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SKID SITE REHABILITATION

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ABSTRACT

The production rates and costs of rehabilitating skid sites with ripping/mounding and ripping/mounding + pushing surrounding debris and soil back over the skid surface were collected from ten skid sites in Kaingaroa Forest.

For skid sites with an average size of 0.43 ha, the cost of ripping/mounding was $56 per skid, or 0.42 productive machine hours. The cost of spreading the soil and debris was $340 per skid, or 3.4 productive machine hours.

Soil compaction sufficient to prevent root growth was present to over 70 cm deep on the skid sites. The depth of the ripping averaged 74 cm.

Nutrition analysis of the soil indicated that total N% was the most significantly different item between the cutover (0.232) and the skid surface (0.037), the level in the soil pushed back over the skid was 0.141.

INTRODUCTION

Skid sites typically occupy 5 to 8% of the potentially productive land in New Zealand's plantation forests. This level of land loss is similar to some Canadian operations (Krag, 1992).

These sites are usually stripped of topsoil and organic matter as well as being compacted to a degree which inhibits root growth (Mason and Cullen, 1986). In order to plant trees on these sites, mechanical cultivation is necessary. However, due to the lack of topsoil, the trees planted on these cultivated areas rarely perform as well as those planted in the adjacent cutover. They are usually smaller in both height and diameter and their foliage is often yellowed.

Many of the treatments used in the past have been cultivation only or cultivation with an initial fertilisation. These treatments are only an amelioration of the compaction and fertility problems and do not rehabilitate the site.

This trial, established in 1992, was designed to compare the benefits of cultivation, with cultivation and returning of topsoil and organic matter. This report deals with the production rates, costs and site factors.

ACKNOWLEDGEMENTS

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Figure 1 - Skid site showing ripping/mounding on the right and ripping/mounding + soil debris spreading on the left

METHODS

Eleven skid sites in Compartments 1057 and 1058 of Kaingaroa Forest were selected for treatment. Ten of the skids were split into two blocks. One half was ripped/mounded at a four metre spacing, the other half was ripped and mounded and then had the surrounding heaps of soil and logging debris spread over it with a bull dozer (Figure 1).

Each of the 10 skids has a plot paired with it in the adjacent cutover which was also ripped and mounded. The eleventh skid had half left untreated and half 100% ripped and the soil/debris spread over it. Growth plots have been established for measurement over the next ten years.

Data collected during the establishment of the trial were:

- production rates of the ripping/mounding and spreading of debris heaps
- soil strength and nutrition status
- rip/mound profiles
- depth of the spread soil/debris
- the size of the skid sites

The measure of soil strength used was shear strength. This was because the skid sites were too compacted for a penetrometer to be used or bulk density samples to be collected.

The cultivation was done by a Komatsu D85 fitted with a ripper/mounder consisting of a winged ripper and four discs (2 each side). The spreading of the soil and debris over the skid was done with a D6 tractor.

RESULTS

The area logged in Compartments 1057/58 was 162.5 ha and used 17 skid sites totalling 9.6 ha, (5.9% of the land area in the compartment).

The eleven skids selected for the trial had an average size of 0.45 ha, (0.33 - 0.64 ha), including the heaps of soil and debris surrounding the working surface.

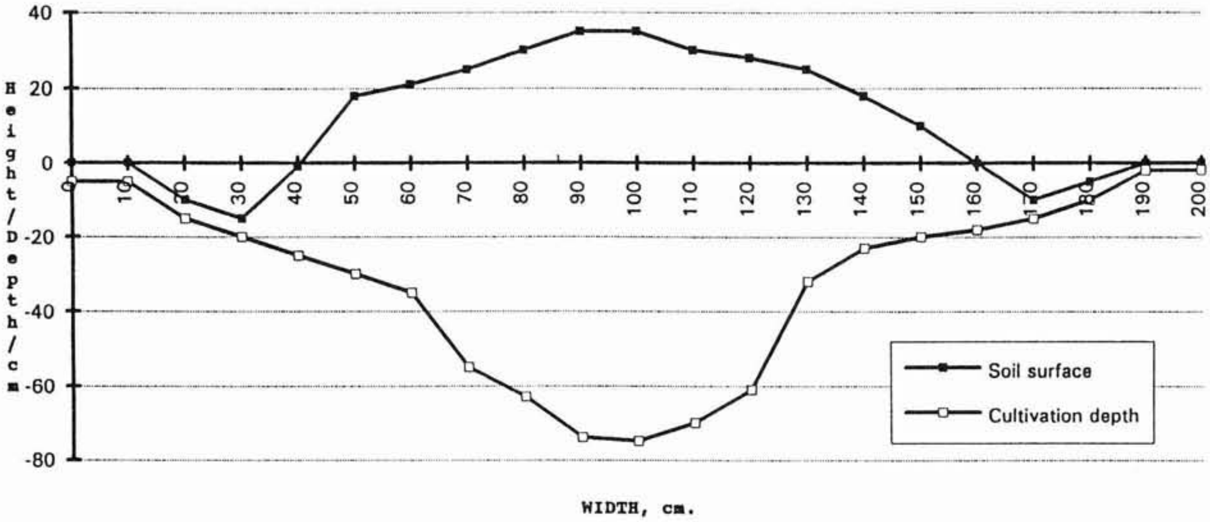

Figure 2 - Graphical representation of the average rip/mound profile

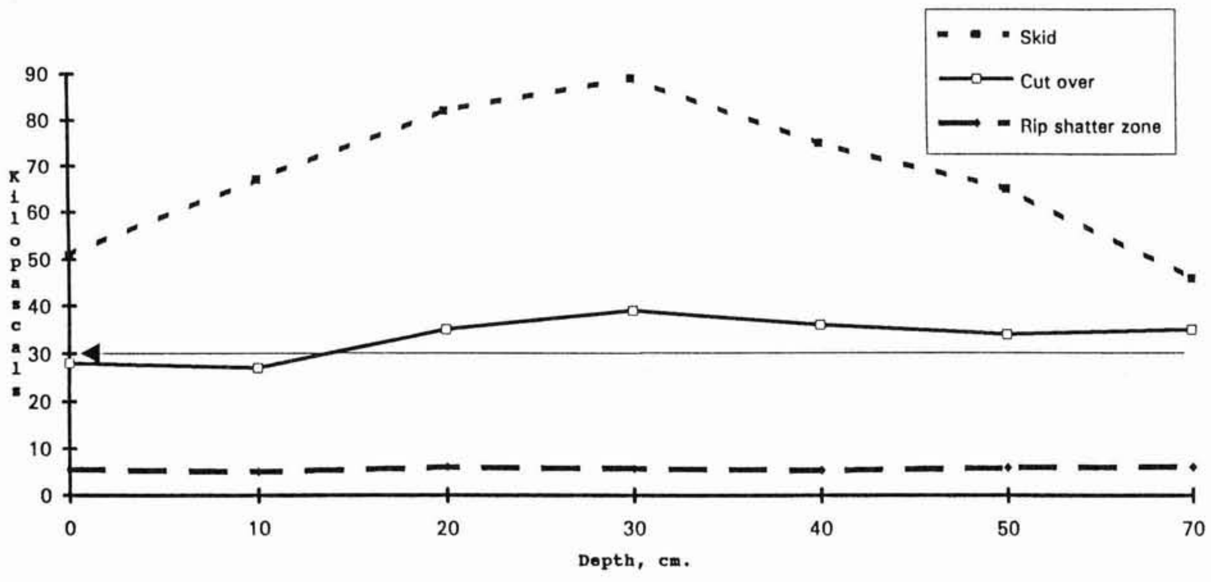

Figure 3 - Soil shear strength by depth in the skid sites, cutover and rip shatter zones

The production rate of the ripping/ mounding operation was 0.42 productive machine hours (PMH) per skid, including time to travel from skid to skid, at a cost of $56/skid.

The production rate of the soil debris spreading operation was 3.4 PMH/skid, including travel time. This part of the operation cost $340/skid.

Total cost per skid to rip/mound and spread the soil and organic debris back over the site was $396/skid. At an average skid size of 0.45 ha, this is a cost per hectare of approximately $880.

Costs were derived from the time study data using a costing method developed for logging contractors. (Wells, 1981).

Profiles of the rip shatter zone and mounds were measured (Figure 2).

The mean maximum height of the mound above the skid surface was 34 cm and the mean maximum rip depth was 74 cm.

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Table 1 - Soil nutrients

	pH	Total N %	C %	Bray 2 P (ppm)	Bray (me %)		
					Ca	Mg	K
Cutover topsoil	5.09	0.232	5.26	72.3	2.26	0.72	0.53
Skid surface.	5.84	0.037	1.29	12.9	0.63	0.12	0.4
Soil/Debris spread.	5.59	0.141	---------	17.7	0.90	0.34	0.57

The soil shear strength in the skid site was approximately twice that of the cutover to a depth of 50 cm and still markedly higher to 70 cm (Figure 3).

The arrow line at the 30 kilopascal level is the point at which soils become impenetrable to radiata pine root growth (Mason and Cullen, 1986). Southern Kaingaroa soils are generally impenetrable to radiata roots.

The graph clearly shows that the uncultivated skid sites have been heavily compacted. It is also noticeable that the compaction level has a peak at around 30 cm deep and although it is still more compact than the cutover at 70 cm, the difference has greatly reduced. The shear strength figures also suggests that compaction is not present below 80 cm.

The depth of soil spread over the skid surface averaged 33cm. This material was generally very loose and is a mixture of topsoil, mineral soil and the woody residue produced on the skid site during logging.

There are some major differences in nutrient status between the three sites. The most noticeable being the large drops in N,C,P,K and Mg between the cutover and the skid site.

The soil in the material pushed back over the skid shows nutrition levels that are generally between that of the cutover and the skid surface (Table 1).

The stripping of top soil during construction of the skid sites had major impacts on soil nutrients. Soil N has been markedly reduced to well below the critical level for radiata pine. Amelioration with either chemical N or biologically fixed N (legumes) is a prerequisite for crop re-establishment. The soil P status has also been affected with skid sites just on the margin for adequacy, (Ballard, 1973, Skinner et al, 1991).

Although there has been a marked decline in the nutrient cation status, (Ca, Mg and K), these declines are unlikely to be of concern, except for Mg, where the change in status is likely to be significant for radiata pine.

In summary, radiata pine nutrition on skid sites is most at risk from deficiencies in N, Mg and P.

By replacing the displaced soils, the soil nutrient status has been partially improved. However, the early growth of radiata pine is still at risk, particularly with N since woody debris is incorporated in the soil pushed back from the skid surrounds. The presence of this wood can result in a "lock-up' of soil mineral N in the decay process.

This area of the forest, including the skid sites was oversown with Yorkshire Fog and Lotus as part of the standard management programme. These species are now well established on the cutover. The sections of skid which were ripped and mounded only remain bare. The sections of skid which had the top soil spread back over them have a partial cover of the oversown species.

DISCUSSION

The costs of this treatment appear high on a per hectare basis. However, some reductions to these costs would be possible. Combining the rip/mound and push soil/debris back over into one operation using the larger bulldozer would eliminate one element of travel time, and would speed up the spreading operation.

Whether the cost is justified will only be determined when the growth data are available to enable a cost benefit analysis to be carried out.

The soil compaction on these skids was still noticeable at 70cm depth, but indications are that it would not be present below 80cm. Therefore, any skid ripping treatment should be aiming for an average ripped depth of around 80cm. Figures from a range of past studies have indicated that the area of land lost to production in the form of skid sites is 5 to 8%. This study is consistent with that at 5.9%.

This is a significant loss of productive land and should be returned to full production if economically feasible.

The soil nutrition analysis indicated that there is a major difference in the level of several key elements between the cutover topsoil, the soil in the ripped skid and the material that was pushed back over the skid. With nutrition differences of this magnitude some growth differences can be expected.

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DEFINITIONS

N	=	nitrogen
C	=	carbon
P	=	phosphorus
Ca	=	calcium
Mg	=	magnesium
K	=	potassium

The costs stated in this Report have been derived using the procedure shown in the LIRA Costing Handbook for Logging Contractors. They are only an indicative estimate and do not necessarily represent the actual costs for this operation.
