 100 and 225. The stocked quadrat³ method of survey was used and in addition a total tally of jack pine seedlings was made on every fifth quadrat.

The plots seeded in 1943 were sampled by means of 1/20-acre sample plots. A diameter tally was made and the heights of representative trees in each diameter class were measured on each sample plot. Where seeding was done in furrows a tally of all seedlings was made and the length of each furrow measured.

On each seeded plot descriptive information regarding soil, minor vegetation, and other factors which affected the results, was recorded.

RESULTS

Experimental Seeding, 1925 to 1928

During this period eight one-quarter-acre plots were seed spotted and 18 broadcast seeded. They were not examined in 1958 and information presented

³A quadrat was considered stocked if it contained one or more seedlings.

TABLE 1. SUMMARY OF SEEDING, 1943 TO 1955

Plot No.	Area (acres)	Date of Seeding	Seed per Acre (ounces)	Scarification	Notes
5/43 to 8/43.....	25	July, 1943	16-32	Complete scarification and scarification in strips	Seeding only on scarified strips
S2-45.....	5	1945	24	Scarification in strips, 30' wide	Seeding only on scarified strips
1/50 and 2/50.....	6	June 17, 1950	8-12	Complete scarification	Cones scattered in 1954
3/50 to 6/50.....	20	Oct. 27—Nov. 1, 1950	4-11	Complete scarification	—
1/51.....	48	July 16-17, 1951	7	Complete scarification	—
2/51.....	25	July 16-17, 1951	3.5	Scarification in strips, 40' wide	Seeding only on scarified strips
1/52.....	30	July 8-10, 1952	7	Complete scarification	—
2/52 and 3/52.....	80	July 8-10, 1952	3.5	Scarification in strips, 35' wide	Seeding only on scarified strips
1/52 (Furrow).....	1	June 11, 1952	— —	Single furrows, 6-9' apart	Seed scattered along furrows
2/52 (Furrow).....	1	Nov. 15, 1952			
1/53 to 5/53.....	15	April 1-7, 1953	12-26	Complete scarification	Seeded on snow
6/53.....	3	April 1-7, 1953	Cones	Complete scarification	Scattered on snow
7/53 and 9/53.....	12	April 8, 1954	26-28	Scarification in strips, 6' wide	Entire plots seeded
8/53.....	1	April 8, 1954	Branches	Complete scarification	—
24, 26, 27 and 28/54.....	31	April 15, 1954	16	—	Seeded on snow
3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15, 19, 20, 21, 22, 23/54	65	May 26—June 18, 1954	16 ¹	Scarification in strips, 6' wide	Entire plots seeded
7/54.....	7	May 28, 1954	16 ¹	Scarification in strips, 6' wide	Entire plot seeded: re-seeded in July 1956
16, 17, 18/54.....	14	June 3, 1954	Cones	Scarification in strips, 6' wide	Re-seeded in July 1956
1/55 to 7/55.....	225	April and Oct., 1955	11	Scarification in strips, 12' wide	Entire plots seeded

¹Seed was covered the same day as sown by dragging a tree over the seeded plots.

is from an unpublished report by Morison⁴ based upon an examination in 1930, three to six growing seasons after seeding.

The seed spot method was in general unsuccessful as six of the eight plots had 17 per cent or less of their seed spots stocked. On the remaining plots, stocking was 33 and 55 per cent.

Broadcast seeding following scarification was more successful (Table 2) and dense seedling stands became established on most of the plots. Figure 2 is a 1957 view of one stand containing 12,780 stems per acre, with diameters of 3 inches and heights to 25 feet.

TABLE 2. NUMBER OF PLOTS AND AVERAGE NUMBER OF SEEDLINGS PER ACRE IN 1930 BY PERCENTAGE STOCKING CLASSES, 1925 TO 1928, BROADCAST SEEDING ON SCARIFIED SOIL

Per Cent Stocking ¹	Number of Plots	Average Number of Seedlings per Acre
<20.....	3	100
20-39.....	1	600
40-59.....	2	4,650
60-79.....	2	2,100
80-100.....	10	12,700

¹Stocking figures have been converted from a one-third milacre basis, the size of the regeneration plots, to a one-milacre basis using Grant's (1951) formula.



Figure 2. View of a stand seeded between 1925 and 1928. In 1957 there were more than 12,000 stems per acre.

Broadcast Seeding, 1943

In 1943 four plots totalling 25 acres were broadcast seeded. Two were completely scarified and seeded and the other two were scarified and seeded in one-half-chain-wide strips (Figure 3). Sampling was confined to areas actually scarified and seeded. In 1958 the four plots supported very dense stands of jack pine saplings, varying from 4,280 to 11,350 stems per acre. Table 3 shows stand tables for two of the seeded plots illustrating the extremes of density.

⁴Morison, M. B. 1931. Direct seeding on the Sandilands Forest Reserve. Typewritten report. 9 pp. and 7 tables.

TABLE 3. STAND TABLES PER ACRE, 1943, SEEDED PLOTS ON SCARIFIED SOIL

d.b.h. (inches)	Number of Jack Pine per Acre	
	Plot 5/43	Plot 6/43
<1.....	967	3,340
1.....	2,647	6,520
2.....	653	1,480
3.....	13	10
Total.....	4,280	11,350



Figure 3. View of a 15-year-old sapling stand which originated after broadcast seeding in strips in 1943

Maximum heights on the four plots were very uniform, varying only between 16 and 18 feet. Although little mortality had occurred, there was good differentiation of crown classes and it appeared probable that appreciable mortality of suppressed saplings would soon occur.

Broadcast Seeding, 1945






















Five acres were scarified and seeded in strips during 1945. Although the location was recorded, no evidence of the seeding could be found and it is assumed to have been a failure.

Broadcast Seeding, 1950 to 1955

Regeneration was examined on 397 of 564 acres broadcast seeded between 1950 and 1955. Some plots were not examined because of their small area or because of their proximity to natural regeneration which had originated after fire. Tables 4 and 5 show summaries of per cent stocking and numbers of seedlings per acre on the plots examined.























Considerable success was achieved by broadcast seeding. Nearly 50 per cent of the 397 acres examined were more than 40 per cent stocked. Thirty-one per cent of the area supported stands exceeding 1,000 seedlings per acre, while an additional 37 per cent had between 500 and 1,000 seedlings per acre. Reasons for some of the failures were apparent and are discussed later.

TABLE 4. BROADCAST SEEDING BETWEEN 1950 AND 1955, PER CENT STOCKING

Plot number	Date of seeding	Total area examined (acres)	Number of acres by per cent stocking				
			< 20	20-39	40-59	60-79	80-100
1/50, 2/50	June 17, 1950	6					
3/50-6/50	Oct. 27 — Nov. 1, 1950	20					
1/51	July 16-17, 1951	48					
2/51	July 16-17, 1951	25					
1/53-5/53	April 1-7, 1953	15					
9/53	April 8, 1954	7 ⁽¹⁾					
3,6,8,9,10, 11,14,22/54	May 26 — June 16, 1954	44 ⁽¹⁾					
7/54	May 28, 1954	7 ⁽¹⁾					
1/55-7/55	April and October, 1955	225 ⁽¹⁾					
Total		397					
Per cent		100	37	14	44	5	0
<p>Scale of number of acres</p>  <p>10 20 60 100 200</p>							

(1) Scarification was carried out on strips 6 to 12 feet in width, with intervening strips of similar width unploughed. The entire plots were seeded. Stocking is the average for the plot.

TABLE 5. BROADCAST SEEDING BETWEEN 1950 AND 1955, NUMBER OF SEEDINGS PER ACRE

Plot number	Date of seeding	Total area examined (acres)	Number of acres of various densities				
			0-499	500-999	1000-1499	1500-1999	>1999
1/50, 2/50	June 17, 1950	6					
3/50 - 6/50	Oct. 27 - Nov. 1, 1950	20					
1/51	July 16-17, 1951	48					
2/51	July 16-17, 1951	25					
1/53 - 5/53	April 1-7, 1953	15					
9/53	April 8, 1954	7 ⁽¹⁾					
3, 6, 8, 9, 10, 11, 14, 22/54	May 26 - June 16, 1954	44 ⁽¹⁾					
7/54	May 28, 1954	7 ⁽¹⁾					
1/55 - 7/55	April and October, 1955	225 ⁽¹⁾					
Total		397					
Per cent		100	32	37	14	10	7
<p>Scale of number of acres</p>  <p>10 20 60 100 200</p>							

(1) Number of seedlings per acre is based on the entire plot, i.e., both scarified and unscarified areas.

Scattering of Cones, 1953 and 1954

In 1953 and 1954 jack pine cones were scattered on four plots having a total area of 17 acres. Stocking averaged 32 per cent and density was 500 seedlings per acre. This technique was not as successful as broadcasting seed.

Seeding in Furrows, 1952

In 1952 furrows, approximately 15 inches wide and from 4 to 6 inches deep, were ploughed at spacings of from 6 to 9 feet on two one-acre plots. Jack pine seed was then dropped, a few seeds at a time, along the furrows at four-foot intervals and covered lightly with soil. One plot was seeded on June 11 and the other on November 15.

TABLE 6. SEEDING IN FURROWS, 1952

Date of Seeding	Average Length of Furrow (feet)	Average Number of Seedlings Per Furrow	Average Distance Between Seedlings (feet)
June 11.....	327	0.8	409
November 15.....	317	6.0	53

The June seeding was a failure (Table 6). Results for the November seeding, although somewhat better, cannot be considered satisfactory. Assuming that the furrows were spaced at intervals of 6 feet, the latter seeding resulted in a stand which averaged only 135 seedlings per acre.

FACTORS THAT AFFECTED RESULTS

Time of Seeding

Time of seeding had an appreciable effect on results of broadcast seeding. Between 1925 and 1928 seeding was done during the months of May, June, September, and October. Seeding in May and October was successful, seeding in June was partly successful, and seeding in September was a failure. For the 1950-55 plots seeding in April and May was most successful (Table 7). Results of June seeding were variable and probably depended upon weather conditions immediately after sowing. Seeding in July was unsuccessful and seeding in the autumn gave variable results.















Poor survival of seedlings which germinated in the summer and autumn has been observed in the Lake States. Those germinating in early summer may be killed by heat or drought and those in late summer and early autumn may fail to harden off and be susceptible to winter damage. Those originating in the spring were observed to have best survival (Eyre and LeBarron, 1944).

The results indicate that seeding on the Sandilands Forest Reserve should be done in the early spring, either in April or May, or possibly in the late autumn, in October or November, to secure spring germination which normally appears to provide maximum opportunity for seedling survival.

Scarification

On the plots seeded in 1954 and 1955, scarification was confined to strips varying from six to 12 feet wide which were separated by unscarified strips of similar width. The entire plots were seeded. The examination on plot 4/55, supported by observations on other plots, provides evidence of the superiority of a scarified seedbed (Table 8).

TABLE 7. EFFECT OF TIME OF SEEDING ON PER CENT STOCKING,
BROADCAST SEEDING BETWEEN 1950 AND 1955

Month of seeding	Total area examined (acres)	Number of acres by per cent stocking			
		< 20	20-39	40-59	60-79
April	22				
May	16				
June	41				
July	73 ⁽¹⁾				
October - November	20				
April and October	225				
<p>Scale of number of acres</p>  <p>10 20 60 100 200</p>					

(1) Re-seeding of plots 7/54 and 18/54 in July 1956 resulted in very few seedlings. Most of the seedlings present on these plots originated from the initial seeding in May and June of 1954.

Seedbed treatment was a prerequisite for successful seeding. It is suggested that in future the entire plot be scarified. Alternatively, to reduce the time and expense involved, scarification may be limited to narrow strips. Both scarified and unscarified strips should be approximately six feet wide.

TABLE 8. PER CENT STOCKING ON SCARIFIED AND UNSCARIFIED SEEDBEDS,
PLOT 4/55

Seedbed	Number of Quadrats	Number of Quadrats Stocked	Per Cent of Quadrats Stocked
Scarified.....	146	83	57
Unscarified.....	51	5	10
Both.....	197	88	45

Lesser Vegetation

There are indications that the grass community provided more intense competition to jack pine seedlings than the ericaceous community, and per cent stocking on grass-covered plots was less than on ericaceous-covered plots (Table 9). Where a dense grass cover occurred, jack pine seedlings were very sparse. During the examination it was observed that such a cover tended to be characteristic of the more gravelly sites.

TABLE 9. PER CENT STOCKING TO JACK PINE BY VEGETATION TYPE

Plot Number	Date of Seeding	Vegetation Type	Per Cent Stocking
16/54.....	Cones in 1954; seed in 1956	Dense grass.....	12.4
18/54.....		Light grass.....	39.3
1-6/55.....	1955	Ericaceous/grass.....	48.7
7/55.....	1955	Dense grass.....	15.7
10/54.....	1954	Ericaceous.....	63.0
10/54.....	1954	Light grass.....	41.0

The above information suggests the need for more intensive scarification and exposure of mineral soil on areas where the ground cover is dominated by grass. Conversely, less intensive scarification should give satisfactory results on ericaceous-covered areas.

Seed

The most successful recent seeding operations were those carried out in 1953, 1954, and 1955. The 1953 seeding was designed to study the results of sowing different quantities of seed, from 12 to 26 ounces per acre, under uniform site and seedbed conditions. In 1958 it was apparent that the amount of seed sown was not reflected in the density of the seedling stand.

Most of the seed used in 1954 had been collected from the Spruce Woods Forest Reserve in 1949 and when sown had a germinative capacity of 40 per cent. The 16 ounces sown per acre contained 6.4 ounces of viable seed and resulted in seedling stands of more than 1,000 stems per acre becoming established on over one-half of the area seeded. In 1955, 11 ounces of seed of unknown viability were sown per acre and resulted in seedling stands up to 2,500 stems per acre.

The Saskatchewan Forestry Branch has had considerable success in seeding jack pine on scarified areas on the Bronson Provincial Forest (Kabzems and Kirby, 1956). Initially seed was sown at a rate of 24 ounces per acre; the quantity has since been reduced to approximately 12 ounces and this latter amount has been adequate.

On the Sandilands Forest Reserve it appears that approximately 8 to 12 ounces of viable seed per acre should be sufficient provided site and seedbed conditions are average. This would usually amount to scattering between 12 and 18 ounces of seed per acre. Greater quantities of seed are neither necessary nor desirable as unfavourable weather conditions may cause seeding failures regardless of amount of seed sown.

Biotic Factors

The stands on the seeded plots were generally healthy and free from animal, insect, or disease damage. Deer have damaged seedlings on a few plots and rabbit damage was observed on one. A jack pine budworm attack in 1957 caused defoliation in the tops of some of the dominant trees on the 1943 seeding plots. The white pine weevil has destroyed a number of terminal shoots, but the trees have recovered with little permanent damage. In general, damage to the seeded plots from biotic agencies was no greater than observed on natural seedling and sapling stands growing on the reserve.

SUMMARY

Direct seeding with jack pine has been carried out sporadically on the Sandilands Forest Reserve in southeastern Manitoba since 1925. In 1958 many of the seeded plots were examined to determine results and to investigate some of the factors which affected them.

Broadcast seeding between 1925 and 1928 resulted in the establishment of dense seedling stands by 1930, whereas the seed spot method was in general unsuccessful. Dense sapling stands were present on plots seeded in 1943.

Approximately one half of the area seeded between 1950 and 1955 was more than 40 per cent stocked. Thirty-one per cent of the area supported stands exceeding 1,000 seedlings per acre, while an additional 37 per cent had between 500 and 1,000 seedlings per acre.

Scattering of cones and seeding in furrows were not successful.

It is suggested that on dry sites on the Sandilands Forest Reserve seeding should be done either in the early spring or late autumn to secure spring germination which normally appears to provide maximum opportunity for seedling survival. Seedbed treatment is a necessity and either the entire area, or strips approximately six feet in width and separated by a similar distance, should be scarified. On grassy areas where competition against jack pine seedlings is more intense than on ericaceous areas, there is need for intensive scarification and exposure of mineral soil. Approximately 8 to 12 ounces of viable seed per acre should be sufficient. Greater quantities are neither necessary nor desirable as unfavourable weather conditions may cause seeding failures regardless of amount of seed sown. In general, damage to the seeded plots from biotic agencies was no greater than observed on natural seedling and sapling stands growing on the reserve.

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APPENDIX

Common and Scientific Names of Species Mentioned in Text

Plants

Bearberry.....	<i>Arctostaphylos uva-ursi</i> (L.) Spreng.
Big blue-stem.....	<i>Andropogon gerardi</i> Vitman
Blueberry.....	<i>Vaccinium angustifolium</i> Ait.
Hair-grass.....	<i>Agrostis scabra</i> Willd.
Jack pine.....	<i>Pinus banksiana</i> Lamb.
June-grass.....	<i>Koeleria cristata</i> (L.) Pers.
Mountain-rice.....	<i>Oryzopsis asperifolia</i> Michx.
Poverty oat-grass.....	<i>Danthonia spicata</i> L. Beauv.
Sheep's-fescue.....	<i>Festuca ovina</i> var. <i>saximontana</i> (Rydb.) Gl.
Wintergreen.....	<i>Gaultheria procumbens</i> L.

Animals

Snowshoe rabbit.....	<i>Lepus americanus phaenotus</i> Allen
White-tailed deer.....	<i>Odocoileus virginianus borealis</i> Miller

Insects

Jack pine budworm.....	<i>Choristoneura pinus</i> Free.
White pine weevil.....	<i>Pissodes strobi</i> (Peck)