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THE SCRUB MUNCHER - A DISC SLASH BREAKER FOR SITE PREPARATION

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Figure 1 - The Scrub Muncher mounted on a PC120 excavator treating heavy slash and undergrowth

SUMMARY

The Scrub Muncher was studied working in heavy slash conditions preparing radiata pine cutover for replanting. The production rate was 0.08 ha per productive machine hour (PMH) or 12.5 PMH/ha. Costs for the operation were estimated at $85 per hour, giving a per hectare cost of $1,060. The operation converted an unplantable site with a slash load of 180 m³ per hectare, to an easily planted site with the same volume of slash but with the slash broken into smaller pieces. Evidence that the Scrub Muncher treatment gives some weed control was found at a separate site planted in 1995.

INTRODUCTION

The use of excavators as base machines for site preparation, both for cultivation and slash clearing, has expanded the number of

options open to forest managers for pre-plant treatment of cutover and scrub.

Burning has become a less popular option due to high costs and concerns over the risks of starting wildfires. This has meant that sites with a combination of rolling to steep terrain and a heavy slash load are proving difficult to clear for re-establishment.

Windrowing with excavators is an option, but there are concerns that on some sites it can have disadvantages. On sites with a gorse seed source, the scarification of the duff layer associated with windrowing has led to high levels of gorse germination. Where excavators have worked in windrows running directly down hill, on slopes in excess of 20°, there have been some instances of erosion in the track marks. These are problems that can be overcome by either spraying or changing the machine's work pattern. Another concern about any windrowing, is that it places most of the nutrients available from the decaying slash in a limited area (10% to 20%) of the total site.

If a cutover has a combination of heavy slash, rolling to steep slopes and low fertility soils, an option that is now available in both the North and South Islands, is the use of excavator-mounted slash breaking tools and spot cultivation equipment. These machines come in a variety of configurations and both disc and drum-type machines are available. The drum-type machines tend to cut the slash material into small pieces, similar to a coarse pulp chip, or mulch. The disc machines break the slash into pieces but do not create a mulch.

One of the disc-type slash breakers, a Scrub Muncher mounted on a Komatsu PC120 excavator, was the subject of this study.

The Scrub Muncher consists of a hydraulically powered 130 cm diameter disc with 16 blunt teeth for breaking up the slash. The disc (horizontal) spins at 600 rpm. The Scrub Muncher is fitted with a hydraulic grab at the rear of the disc housing that enables it to grasp logs and place them in a heap rather than simply push them aside. The Scrub Muncher weighs 1.2 tonnes. The 12 tonne excavator is a relatively small base machine and the Scrub Muncher appeared to be working close to the limit of its capabilities. A larger unit may have been able to work more quickly. However, a larger machine would have a higher capital cost and so the overall cost per hectare may not be reduced.

The Scrub Muncher breaks the slash, especially branch material and light scrub, into smaller pieces. This lowers the overall height of the slash. The pieces it produces are often 0.5 m to 1.0 m long. The range of sizes is large with some pieces as small as 3 to 4 cm. It does not attempt to break up the larger diameter stem wood. The treatment makes the site easier to walk across, and to plant, as the broken up slash can easily be kicked aside to access the soil. The treatment does not reduce the volume of slash but reduces the size of the pieces and the amount of hindrance from the slash.

The site being worked had a very heavy slash load, made up of radiata pine slash, native scrub species and remnant native slash (Rata logs and stumps) from the establishment of the previous radiata stand. The whole site was being treated. Row or spot treatments may result in a higher production rate and a lower cost per hectare than those found in this study.

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METHODS

Before the operation commenced, the site was pre-assessed for the volume and type of slash, using the line intersect method (Warren and Olsen, 1964; Hall, 1996). The amount of slash cover was also assessed using the point sampling method (McMahon, 1995). The amount and type of vegetation cover was also assessed using area plots.

The operation was studied using activity sampling. The amount of time spent on each element of the machine's work cycle was determined, and the rate of production was assessed by measuring the area of land prepared during the total recorded time.

After the operation was completed, the site was re-assessed for volume and type of slash, vegetation, ground cover and plantability. Plantability was assessed by a subjective assessment of 50 randomly located spots. The scale used was from one to five with one being no hindrance and five being impossible to plant.

A site planted in the winter of 1995, where the Scrub Muncher and excavator windrowing had been used within the same setting, was studied. The vegetation cover and survivals in both treatments were assessed.

RESULTS AND DISCUSSION

The treatment of the slash by the Scrub Muncher had little effect on the volume of stem wood on the site (Table 1). The machine was not designed to, nor able to, break up larger diameter stem wood (>25cm diameter). The volume of both branch material and native scrub was reduced. This material was still on site but was broken into pieces too small to be measured or to fit into the categories measured by line intersect sampling.

The effect of the Scrub Muncher on the smaller diameter material, such as branches and scrub, was to break it into smaller lengths with some splitting along the grain also reducing diameter.

Before the site was treated, 25% of the area had vegetation cover made up of standing scrub, fern and weeds (Table 2). The standing scrub was often partially flattened by the logging operation but still solidly rooted in the ground. This material was mostly Kamahi, Wineberry and Bush-lawyer, and was a major impediment to site access and planting. After the operation, there was no standing scrub and only a very small amount of other vegetation.

Table 1 - Estimated slash volume (m^3 per hectare)

	Dead Native	Radiata Stem	Radiata branch	Native scrub	**Total**
Pre Treatment	75 m^3/ha	21 m^3/ha	59 m^3/ha	33 m^3/ha	188 m^3/ha
Post Treatment	73 m^3/ha	22 m^3/ha	41 m^3/ha	20 m^3/ha	156 m^3/ha

Table 2 - Vegetation cover

	No Vegetation	Standing scrub	Fern	Weeds
Pre Treatment	75%	5%	11%	9%
Post Treatment	99%	0%	0.5%	0.5%

Table 3 - Ground cover

	Bare soil	Duff	Broken slash	Native logs	Pine logs	Stumps	Heavy slash	Mix: soil, duff, slash
Pre Treatment	14%	11%	0%	2%	4%	3%	58%	8%
Post Treatment	21%	7%	37%	3%	1%	2%	2%	27%

Table 4 - Planting hindrance

	No Hindrance	Light Hindrance	Moderate Hindrance	Heavy Hindrance	Impossible to plant
Pre Treatment	14%	12%	8%	8%	58%
Post Treatment	54%	28%	8%	6%	6%

The ground cover prior to the Scrub Muncher treatment was dominated by heavy slash, covering 58% of the area (Table 3). This changed substantially with the slash being broken down and thrown about by the machine, with only 2% of the site being under heavy slash after treatment. Most of the heavy slash was converted to broken slash. There were also increases in the amount of bare soil and mixed soil, duff and slash.

The operation had a substantial impact on the hindrance level on the site. Prior to the operation, walking was difficult, due not only to the volume of slash and scrub but also due to its height above the ground. Treatment by the Scrub Muncher resulted in a much lower slash height making it easier to traverse the site.

Breaking down the slash had a major effect on the ease with which the site could be planted. It not only reduced the walk hindrance, but having reached the planting spot, the hindrance to planting was also substantially reduced. In the pre-treatment assessment, 58% of the site was judged to be impossible to plant (Table 4). This was because there was such a high volume of slash in large pieces that it was not possible for a planter to prepare a planting spot adequately. In many cases, there would have been great difficulty in even reaching the soil. After the treatment, 82% of the site was judged to have no or light hindrance compared to 26% before treatment. When the slash has been broken down into smaller pieces, it is much easier to kick aside to clear a planting spot.

Production study data

The operation was studied over two days for 13.2 PMH. During this time, the machine completed just over one hectare of treated cutover. This was at a rate of 0.08 ha/ PMH or 12.5 PMH/ ha.

The machine was also the subject of an activity sampling study.

Table 5 - Activity sampling data (productive time)

	% of observations	Confidence Limit (95%)
Treat slash	76%	±2.2
Move	11%	±1.6
Slew	5%	±1.1
Windrow	7%	±1.3
Stuck	1%	±0.5

Table 6 - Percent of ground covered by vegetation by height class

	% Bare ground	% with Vegetation cover	% of total 0 - 30 cm high vegetation	% of total 30 - 100 cm high vegetation
Windrow	25	75	42	33
Scrub Muncher	57	43	34	9

The majority of the machine's time was spent on activities that were productive with 76% on actually breaking up slash (Table 5). There was little in the work method that could be modified to improve production. The windrowing element refers to the time spent by the machine grabbing and lifting aside the larger logs that were impeding its progress.

Availability of the machine was 97% and utilisation was 89%. The time the machine was unavailable was due to replacing or tightening worn teeth on the disc.

The machine was costed at $85 per hour, giving a cost per hectare of $1,060 (Riddle, 1994). The apparently high cost of the treatment needs to be considered in relation to the very high slash level which was three times that of a typical radiata cutover. Some of the costs of the operation may be partially offset by reduced costs in other phases of re-establishment (planting and releasing).

Site established previous year

A survey of a site re-established in 1995 was completed. Part of the block had been treated by the Scrub Muncher and part by excavator windrowing. Survivals in the block were similar at 83% and 84% respectively. Tree growth was not assessed as animal browsing in both parts of the block had masked any treatment effect. However there was a measurable difference in vegetation cover between the two treatments which may be related to the slash treatment (Table 6).

There was a much greater proportion of the site free of weeds in the area treated by the Scrub Muncher and the weeds that were present were generally shorter (Figure 2). The exact reason for the reduction in weeds in the area treated by the Scrub Muncher is not known. The timing of the operation may be important.

It is likely that on steeper land, the retention of the slash on site will reduce the potential for soil erosion. Soil moisture retention may also be affected, with the slash layer reducing evaporation.

The Scrub Muncher and other similar treatments have the advantage of leaving the nutrients from the decaying slash adjacent to the trees, rather than in clumps (as in windrowing). Research on the effects of this on tree growth is necessary to assess the effectiveness of this operation more fully.

CONCLUSIONS

The major findings of this study were:

- The Scrub Muncher was effective at turning a site that had very poor planting conditions into a much easier site to plant.

- The volume of slash on the site was left largely the same by the treatment, with the major change being in the size and orientation of the pieces.

Figure 2 - Windrowed area on left, Scrub Muncher treated area on right, nine months after planting

• The creation of a layer of slash at ground level appeared to have some effect on weed growth. The weed re-growth at one site was noticeably less than that at a windrowed site of the same age nine months after the treatment.

• The cost of the treatment was estimated at $1060 per hectare.

The costs stated in this report have been derived using LIRO costing procedures. They are an indicative estimate and do not necessarily represent the actual costs for this operation.

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