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V-Blade Scarifier Proves Most Efficient

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Many thousands of acres of hardwood forest lands in eastern Canada need rehabilitation, and for this the underplanting of valuable conifers is often the only practical method. Underplanting, as experience and experiments have proven, is effective only with proper site preparation. This report describes pilot trials of what were considered the most appropriate site preparation techniques for underplanting -- comparing strip scarification by means of the new "shark-fin" scarifier, the angle-dozer blade and the V-blade. In addition, a limited comparison of hand and machine planting is involved.

Hardwood Problem Areas

The trials were carried out in October, 1965, in the Goulais River area, 45 miles northeast of Sault Ste. Marie, Ontario, on two types of stands, representative of those most requiring treatment.

- (1) Overmature tolerant hardwood forests on rich till slopes, high-graded for yellow birch, leaving irregular stands of large cull maple or birch, suppressed and deformed trees and weed species.
- (2) Understocked intolerant hardwood stands on sandy sites in valleys.

These sites formerly supported valuable stands of pine but cutting and

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fire have resulted in low-grade stands mainly of aspen and white birch.

Earlier experiments (Wang and Horton, 1965) showed excellent results in survival and growth of white pine and white spruce planted on such sites after strip scarification and reduction of canopy density to 30-40 per cent. Analyses relating stock performance and cost showed that 3 + 0 stock was more suitable than 2 + 2 and 2 + 0 stock with both species. As a dividend, an abundance of natural yellow birch regeneration developed on the scarified strips. Cost calculations were made, but experimental restrictions prevented an adequate cost analysis on an operational scale -- such as is presented in the following report.

Three Scarification Methods for Hardwood Slopes

Under a cooperative arrangement with the Ontario Department of Lands and Forests some 200 acres of tolerant hardwoods and 30 acres of intolerant hardwoods were treated. Let us consider first the site preparation treatments in the tolerant hardwoods. A typical area was selected, in which all merchantable yellow birch and a few hard maple had been logged leaving a poor stand, predominantly maple of all sizes, with a patchy undergrowth of dense maple seedlings. The soil is a rich till, one to several feet deep, with many boulders and some outcroppings. Slopes ranged from 5 to 20 per cent, providing good drainage except in pockets (Figure 1).

The area was divided into convenient operating blocks of 5 to 10 acres, and 3 treatments were applied to separate but similar blocks as

described below. For each method a concentric pattern of scarification was used, working from the periphery of a block inwards, skirting large trees, rocks or other obstacles and thus minimizing stoppage and backup. The aim was to scarify approximately 50 per cent of the ground in alternate strips.

1. D-7E tractor towing "shark-fin" scarifying barrels

This new scarification device (Figure 2) was developed by the Ontario Department of Lands and Forests primarily for site preparation of pulpwood cutovers, and this was its first application in tolerant hardwood sites. Considerable preliminary testing and adjusting was necessary under the adverse conditions of slope, rocks and heavy residual timber before a continuous operation was even possible. The barrels frequently became fouled behind trees or rocks and often required winching. Abnormally wet ground augmented the traction problem. Finally, reasonable progress was attained with an arrangement of two rows of two barrels in tandem, using the front-mounted, angle-dozer blade for clearing away small trees and rocks. With a double run per strip, a corridor was cleared 11-12 feet wide, with two rough, irregular furrows of well mixed topsoil and humus about 3 feet wide and from several inches to more than one foot in depth.

The seedbed produced was considered close to ideal from the viewpoint of underplanting efficiency, seedling development chance and incidental birch regeneration. As shown in Table 1, an adequate seedbed was produced on 86 per cent of the strip-treated area (43 per cent of total

area). It was, however, a very expensive operation.

2. The same D-7E tractor with angle-dozer blade used for scalping

Scarifying by manipulating the blade in a gentle up and down scalping action, and by some swinging track action, this method at one run over each strip gave much better area coverage than the above, but considerably less intensive scarification (55 per cent in adequate seed-bed) (Table 1). It did, however, permit fair distribution of planted stock within the scarified corridors, and the operational cost was well within the standard range for scarification (\$8 to \$15 per acre).

3. A D-6 tractor with front-mounted V-blade (Lowther type -- 5 feet wide)

This equipment, normally used for clearing with the heavy duty WILDLAND PLANTER unit, produced an irregularly scalped corridor 4 to 6 feet wide and from several inches to one foot deep (Figure 3). The method was comparable to the barrel scarifier in intensity of treatment -- 80 per cent of the corridor being scarified to mineral soil -- but the blade did not mix humus and topsoil as did the swivelling barrels. Cost of the V-blade scarification was less than one-third that of the barrels (Table 1).

V-Blade Effective on Aspen Flats

In the intolerant hardwood stand only the D-6 and V-blade arrangement was used. The area treated was fairly typical understocked aspen on a flat valley terrace of loamy fine sand underlain with coarser materials

(Figure 4). Originating after fire some 30 years previously, the stand was predominantly trembling aspen 35-40 feet tall, with occasional smaller spruce, balsam fir and white pine, and dense ground vegetation of blueberries, spiraea and sedges in the open and hazel clumps and bracken fern in shaded areas.

The V-blade used either with or without a modified WILDLAND PLANTER, proved effective in preparing planting strips in one pass. In this respect the V-blade out-performed both a straight 'dozer blade and a rock rake which had been used on the same ground to prepare corridors for experimental direct seeding and planting in earlier projects (Horton and Wang, 1965; Wang and Horton, 1966). With these latter tools, two passes per strip were required to produce a seedbed comparable to the V-blade's one-pass effect. As Table 1 indicates, the V-blade performed more efficiently (25 per cent cheaper) in the intolerant hardwood area than the tolerant hardwoods.

Manual vs Mechanical Underplanting

Following the conclusions from the earlier underplanting experiment in this area, we decided to use 3 + 0 stock of white pine and white spruce for the operational trials, planting in the fall of 1965 and spring of 1966 to provide an additional comparison of seasonal effect. A planting rate of 500 trees per acre was chosen, equivalent to an average spacing of approximately 6 feet within rows and 12 feet between rows.

These trials were designed to compare the efficiency of hand versus machine planting on the two contrasting conditions, recognizing the likelihood that the intolerant hardwood stand would be better suited to machine planting, and the tolerant hardwood stand to hand planting. In practice, however, it was not feasible to use the planting machine on the obstacle-covered tolerant hardwood strips. Besides this, the width of the scarified corridors permitted planting two rows of seedlings by hand, whereas only one row was possible by machine. In the narrower corridors made by the V-blade it was not always possible to plant two rows uniformly side by side, but an irregular staggered spacing enabled planting the prescribed 500 trees per acre.

It will be noted in Table 1 that in the tolerant hardwood area planting costs were similar for the three methods of scarification. This is because the planting was done by piecework -- at 2 cents per tree -- and the men found no difficulty in planting approximately 500 trees per acre regardless of the site preparation method.

We can compare the relative efficiency of hand and machine planting on the intolerant hardwood site, based on the same figure of 500 trees per acre. As Table 1 shows, the machine method cost less than 2/3 as much as the manual.

Barrels vs V-Blades

For final evaluation of the effectiveness of seedbeds produced by the different scarification methods, we must wait and assess the

relative performance of the planted stock. Comparisons between sites, seedbeds, species, and planting seasons will eventually be available. Meanwhile we can judge the merits of the different methods by their costs -- and the advantages of the V-blade as a site preparation tool for either hand or machine planting are apparent.

This should not be taken as a denunciation of the shark-fin scarifier. It was designed primarily for treating pulpwood cutovers and brushy areas, and is proving very effective in such conditions. But it cannot cope efficiently with the hardwood slopes, since the barrels frequently hang-up behind residual maples or large rocks, necessitating stopping and winching -- a slow process. Moreover, with the combination of two rows of two barrels in tandem, a double run per corridor was needed for adequate seedbed preparation. With the addition of another barrel in each tandem row, one pass proved sufficient, but decreased traction and increased breakage of cables and swivel connections prohibited this arrangement. Though a larger tractor would remedy the traction problem, it would result in decreased manoeuvrability as well as higher machine costs.

When the barrels were removed and scarification was done by the same D-7E machine using the angle-dozer blade, the coverage was much improved but the intensity of scarification, with one pass, was appreciably reduced (by 35 per cent). A better job was done at lower cost by the very manoeuvrable D-6 tractor with V-blade. Operated in a concentric pattern around 5- to 10-acre blocks, this equipment permitted continuous operation. It is highly recommended for such operations.

References

- Horton, K.W. and B.S.P. Wang. 1965. Experimental seeding of conifers in scarified strips. Canada Department of Forestry, Ontario Region. Mimeo 65-0-12. 18 pp.
- Wang, B.S.P. and K.W. Horton. 1966. An underplanting experiment with white pine and white spruce seedling and transplant stock. Jour. Forestry (In press).

Table 1. Comparison of cost for site preparation and planting.

Stand	Site preparation			Planting			Total cost	
	Type of machine used ¹	% of treated area scarified ²	Cost per acre (\$)	Cost per acre (\$)			per acre (\$)	
				Stock ⁴	Hand ³	Machine ⁵	Hand	Machine
Tolerant hardwood	D-7E - shark-fin scarifier	36	28.40	5.00	10.00	-	43.40	-
	D-7E - angle dozer blade	55	9.84	5.00	10.00	-	24.84	
	D-6 - V-blade	80	8.00	5.00	10.00	-	23.00	
Intolerant hardwood	D-6 - V-blade	84	6.00	5.00	10.00	2.30	21.00	13.30

¹ Rental costs of D-7E with angle dozer blade and D-6 with V-blade were calculated at \$15 and \$10 per hour respectively, but this did not include the shark-fin scarifier.

² Per cent scarification within treated strips, which represented 50 per cent of the total area.

³ Planting cost per acre was calculated on the basis of 500 trees per acre at 2 cents per tree hand-planted.

⁴ Cost of planting stock was calculated on the basis of 1 cent per tree.

⁵ Rental costs of the modified Lowther Planter were calculated on the basis of \$1.25 per hour for the machine and \$2.00 per hour for the operator.



Figure 1. Stand conditions of tolerant hardwoods on rich till slopes and planting strip prepared by D-7E tractor with shark-fin scarifier.

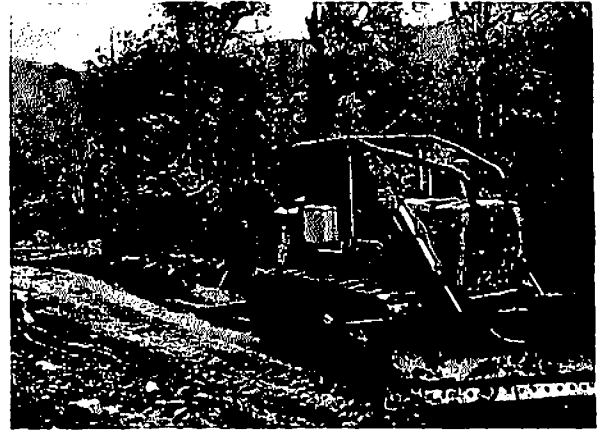


Figure 2. D-7E tractor towing "shark-fin" scarifying barrels.



Figure 3. D-6 tractor with a V-blade and a modified WILDLAND PLANTER

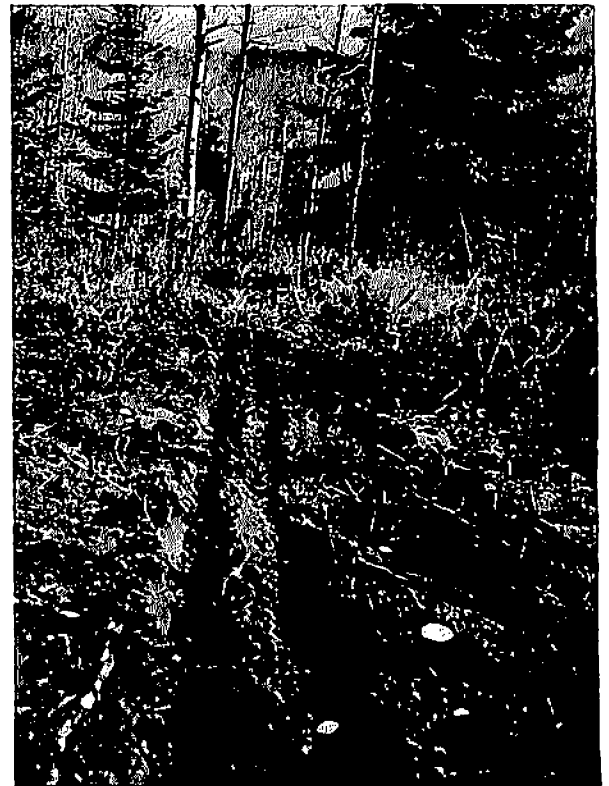


Figure 4. A typical scarified strip in an intolerant hardwood stand on a flat valley terrace.