CONTROL OF WILDING CONIFERS BY APPLYING HERBICIDES TO CUT STUMPS

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SUMMARY

Four herbicides were applied to freshly cut stumps of three species of conifers growing on two sites, at 700 m a.s.l. and 1400 m a.s.l., in the Craigieburn Forest Park area. Sodium chlorate, ammonium sulphamate, and glyphosate were effective in killing lodgepole pine (*Pinus contorta*), Scots pine (*P. sylvestris*) and mountain pine (*P. uncinata*) stumps. 2,4-D was effective on lodgepole but ineffective against mountain pine and was not as effective as the other three chemicals on Scots pine at the higher altitude. On uneven or stony ground it is difficult to remove all live foliage, which ensures the killing of a high proportion of the cut trees. Sodium chlorate was the fastest acting chemical at the higher altitude site and is considered to be the most practical chemical for killing conifer stumps.

INTRODUCTION

Uncontrolled natural regeneration of introduced trees in New Zealand's rangelands is causing land managers concern. In the North Island, uncontrolled spread of lodgepole pine (*Pinus contorta*) covered some 30,000 ha of the Central Plateau in 1975 (Hunter and Douglas 1984). The largest area of spread in the South Island is 6,000 ha of Corsican pine (*P. nigra*) on the Amuri Range near Hanmer Springs (Ledgard 1988).

Prevention of uncontrolled spread can be achieved by good stock management (Benecke 1967). However, where stock grazing is not feasible, seedlings up to 50 cm tall can be handpulled. Taller seedlings need to be cut at ground level, or killed by chemicals. Larger trees have to be felled with a chainsaw and all green foliage removed. When complete foliage removal is difficult because green crowns are close to an uneven or stony ground surface, it is often more efficient to cut higher up the stem and then kill the stump with chemicals.

Little research has been published in New Zealand on the chemicals most suited for controlling wilding conifers. The soil sterilants bromacil, GS 29696 and karbutilate were shown to be effective for killing young lodgepole pine (Davenport and Preest 1974), but the silver tussock surrounding each treated tree was also killed. Because foliage-applied herbicides are generally poorly translocated in pines, good crown penetration and foliar coverage are necessary (Preest 1985). Small trees (less than 2 m tall) are therefore easier to treat and kill than larger trees. Preest successfully killed sparsely scattered pines up to 3 m tall with bromacil granules on the ground and a glyphosate/water solution applied to cut stumps and any remaining foliage. For trees over 3 m tall, he recommended poisoning with ammonium sulphamate applied to holes or notches in the stem. Glyphosate has been tested in Southland on lodgepole pine and prevented regrowth when used at 20 ml/litre of water with 2 ml/litre Agral LN (P.W. Adams, NZ Forest Service, pers. comm.).

In 1986 four commonly available herbicides were tested on stumps of lodgepole pine, Scots pine, and mountain pine at two sites in the Craigieburn Forest Park area. The effectiveness of these herbicides is evaluated in this paper.

METHOD

Site 1: The trees tested were 200 lodgepole pine, 200 Scots pine (*P. sylvestris*), and 100 mountain pine (*P. uncinata*), planted in contour lines at 1400 m a.s.l., above the Proc. 41st N.Z. Weed and Pest Control Conf.

natural timberline. The trees were 26 years old, ranging in height from 1.5 m to 4.0 m. The site was sloping and varied from semi mobile scree to intact tall tussock.

Site 2: The trees selected were 230 lodgepole pine and 120 Scots pine, growing in a closely planted unthinned woodlot at 700 m a.s.l.. The trees were 13 years old and were all taller than 2 m. For Scots pine average height was 4.5 m and diameter at breast height 7.0 cm, and for lodgepole pine measurements were 6.3 m and 10.0 cm. The site was flat, highly modified short tussock grassland.

The trees were felled with a chainsaw at approximately 50 cm above ground level. Each stump was tagged. As some trees were multileadered from the base, individual stump diameters varied widely, ranging from 2.2 cm to 29.3 cm. After felling, the amount of foliage left on the stumps was noted. Levels varied from a few green needles to two full whorls of green branches.

Four chemicals were tested in December 1986: glyphosate (a broad spectrum, translocated herbicide, applied with the surfactant Silwet L-77 [Pulse]), sodium chlorate (an inorganic compound which non-selectively inhibits plant growth), ammonium sulphamate (an inorganic compound that kills by contact and translocation), and 2,4-D butyl ester (a selective, translocated phenoxy herbicide, applied with diesel). Each was applied systematically to a similar number of trees, with an untreated control (Table 1). Glyphosate and Silwet L-77, 2,4-D and diesel, and ammonium sulphamate were sprayed to drip point onto individual tree stumps with a hand-held compressed air sprayer. Sodium chlorate powder was sprinkled over the entire cut stump surface. All stumps were treated immediately after cutting.

Chemical effectiveness was determined by visual assessment of percent mortality (based on presence of live foliage) 1, 2, 5, and 13 months after treatment.

RESULTS

Ammonium sulphamate, glyphosate, sodium chlorate and 2,4-D were all effective in killing lodgepole and Scots pine stumps after 13 months, achieving on average 80.6% mortality (Table 2). However, at the higher altitude site, 2,4-D was less effective than the other three chemicals on Scots pine. As a representative example of relative chemical effectiveness and mortality rate, the percentage mortality for lodgepole pine at the higher altitude site is given (Figure 1).

TABLE 1: Summary of treatments

Herbicide	g ai/litre	Herbicide mixture	Av. rate applied* (per 11cm diam. stump)	Approximate chemical cost**	No. of trees Site 1	No. of trees Site 2
ammonium sulphamate (Ammate XL)	800	50% ammonium sulphamate + 50% water	7 ml	1	97	72
glyphosate (Roundup)	360	20% glyphosate + 1% Silwet L-77 + 79% water	7 ml	3	101	71
sodium chlorate (Sodakem)	590	undiluted powder	6 g	2	99	68
2,4-D	360	50% 2,4-D + 50% diesel	7 ml	2	99	71
untreated	-	-	-	-	98	69

* Calculated by calibration according to size of stump.

**Cost/11 cm diam. stump

TABLE 2: Chemical control of lodgepole, Scots, and mountain pine : mean % mortality 13 months after treatment. Significance values were calculated by χ^2 tests on absolute mortality values for each herbicide and tested against the untreated control.

Site	Herbicide	Lodgepole	% Mortality Scots	Mountain
1 (1400 m a.s.l.)	ammonium sulphamate	79.5 **	75.0 **	52.6 **
	glyphosate	76.5 **	77.5 **	60.0 **
	sodium chlorate	85.7 **	80.0 **	79.0 **
	2,4-D	74.5 **	46.1 **	28.6 NS
	untreated	19.2	7.7	10.0
2 (700 m a.s.l.)	ammonium sulphamate	85.4 **	79.2 **	-
	glyphosate	95.6 **	83.3 **	-
	sodium chlorate	90.9 **	80.9 **	-
	2,4-D	83.0 **	95.7 **	-
	untreated	24.4	4.3	-

** = highly significant $P < 0.01$

NS = not significant $P > 0.05$

Mortality of mountain pine, which was only present at the higher altitude site, appeared to be less than for lodgepole and Scots pine for all treatments except sodium chlorate. Mountain pine mortality from 2,4-D did not differ significantly from natural control mortality, and there was also no significant difference between ammonium sulphamate and 2,4-D.

Foliage on the cut stumps died slowly, particularly at the higher altitude site where mortality after 2 months with either glyphosate or ammonium sulphamate was 4%, 17% and 5% for lodgepole, Scots, and mountain pine respectively. Sodium chlorate gave better results (38%, 44% and 5% for lodgepole, Scots, and mountain pine respectively) but 2,4-D had killed an average of only 10% of any of the three species at either site after the same period.

It was observed that the less foliage left on lodgepole pine stumps the higher the mortality achieved. When all foliage was removed chemical application appeared unnecessary.

Fig. 1: Percent mortality of lodgepole pine at site 1 (1400 m a.s.l.)

DISCUSSION

Sodium chlorate powder was effective in killing lodgepole, Scots, and mountain pine stumps. Being a dry powder it is the easiest chemical to apply in rugged country. Ammonium sulphamate and glyphosate were equally effective in killing lodgepole and Scots pine but must be applied as liquid sprays. The 2,4-D treatment was slow, ineffective on mountain pine, and less effective than the other three chemicals for Scots pine at the higher altitude site. These four herbicides were quite inexpensive for stump application (Table 1).

There has been little research done in New Zealand on the application of herbicides to stumps or on the kinetics and dose-response curves of absorption into stumps. The immediate effect of some "slowly acting herbicides" on a sensitive metabolic step need not immediately show up in a measureable form (Fedtke 1982). In some cases the low temperatures experienced at high altitudes may reduce the effect of the chemicals.

CONCLUSION

If the removal of all green foliage is impracticable the use of sodium chlorate, ammonium sulphamate, glyphosate or in some situations 2,4-D, is recommended for control of conifer regeneration on cut stumps. Sodium chlorate is particularly suitable as it is the most practical to use in rugged country, where wildings are frequently found.

REFERENCES

- Benecke, U., 1967. The weed potential of lodgepole pine. *Review 13. Tussock Grasslands and Mountain Lands Institute*: 36-42.
- Davenhill, N.A. and Preest, D.S., 1974. Interim evaluation of several soil sterilants for the control of contorta pine. *Proc. 27th NZ Weed and Pest Control Conf.*: 19-23.
- Fedtke, C., 1982. *Biochemistry and Physiology of Herbicide Action*. Berlin; New York: Springer-Verlag. 202 pp.
- Hunter, G.G. and Douglas, M.H., 1984. Spread of exotic conifers on South Island rangelands. *NZ Journal of Forestry* 29(1): 78-96.
- Ledgard, N.J., 1988. The spread of introduced trees in New Zealand's rangelands — South Island high country experience. *Review 44. Tussock Grasslands and Mountain Lands Institute*: 1-8.
- Preest, D.S., 1985. Chemical aids to planting site preparation. *FRI Bulletin No. 100*: 47 pp.