OPERATIONAL TRIALS OF A
SPOT SCARIFIER

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Trials with Spot Scarifier

Silviculture Branch determined a need for a site preparation machine which would prepare raised planting spots in wet and brushy sites. The preferred planting spot would consist of an overturned humus layer overlain with approximately 10 cms. of mineral soil. Our requirements were that the machine work on an intermittent basis and that it utilize a readily available prime mover.

A request was made to Engineering Branch detailing our requirements and after several discussions Engineering Branch constructed a machine and carried out trials as described in the following report.

Silviculture Branch supplied the funds and has been closely involved in all stages of design and trials.

While the mounding unit is not yet operating to the desired standard it nevertheless provided many planting sites which are superior to those which can be achieved by any other mechanized method.

Progress to date is encouraging. The project is being continued.

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Silviculture Library.
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Appendix I
Summary:

Preliminary tests of a spot scarifier designed and built by the British Columbia Forest Service in 1979 warranted operational trials to be undertaken in 1980.

The results of these trials conducted on wet and brushy sites of the interior of British Columbia showed the operational efficiency, productivity and cost of the scarifier were in line with other methods of scarification. Further modifications can be made to the scarifier to improve efficiency and increase the percentage of ideal and acceptable planting spots produced.
Background:

In 1978 a decision was made to proceed with development of equipment capable of preparing micro-sites consisting of inverted patches of duff covered with mineral soil. This lead to the design and development of the spot scarifier (see Figure 1).

The first prototype was mounted on the winch plate of a Caterpillar D7-G with a "W" blade attached to the C-frame. Using the electrical and hydraulic systems of the tractor the scarifier buckets reciprocate automatically with adjustments provided for speed and depth of penetration.

Preliminary testing at sites in coastal British Columbia indicated acceptable mechanical availability and sufficient strength of unit construction. The severity of the site prevented any meaningful conclusions from being drawn regarding the quality and quantity of planting spots produced. However, visual assessment of the scarifying action warranted operational trials to be undertaken in 1980.

![Figure 1: Spot Scarifier](image)
Introduction:

During July 1980 the spot scarifier was transferred to the Prince George shop from Vancouver, where it was mounted on a 1972 D7-F Caterpillar tractor. The test site is located 90 km S.E. of Prince George near Stoney Lake on the Willow River Forest Road. During the two week trial period two different V-blades were used along with several bucket configurations to determine the best combination for preparing the desired planting spots. (See Figure 2).

A further objective of the trials was to identify the production and cost figures associated with scarifying under the given site conditions. Also a complete log of downtime was necessary to estimate mechanical availability of the scarifier and the efficiency and utilization of the prime mover.

**Figure 2**

**Longitudinal section of desired planting spot**

---

1McMinn, R.G. and S.G. Homoky
Biological effectiveness of equipment tested in
Results:

Table I outlines the results of time studies on site. The total standard time of 44.5 hours includes 20.1 operating hours, 19.4 hours of lost time and 5.0 hours of allowable delays. The average efficiency factor for the unit was 0.45 whereas for the prime mover it was 0.77.

Of the lost time 5% was attributable to the prime mover in wet ground conditions. The remaining 95% to the scarifier and blade, 43% to modifications and adjustments, 36% to mechanical failures and 16% to electrical and hydraulic problems.

Table II shows the results of sampling planting spot quality and production.

For the first left bucket design (LB1) 37% of the planting spots were ideal and/or acceptable compared to 42% for the first right bucket (RB1). With buckets LB1 and RB2 the average percentage acceptable were 35% and 49% respectively.

Average production during the same time period was 0.70 hectare/operating hour or 0.53 hectare/hour based on an average efficiency factor of 0.75. The corresponding cost per hectare would be $117.30/hectare.
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ALL TIMES GIVEN IN MINUTES.
**44 minutes to weld pin togs for plough.

* Attaching C&H plough took 265 minutes.
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* Special Cases

Note: I - Ideal
A - Acceptable
U - Unacceptable
Conclusions:

1. The first bucket configuration tested had insufficient capacity, and would close the contacts on the pressure switches before reaching the full down position. Hence the planting spots prepared were not overturned and/or not enough mineral soil was placed on top of the overturned duff. Subsequent bucket modifications increased their capacity by increasing the distance from the leading edge to the back of the buckets. This partially solved the problem but still over 50% of the cycles resulted in unacceptable planting spots. When the buckets reached the full down position the overturning effect was achieved but the 5-10 cm of mineral soil desired on top was not always there.

2. The operators' view of the scarifier was impaired by the hydraulic control panel mounted behind the cab. This resulted in time lost when backing up since the operator had no control over bucket lift nor indication of when both buckets were in the full up position.

3. The scarifier proved to be structurally and mechanically sound except for the rod and piston end pins on the bucket cylinders. These pins sheared off several times accounting for 36% of the total downtime.

4. Re-plumbing and tightening of the hydraulic components and fittings would eliminate most of the fluid loss and downtime associated with it. Also the hydraulic changeover and hook-up to the prime mover is too complicated and time consuming.
Conclusions Cont'd.

5. The electrical control system was inconsistent due to the fine adjustments required on the limit switches and the constant jarring.

6. Both the Beales' type V-blade and the C&H plough successfully cleared the brush and debris and where the duff layer was scalped, planting spots of mixed mineral soil were produced. Using the C&H plough the operator was able to maintain the forward motion better with less delays to clear the blade of stumps and debris. However the mounting of the C&H plough is time consuming (4 hours) and costly.
Recommendations:

1. Rebuild buckets to conform to proper attack angle and capacity with open sides.

2. Drill out cylinder pin holes to 1\(\frac{1}{2}\)" diameter and 1" wide side flanges.

3. Cams be replaced with more positive mechanism for limit switches. Must be more easily adjusted.

4. Reduce number and size of bolts on bucket flanges to allow shearing.

5. Extend overall digging depth to 28" from 24" to provide more mineral soil on overturned duff.

6. Modify Beales' V-blade to decrease interior angle, remove bottom cutting edge and add stinger to keep blade in ground.

7. Isolate electrical package from shock and vibration.

8. Simplify hydraulic hook-up by using tilt control for scarifier lift and adding own hydraulic pump with 50-50 split. Use quick disconnect coupling where feasible.

9. Use indicator light to signal buckets in full up position for backing up.


11. Planting spot production and quality warrant further development and testing of spot scarifier.
Discussion:

Site:

TSL-A0-8577 CPY Block B, Unit 2, located 90 km S.E. of Prince George on the Willow River Forest Road originally had a good spruce stand (Sp 841) which blew down in 1975 then was logged in 1976-77 yielding 373 m$^3$/ha. Regeneration surveys in the Spring of 1980 showed NSR hence the area was scheduled for replanting with 2+0 spruce during the 1981 planting season.

Approximately 30 hectares of the 139 hectare area was heavily brushed in patches which necessitated some form of site preparation. A 10-15 cm duff layer covered a silty gravel soil with frequent boulders. Also patches of clay and organic material were encountered. Soil moisture varied from wet to very wet.

Another site characteristic which influenced operations was the stump state. Having been a blow down sale area, high stumps averaging 0.9 m in height and 53 cm in diameter were common with 250/hectare being the average.

Scarifier:

Following 1979 field tests most of the hydraulic components were repackaged on a common base plate. This was then mounted behind the operator's cab by means of brackets which bolted directly to the winch plate of the prime mover (see Figure 3). The buckets were also made shallower by welding steel plate inside. Otherwise the unit and scarification cycle remained the same. (See Appendix 1).

Once on site it was apparent the shallow buckets were not preparing the desired planting sites, hence a series of modifications were tried as follows.
A larger more rigid manifold for the return flow was also added the first day of the trial.
Discussion - Scarifier Cont'd.

LEFT BUCKET 1

RIGHT BUCKET 1

LEFT BUCKET 2
SAME AS ABOVE

RIGHT BUCKET 2

Production:

A 1970 D7-F Caterpillar tractor in good condition was used for the trials and the owner-operator was experienced in land clearing operations and in the use of the C&H plough. The Beales' type V-blade was new to the operator but after several hours use it was evident that a smaller interior angle was necessary and that the cutting edge rather than shearing off stumps was digging in and
Discussion - Production Cont'd.

Stopping the crawler tractor's forward progress. Forward motion was not impeded by the scarifier, however delays were encountered while the operator ensured the buckets were in the full up position before backing up.

The entire 30 hectare area was carefully surveyed prior to treatment to locate wet spots and gullies. These were delineated from the treatment blocks and as long runs as possible layed out to minimize the turning around time. Approximately 14 hectares were treated in total during 20 operating hours and an additional 2 hectares treated in a control block and while setting up the scarifier.
Cost:

The costs in $/ha treated shown in Table I were derived from the rental rate for the 1970 D7-F Caterpillar tractor of $55.50/hr without blade or winch. To allow for V-blade and scarifier rental an additional 15% and 25% were added to the base rate respectively.

Rental Rate = $55.50 + 8.32 + 13.87 = $77.70/hr.

Production Cost = $77.70/hr ÷ 0.7 ha/hr.

= $111.00/ha @ 100% efficiency
or $148.00/ha @ 75% efficiency

Total project costs included:

Rentals:

Electric Welder @ $100/week - $ 150.00
D7F Cat - 38 hours @ 55.50 - $ 2109.00
60 hours @ 27.75 - $ 1665.00

Transportation:

Lowbed to and from site - $ 768.00

Supplies:

Maintenance and repairs - $ 700.00

Total - $5392.00
DEVELOPMENT AND TESTING OF A SPOT SCARIFIER

by

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Engineering Branch

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Engineering Branch

and

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for presentation at the 1979 Winter Meeting
AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS

Hyatt Regency Hotel
New Orleans, LA
December 11-14, 1979

SUMMARY:

In a joint research project the Canadian Forestry Service
and the British Columbia Forest Service determined the
type of micro-site needed for planting seedlings on wet
and brushy sites of interior British Columbia. A scarifier
designed to produce the desired micro-site was built and
tested in 1979. The preliminary tests warrant operational
trials to be undertaken in 1980.

American Society of Agricultural Engineers
St. Joseph, Michigan 49085
Introduction:

There are large areas in British Columbia where the planting of trees and subsequent seedling development are hampered by the presence of competing vegetation and/or by excessive soil moisture. In some instances, the situation is compounded by the presence of slash left during harvesting the timber stand previously occupying the site.

On such areas, afforestation must be preceded by site preparation in order to:

1. improve trafficability for the planters;
2. produce micro-sites for the seedlings with reduced competition and improved soil aeration by reducing moisture content.

Following several years of research, R.G. McMinn of the Pacific Forest Research Centre of the Canadian Forestry Service (1, 2) defined the required characteristics of planting micro-sites on wet and/or brushy sites in interior British Columbia regions. Upon request of the Silviculture Branch of the British Columbia Forest Service, based on the Canadian Forestry Service finding, and on British Columbia Forest Service and industry experience, the Engineering Branch developed and tested a prototype spot scarifier designed to produce the desired micro-site.

Background:

A joint research project of the British Columbia Forest Service and the Canadian Forestry Service began in 1974 with the testing of seven different types of site preparation equipment. The tests were followed by planting efficiency evaluation and the evaluation of the biological effectiveness of the equipment through monitoring seedling survival and growth.

The equipment tested included a "W" blade, a Brush blade, a shark fin drag scarification assembly, the Swedish Bracke cultivator, the T.T.S. trencher, the Track Mack TM72 with slash abatement disc, and a backhoe assembly mounted on the back of a tractor. Mechanical performance and operational costs have been summarized in a report released in 1974 (3).

Planter productivity was described in an internal file report prepared in 1976. The general conclusion was that trafficability was improved by all equipment tested (4).

Evaluation of the performance of the seedlings planted continues. To date, McMinn has found that seedlings planted in inverted patches of duff covered with mineral soil, generally performed better than seedlings planted in other types of prepared micro-sites. (Figure 1).
FIGURE 1:

Height (cm) of white spruce seedlings three years after outplanting in sites treated by various site preparation implements (UN = untreated, HO = backhoe assembly, TTS = TTS disc trencher furrow, MC = Track Mack TM72, BB = brushblade, SF = sharkfin, IV = inverted patch formed by Bracke Cultivator) (5).

Control of competing vegetation, retention of the fertility of duff and uppermost mineral soil accessible to newly planted seedlings, a mineral soil surface which allows warming of soils in the seedling root zone, and adequate soil aeration by reduction of soil waterlogging were found to be the most important site factors influencing seedling performance. Inversion of patches of soil appears to be the most economical way of achieving these objectives.

In 1978, a decision was reached to proceed with developing equipment capable of preparing such a planting site more consistently than the equipment tested in the trials.

Objective and Design Criteria:

Based on a province-wide experience and the previously described test, silviculturalists determined that the equipment to be developed should meet the following criteria for cool, moist, brush susceptible sites.

1. The planting spot should consist of overturned material with bare ground exposed and lying over a humus/duff layer.
2. It should be raised above the surrounding ground level.

3. The depth of the overturned layer should be controllable.

4. The overturned layer should be compressed to establish capillary contact with lower levels.

5. The machine should not prepare more ground than is required.

6. It must prepare two planting rows spaced not less than 2 metres apart at one pass.

7. The spacing between planting spots in the same row is also to be adjustable.

8. The machine must not have or produce an adverse effect on the total site.

9. The machine must attach readily to prime movers which are commonly available.

Width - 460 m
Depth - adjustable
Length - adjustable

FIGURE 2:
Longitudinal Section of Desired Planting Spot.

As a search for existing equipment capable of performing the required work ended with negative results, a feasibility study was undertaken to compare the relative advantage of modifying various "off-the-shelf" scarifiers with development of a new piece of equipment. After careful consideration, the choice fell on the latter solution.

The concept of attaching a scarifier unit consisting of two automatically reciprocating implements to a readily available prime mover was pursued.
The Scarifier:

The force needed to dig up and turn over the soil was calculated. This, together with the maximum number of digging cycles per minute and the need for an additional implement to clear the way and improve trafficability for subsequent planning, determined the required power output. The additional implement should be a "V" blade capable of moving aside slash and cull logs without excessive disturbance of the duff.

Based on power requirements, terrain and slash conditions and commonly used equipment, a crawler tractor in the 150 kw range (Cat. D-7, International TD-20, etc.) was chosen to be the prime mover. These machines have double hydraulic pumps with high volume and low volume output ports used to activate the blade lift and tilt (or ripper) simultaneously in normal operations.

The prototype was designed to be coupled to a Caterpillar D-7G which was available for the trials.

It was decided to mount the scarifier on a plate which bolts directly onto the back of the tractor so as to facilitate turning and backing up as required to maneuver in slash and between stumps. (See Figure 3).

**FIGURE 3:**

View of the scarifier mounted on the prime mover..
The scarifier is attached to the plate by means of two hinges and a hydraulic lift cylinder. The depth of scarification is adjusted by extending or retracting the lift cylinder piston. The same cylinder lifts the implement clear of the ground for maneuvering or transportation of the machine.

The scarifier consists of a three compartment box-frame constructed of 19 mm steel plate carrying the digging buckets on either side on 150 mm Ø solid steel shafts. The box frame contains the electronic and hydraulic components which govern and activate the scarifying motion of the buckets. (Figure 4).

FIGURE 4:
Box frame of scarifier with electronic and hydraulic components inside.

The buckets were designed to achieve the desired overturning of the soil. In full down position, the soil material attack angle is 30° at the leading edge, then follows a 220 mm radius curve to project the overturned soil layer forward in conjunction with the forward motion of the prime mover.

Hydraulic power is drawn from the main pump of the tractor. For our purposes, the output ports of the pump were inverted, using the smaller port with 1 dm³/second at 6.9 MP output to control the blade and the larger port with 2 dm³/second at 6.9 MP to operate the scarifier and the lift cylinder. Electric power for the governing system is taken directly from the 24 volt battery of the tractor.
FIGURE 5:

Schematic diagram showing electric and hydraulic circuits of the lift cylinder and of the right half of the scarifier.

The main electric switch, the blade control, the lift cylinder control, and the hydraulic flow control valve for the scarifier are located in the operator's cabin.

The operator initiates the scarifying action by switching on the power. Once initiated, the digging cycles repeat automatically. After setting the desired digging depth and planting spot length by adjusting the lift cylinder and the hydraulic flow, the operator can concentrate on blade control and on the forward motion of the prime mover. Only periodic checking of the scarifying action and lifting the implement for backing up or turning around are necessary.

In the automatic operation, starting in the up position, an electric impulse opens the directional control valve and the cylinder moves the bucket to the down position by rotating the shaft 90°. When the bucket reaches fully down position, a cam on the shaft activates a limit switch which reverses the flow to the cylinder and the bucket is returned to the up position. Reaching the up position, another limit switch is activated which sends an electric impulse to the adjustable delay timer. After a period of delay necessary to achieve
the desired planting spot spacing, the electric impulse is forwarded to the control valve and the cycle begins again.

When obstruction, such as logs, stumps, rocks or boulders, are encountered by the bucket during the downward motion, a pressure sensitive switch is activated which returns the bucket to the up position, aborting the rest of the cycle. As a measure of safety, a pressure relief valve is also built into the system to allow bypass of the hydraulic fluid if for some reason the cycle cannot be completed and the pressure sensitive (abort) switch fails to function.

Two buckets are arranged symmetrically, on the two sides of the scarifier, with two sets of electronic and hydraulic components. The two sides begin the down stroke together but can complete their cycles independently. If one side cannot complete the cycle on account of an obstruction, it will return to the up position and wait for the other side to complete its cycle. Then, following the predetermined delay period, the two sides begin the new down stroke together again.

Testing:

The scarifier was mounted on a D-7G Caterpillar tractor equipped with a Beales' type 'V' blade and was tested for mechanical functioning and strength of construction.

The site selected for the test in the Terepocki Creek drainage in Coastal British Columbia had 1350 stumps/hectare with average diameter of 0.47 m. Slash and underground obstruction conditions resembled or surpassed the severity of such conditions prevailing on wet and bushy sites in the interior of British Columbia. The terrain was uneven in places but generally flat.

The test involved 9 operating hours over a 3 day test period. The operator was instructed not to be unusually cautious with the equipment. It was found that all components functioned well, and that the scarifier withstood heavy-handed use on the unusually severe site.

The prime mover travelled at a speed of approximately 0.9 km/hr with the scarifier doing 600 cycles (1200 spots) per hour.

On this severe site, as much as 34% of the spots could not be completed because of underground obstructions.

The nature of this coastal site is quite different from that of interior wet and brushy sites, therefore, no meaningful conclusions could be drawn regarding the quality of the planting spot produced. However, visual assessment of the scarifying action gave enough reason for optimism to warrant operational testing.
Operational testing of the equipment on appropriate interior sites is scheduled for next year. As the clearing of the slash in front of the machine is critical, several types of "V" blades will also be tested.

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References:

(1) McMinn, R.G. and S.G. Homoky
    Biological Effectiveness of Equipment Tested in Silvicultural -
    Mechanical Site Preparation Trials. A preliminary report.
    Canadian Forestry Service and British Columbia Forest Service

(2) McMinn, R.G. and S.G. Homoky
    Biological Effectiveness of Equipment Tested in Silvicultural -
    Mechanical Site Preparation Trials. An interim report.
    Canadian Forestry Service and British Columbia Forest Service

(3) Nelitz, E., P. Castley and K. Apt
    Silvicultural Mechanical Site Preparation -

(4) Brown, R.
    Report on Time Studies to Assess Planter Productivity on Areas
    Prepared by Different Equipment Tested in Silvicultural Mechanical
    Site Preparation. A British Columbia Forest Service Internal Report.
    (1976).

(5) McMinn, R.G.
    A Tour Guide for Viewing Test Areas of Planting following S.M.S.P.