



# **ASSESSMENT OF OPERATIONAL SCARIFICATION IN THE SPRUCE-ASPEN FOREST OF ALBERTA**

**PROJECT A-62**

by

**J. C. Lees**

**FOREST RESEARCH LABORATORY  
CALGARY, ALBERTA  
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- Internal report, 1965 -

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INTRODUCTION

Research into the selection of optimum harvest cutting methods and testing of mineral soil seedbeds for white spruce regeneration was begun in the spruce-aspen forest in 1951. In 1952, studies of mechanical scarification under varying residual stand densities were initiated. Results of these efforts were encouraging and in 1959 operational trials of seedbed scarification were started by the Alberta Forest Service. Further research studies were designed to examine the site range application of scarification under spruce-aspen shelterwood and to test a variety of promising machinery. In the first year of operation, approximately 100 acres under partially-cut stands were treated in each of four forests, Grande Prairie, Peace River, Slave Lake and Lac la Biche. Each year subsequently an increased area has been treated, under shelterwood, on clearcut, and on burned areas. This report deals with an assessment of regeneration stocking to white spruce on samples within the trial areas.

Under the terms of research project A-62 "Relative effectiveness of various equipment for scarification in spruce-aspen stands",

it was planned to assess the 1959 scarification in all four forests during the summer of 1964, the 1960 scarification in 1965 and so on until a variety of site and stand conditions scarified with different machinery had been sampled. However, bad weather and poor access has prevented sampling in the Peace River Forest to date.

#### ASSESSMENT

Sample plots, each 10 acres, were subjectively selected in the trial areas. These were surveyed using two 5-chain strips comprising units of 10 contiguous milliacre quadrats at one-chain intervals along the strips--a total of 100 quadrats per sample (Figure 1).

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Figure 1

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On each quadrat the following records were made:

1. Scarified or not scarified--any machine disturbance was classed as scarification provided there was a one square foot patch of exposed mineral soil
2. Stocking to white spruce seedlings
3. Height of the tallest white spruce seedling
4. Leader length of the tallest white spruce seedling
5. Vigour of tallest seedlings (3 classes)
6. Vegetative competition (3 classes) for tallest seedling
7. Rooting medium (5 classes), tallest seedling

A few samples were taken from the Bt soil horizon for textural analysis. The summary of results to date appears in Table 1 at the end of this report.

Location 1 - Snuff Mountain

Grande Prairie Forest Management Project

Results:

The 10-acre sample plot selected in 1964 at Snuff Mountain was on a well-drained till slope which had been burned over in 1951. Scrub alder, birch, willow and aspen had invaded the slope and ground vegetation including tall shrubs, grasses and herbs was heavy. A few volunteer spruce seedlings occurred, originating from 1/2 mile distant stands. Scarification was completed in 1960 using a straight blade on a medium-size bulldozer. The scarified spots were fall-seeded with white spruce. A minimum of two and sometimes three or four seedspots had been selected on each scarified area. A pinch (approx. 20-30 seeds) were sown at each spot.

A summary of the survey results shows:

1. Scarification was satisfactory and amounted to 49.5 per cent of the quadrats examined,
2. Stocking to white spruce seedlings was satisfactory and amounted to 38 per cent. Scarified seedbeds were 70 per cent stocked and unscarified seedbeds, 6 per cent stocked.
3. Mean height of the tallest white spruce seedlings after four growing seasons was 2.4 inches. However the growth rate is

accelerating and the average leader length was 0.9 inches.

4. Vegetative competition is moderate, only 20 per cent of quadrats were classed as having heavy vegetation competition.
5. Most frequently stocked seedbed was mineral soil although 11 per cent of tallest seedlings on scarified quadrats occupied rotten wood seedbeds.

### Discussion

The scarification was satisfactory and the stocking level acceptable. However the height growth is generally slow and competition from encroaching vegetation is becoming increasingly serious. Side competition on scarified areas has reached a point where snow may compress the vegetation over the seedlings. Several examples of seedlings which had been compressed were found. These had a creeping habit with only the current leader upright. Re-assessment in five years' time would determine whether seedling growth is combative with vegetation encroachment.

### Location 2 - Snuff Mountain

#### Grande Prairie Forest Management Project

### Results

An area scarified and seeded in 1962 under mature hardwoods on upland sites was also examined in 1964. A tentative 10-acre sample plot was located for future surveys. Distribution and extent of scarified areas while not quantitatively measured, appeared to be very satisfactory. The subjective sample of scarified areas, however,

revealed that mortality was exceptionally high because of smothering by hardwood leaves. Germinants were found dead on clumped seedspots under the mat of litter. Vegetation encroachment in two growing seasons had been rapid.

### Discussion

This area is more suited to regeneration of white spruce using scarification and underplanting with vigorous transplant stock. The scarification should be deep enough to remove the perennating root-stocks of competing vegetation. Removal of any merchantable portion of the hardwood stands would be beneficial once the transplants are established.

### Location 3 - Demmitt

#### Grande Prairie Forest Management Project

### Results

The sample selected in 1964 at Demmitt was on a moderately well drained till slope under spruce-aspen stands partially cut in 1952-53. Stem distribution in the residual stand was patchy and large clumps of small spruce frequently occurred. Stand age was around 75. Scarification was completed in 1959 with a straight blade on a medium-size bulldozer. However it was found that large areas, up to 5 acres in extent had been left unscarified, and there were several areas where stem density had prevented access for scarification. Under the dense shelterwood, vegetative competition was light. Grasses invaded the openings. Natural seedfall from the shelterwood was the seed source.

From the survey of 100 milliacre quadrats, the following results were obtained:

1. Distribution and extent of scarified seedbeds was unsatisfactory and amounted to 20 per cent of quadrats.
2. Stocking to white spruce seedlings was unacceptable and amounted to 16 per cent overall. Seventy five per cent of the scarified seedbeds and five per cent of the unscarified were stocked.
3. After five growing seasons, average height of the tallest white spruce seedlings was 2.3 inches with a mean leader length of 0.6 inches.
4. Vegetative competition was light with 91 per cent of quadrats in this classification.
5. Most frequently stocked seedbed was mineral soil, although 19 per cent of seedlings on scarified areas occupied rotten wood seedbeds.

#### Discussion

Scarification was carried out too early in the rotation of this stand. This is evidenced by the low vigour and overall stocking level of the seedlings and the poor distribution of scarified areas. However the high level of stocking on scarified seedbeds indicates that these were quite suitable for germination and initial survival. When the stand is opened out at the next commercial logging further scarification could be carried out with a greater chance of success.



#### Location 4 - Smith

#### Slave Lake Forest Management Project

#### Results

A 10-acre sample plot on moderately well-drained clay loam till was selected from nine 10-acre blocks scarified in 1959 under partially-cut spruce-aspen stands. A 6-toothed blade on a TD9 bulldozer was used. High and low shrubs, herbs and luxuriant grasses were present under the fairly open canopy. Natural seedfall from the shelterwood provided the seed supply.

From a survey of 100 quadrats examined in 1963 the following results were obtained.

1. Scarification was satisfactory and accounted for 35.4 per cent of quadrats.
2. Stocking to white spruce seedlings was adequate and amounted to 53 per cent overall. Ninety per cent of scarified and 35.3 per cent of unscarified seedbeds were stocked.
3. The average height of the tallest seedlings after four growing seasons was 2.7 inches with an average leader of 1.1 inches. Total heights of over 3 inches with leaders of 1.5 inches were common.
4. Vegetative competition was heavy with 44 per cent of quadrats in this classification.

#### Discussion

The scarification operation was satisfactory and the regeneration stocking level is acceptable. However the rather slow growth

means that the encroaching ground vegetation is an increasing threat to survival. Further, it is not known how the seedlings will respond to removal of the overstory, planned for the immediate future. Subsequent measurement of the regeneration status will take place in 1969.

Location 5 - Calling Lake

Lac la Biche Forest Management Project

Results

A 10-acre sample was surveyed on a 79 acre block which had been scarified in 1959 under partially-cut stands. The residual stand contained 54 per cent spruce by volume, well-distributed on the area. Slash was light and 4 to 5 inches of duff was found over well-drained sandy loams and clay loam tills. A TD9 tractor with a straight blade was used. Natural seedfall in 1959 provided the seed supply.

In 1965 the survey showed the following.

1. Scarification was satisfactory and amounted to 31 per cent of the surveyed area.
2. Overall stocking to white spruce seedlings amounted to 46 per cent. Scarified seedbeds were 67.4 per cent stocked and unscarified 32.6 per cent.
3. Height growth is excellent with an average for stocked quadrats of 6.8 inches and a mean leader length of 1.8 inches. Vigour is good with 96 per cent of seedlings in good or moderate vigour classes.

4. Vegetative competition is moderate to light with 76 per cent of quadrats in these classifications.

#### Discussion

The scarification operation was satisfactory and the regeneration stocking level is acceptable. Vegetative competition does not seem to be a threat to survival. Removal of the spruce overstory is contemplated by the Divisional Forester and should provide interesting seedling growth responses. Further sampling should be carried out in this area following overstory removal.

#### Location 6 - Fawcett Lake

##### Slave Lake Forest Management Project

#### Results

Two 10-acre samples were surveyed on areas scarified and seeded in 1961 just north of the west end of Fawcett Lake. An HD-11 tractor with a straight blade was used on a series of rolling hardwood ridges on moderately well-drained clay loam tills. Aspen was the main stand component and was about 70 years old. Ground vegetation was heavy with many shrubs. Grasses predominated on the scarified areas.

From the 200 milliacre quadrat survey in 1965 the following results were obtained.

1. Scarification covered 28 per cent of the area.
2. Overall stocking to spruce seedlings was less than 10 per cent with no increase on scarified seedbeds.

3. Height growth of the surviving seedlings was quite good with very good vigour.
4. Ground vegetation overall was moderately heavy and mainly grasses.

### Discussion

On hardwood areas where only the scarified seedbeds can be expected to support spruce seedlings, it is important to carry out extensive scarification. Failure of regeneration on this area must be attributed to several causes.

- a. Probably insufficient scarification
- b. Insufficient seed sown on each spot
- c. Hardwood litter covers the germinants (balsam poplar is more harmful than aspen)
- d. Vegetative competition is more severe under the light hardwood canopy.

Conversion of immature and mature hardwood stands to spruce is a difficult task and probably scarification with hand seeding is not the answer to the problem. Extensive scarification, deep enough to remove perennating rootstocks of grasses and followed by planting is a method worthy of further study. An alternative species for upland ridges might be lodgepole pine, which has more vigorous early growth.

### Location 7 - Smith - Oldberg's Summer Camp

#### Slave Lake Forest Management Project

### Results

A 10-acre sample area was surveyed in 1965 on this area which had suffered a light burn in July 1960. It was partially cut in August and September 1960 leaving a few well distributed spruce and dominant hardwoods. Ground disturbance was the result of fire-line construction, skid trails, roads and landings. Some fill-in scarification was carried out after the fire. Natural seedfall occurred one year later in 1961.

1. There was 90 per cent mineral soil exposure of one kind or another.
2. Regeneration stocking was low at 24 per cent overall. Stocking on scarified ground was 25 per cent and on unscarified ground 4 per cent.
3. Seedling vigour was excellent with an average height after four growing seasons of 5.2 inches and leader length of 1.9 inches.
4. Vegetation competition, mainly fireweed and grasses was very heavy on scarified seedbeds.

#### Discussion

This is a very interesting area. Perhaps it indicates that where summer logging is economically feasible, the resulting ground disturbance is useful in regeneration efforts. In this case there was probably an inadequate supply of seed. Also, any fill-in scarification would have been better done in 1961 in conjunction with the improved seed supply.

## CONCLUSION

Under a variety of stand conditions as described above, adequate mineral soil exposure can be achieved by scarification. Germination of spruce seed and initial seedling survival on the mineral soil seedbed is good. However, the rate of ground vegetation encroachment on the receptive seedbed and the accumulation of hardwood litter affect subsequent growth and survival. Extensive scarification, using large patches is indicated, cutting the perennating rootstocks and mixing the upper soil horizons. Provided there is an adequate seed supply, this treatment is effective.

Two conditions may require alternative treatment.

- a) On burned-over areas, high insolation encourages dense ground vegetation cover. Trials of transplant stock on scarified areas are suggested here. Species such as lodgepole pine may usefully be included in mixture with spruce since their vigorous early growth can combat vegetation encroachment.
- b) Mature hardwood ridges provide leaf-fall problems which may be overcome through the use of vigorous transplant stock. Lodgepole pine might be used here too in mixture with spruce. Tests of herbicides in suppressing vegetative competition, especially from grasses, are overdue.

Table 1. WHITE SPRUCE REGENERATION STATUS ON 6 OPERATIONAL SCARIFICATION PROJECTS  
(Basis - 100 milliacre quadrat samples)

Location	Year scarified	Equipment used	Cover- type	Scarification distribution per cent <sup>1</sup>	Milliacre stocking per cent		Av. ht. tallest Ws	Seedling inches	Leader length	Vegetation competition distribution <sup>2</sup>		
					Overall	Scarified seedbed	Unscarified seedbed			Light	Moderate	Heavy
Snuff Mountain	1960	Straight blade	Burn	49.5	38	70	6	2.4	0.9	49	31	20
Demmitt	1959	Straight blade	Partial cut	20	16	75	5	2.3	0.6	91	9	0
Smith	1959	Toothed blade	Partial cut	35.4	53	90	35	2.7	1.1	19	37	44
Calling Lake	1959	Straight blade	Partial cut	31	46	67	33	6.8	1.8	43	33	24
Fawcett Lake a	1961	Straight blade	Hardwood ridge	44	5	9	2	6.1	3.0	61	35	4
Fawcett Lake b	1961	Straight blade	Hardwood ridge	13	9	8	11	8.9	1.2	37	39	23
Smith	1960	Straight blade	Burn & partial cut	91	24	25	4	5.2	1.9	34	42	23

<sup>1</sup> Quadrats with 1 sq. ft. mineral soil exposed

<sup>2</sup> Light - side competition only  
Moderate - side and some overtop  
Heavy - severe overtop competition

Figure 1: Sample plot layout - 10 acres.

100 quadrats in units of 10, one chain apart.

