EFFECT OF APPLICATION VOLUME AND SPRAY ADDITIVE CONCENTRATION ON THE CONTROL OF BRACKEN

J.W. RAY, A.L. VANNER and B. RICHARDSON

Forest Research Institute, Private Bag, Rotorua

SUMMARY

Hardened mature bracken was aerially sprayed using application volumes of 220 and 20 litres/ha, with either glyphosate or asulam plus various spray additives. Silwet M was the most effective additive tried. Herbicide effectiveness increased with increased amounts of Silwet M, irrespective of application volume. It is suggested that application volumes for aerially applied sprays for bracken control could be reduced.

INTRODUCTION

The vagaries of the New Zealand weather severely limit the time for the aerial application of pesticides. Furthermore, the productivity of aircraft, in terms of hectares sprayed per hour, depends largely on the volume of spray applied per hectare (Akersson and Yates 1974). Therefore, to make better use of available time, reductions in the application volume would be advantageous, provided there was no decrease in the effectiveness of the pesticide applied.

In two trials to control bracken Richardson *et al* (in press) and Ray (unpublished) found that a higher percentage of the applied spray was retained on the foliage when glyphosate was applied in lower rather than higher water volumes.

Zabkiewicz *et al* (1985) showed that Silwet M increased both the penetration of glyphosate into gorse and its herbicidal effectiveness when applied in 300 litres water/ha.

The objectives of the trial were threefold: to ascertain whether Silwet M should be added to spray mixtures on a v/v basis or at a fixed rate per hectare when using reduced application volumes; to compare the herbicidal effectiveness of glyphosate with Silwet M at higher and lower rates than those recommended; and to compare the performance of Silwet M with that of two other commonly used additives.

METHODS

The trial was carried out on the northern side of the Mamaku Plateau near Rotorua. The area, having an original cover of manuka, gorse, and bracken, was crushed in May 1984, burnt in October and by July 1985, was covered by a uniform stand of dense bracken 0.4 to 0.6 m tall with gorse seedlings and regrowth scattered under the canopy.

Ten unreplicated treatments were applied to individual plots 150 x 70 m, separated by buffer strips 5 m wide. The spray applications were made on 2 July 1985 using a Bell Jet Ranger helicopter fitted with a doppler radar unit which gave the pilot a read-out of ground speed. The flying speed for all treatments was 45 knots. Plots were sprayed with a lane separation of 10 m, indicated to the pilot by flagmen stationed at the beginning and end of each run. The herbicides were applied either in a total volume of 220 litres/ha using D8-46 nozzles pressurised at 300 kPa or in a total volume of 20 litres/ha using six Micronair AU 5000 units.

The spray mixtures and application volumes are listed in Table 1. Tartrazine dye was added to each spray mixture. Temperature, humidity, windspeed, and direction were monitored at 1, 5, and 10 m above the ground during the period when the spray was being applied.

After spraying, 50 pinnae were picked at random from the upper canopy in each treatment along two centrally located transects, 50 m apart, orientated at right angles to

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TABLE 1: The effect of two herbicides with additives at different rates on frond emergence of bracken, spray recovery, and droplet size.

Herbicide	Rate (kg ai/ha)	Application volume (litres/ha)	Additive	Additive rate (ml/ha)	Frond emergence (No./0.79m ²)	Spray recovery index	Droplet size vmd (µm)
asulam (Asulox)	5.6	220	Silwet M (Pulse)	220	0.1 a	0.57 a	902
asulam	5.6	20	Silwet M	20	6.5 d	0.65 a	155
glyphosate (Roundup)	3.6	20	—	—	13.0 e	0.36 cd	336
glyphosate	3.6	20	Triton X-45	100	9.8 e	0.45 b	233
glyphosate	3.6	20	Silwet M	50	6.1 d	0.42 bc	259
glyphosate	3.6	20	Silwet M	550	2.0 c	0.44 b	241
glyphosate	3.6	220	Silwet M	550	1.5 b	0.37 cd	974
glyphosate	3.6	220	Silwet M	800	0.9 b	0.28 e	nm*
glyphosate	3.6	220	Silwet M	275	2.8 c	0.43 bc	682
glyphosate	3.6	220	diesel + Triton X-45	15000 + 220	5.0 d	0.33 de	1087
untreated	—	—	—	—	23.1 f	—	—

Treatments joined by the same letter are not significantly different ($p=0.05$)

*nm = not measured

the flight lines. No samples were taken from within 10 m of the edge of each block. The foliage samples were used to determine spray recovery using the method of Richardson *et al* (in press).

To make the spray recovery figures from all treatments comparable, all figures have been standardised using a Spray Recovery Index (SRI) where

$$\text{SRI} = \frac{\text{deposit on pinnae (}\mu\text{ litres/cm}^2\text{)}}{\text{application volume (litres/ha)}} \times 100$$

The higher the SRI, the higher the recovery of spray on the foliage.

Spray droplets were collected from above the canopy on caste-coated card placed horizontally on stakes. The droplet size was determined by measuring the stain sizes using an image analyser and converting this to droplet size using a spread factor determined for each spray mixture. This has been expressed as volume medium diameter (vmd).

Herbicidal effectiveness was assessed 5 months after spraying by counting the number of new fronds which had emerged. Two diagonal transects were marked out within the original pinnae sampling area. The number of new and emerging fronds was counted in 50 subplots (0.79 m²) in each treatment area. Counts were also made in an adjacent unsprayed area.

Both the SRI and frond emergence data were analysed after log transformation [$\log(1+x)$]; differences between treatments were determined using LSD at the 5% level.

RESULTS AND DISCUSSION

All the results are given in Table 1.

Weather conditions were similar during all applications, with an inversion persisting until after the completion of all treatments.

The current recommendation for long-term bracken control is an application volume of 220 litres/ha containing 3.6 kg ai glyphosate and 550 ml Silwet M (0.25% v/v). This rate gave good control of bracken regrowth in this trial (Table 1). When the

application volume was reduced to 20 litres/ha the same quantity of glyphosate plus 50 ml of Silwet M (0.25% v/v) gave much poorer control, although the SRI did not change significantly.

Similarly, applying 5.6 kg ai asulam in 220 litres water/ha plus 220 ml Silwet M (0.2% v/v) resulted in good bracken control, whilst the same quantity of asulam in 20 litres water/ha plus 20 ml Silwet M (0.1% v/v) gave poor control. Again, the SRI was unchanged.

Increasing the Silwet M to 550 ml in the low-volume glyphosate application almost restored the herbicidal activity to that obtained with the high-volume application (2 vs 1.5 fronds/0.79 m²), although the SRI did not differ. With the high-volume glyphosate applications, increasing the Silwet M from 550 to 800 ml/ha decreased the SRI but left the herbicidal effect unchanged. Reducing the rate of Silwet M to 275 ml/ha reduced the herbicidal activity but not the SRI.

These results indicate that the herbicidal activity of both glyphosate and asulam are directly related to the rate of Silwet M, expressed on a per hectare basis. The use of the present recommendations based on a v/v percentage will not prove effective if spray application volumes are reduced.

At the low application volume, glyphosate alone did not show a high level of herbicidal activity and this was not significantly increased by the addition of Triton X-45, despite a higher spray recovery. The addition of Silwet M at both the rates used, gave significantly better herbicidal activity than the addition of Triton X-45. At the high-volume application a greater herbicidal effectiveness was observed with all rates of Silwet M tested than with diesel plus Triton X-45.

The range of droplet sizes produced in the trial does not appear to have had any effect on spray recovery by the bracken fronds. For example with the asulam there is no difference between the spray recovery at either application volume although the vmd for the high volume application was 902 μ m and that for the low volume 155 μ m (Table 1). In a hand-spray trial, Richardson (unpublished data) obtained a similar result when he found that bracken captured droplets ranging in size from 50 to 800 μ m with equal efficiency.

The results of this trial suggest that, for bracken control, application volumes could be reduced provided the amount of Silwet M per hectare was not reduced. Although high application volumes are recommended for the spraying of glyphosate from the air in New Zealand, Australian label recommendations say that glyphosate can be applied from the air in as low a total volume as 15 litres/ha. Based on this trial and other unpublished work, the authors believe that bracken could be controlled using the recommended rate of glyphosate applied in a total volume of 50 litres/ha using D5-25 nozzles, provided that Silwet M is added at 550 ml/ha.

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