ORGANOSILICONE SURFACTANTS HELP RAINFASTNESS OF GLYPHOSATE ON GORSE AND BROOM

JOHN M. BALNEAVES

Forest Research Institute, P.O. Box 31-011, Christchurch, New Zealand

SUMMARY

Two-year-old gorse and broom plants, raised in pots, were sprayed with combinations of glyphosate and two commercially available organosilicone surfactants followed by artificial "rain" at different intervals, to evaluate effectiveness of the sprays. Plant mortality and height of surviving plants was evaluated statistically to confirm that the addition of either surfactant was very beneficial in enhancing spray effectiveness with rainfall soon after application. These data indicated that both surfactants enhanced glyphosate activity and no difference could be detected between surfactant effectiveness. Further evaluation of the different surfactant concentrations tested showed that 0.5% v/v was essential for control where "rainfall" occurred within 2 hours of application.

Keywords: Organosilicone surfactants, glyphosate, *Ulex europaeus*, *Cytisus scoparius*, rainfastness.

INTRODUCTION

During an earlier spraying trial in North Canterbury, to control mature gorse (*Ulex europaeus*), heavy rain fell within 1 hour of spraying. Those gorse plants receiving glyphosate (Roundup) alone exhibited no herbicidal effect; plants receiving glyphosate and Silwet L-77 were desiccated to such an extent that the upper 60 cm portions of the gorse plants were completely killed (Balneaves 1986). Further work (Balneaves and Fredric 1988) demonstrated that indeed Silwet L-77 rendered glyphosate rainfast provided Silwet L-77 concentrations were 0.3 - 0.5% v/v. However, when added to metsulfuron methyl lower concentrations (0.1 - 0.2% v/v) of Silwet L-77 rendered this product rainfast when applied to gorse and broom (*Cytisus scoparius*) (Balneaves in press).

Development of other organosilicone surfactants similar to Silwet L-77 has been inevitable and this report describes the results of testing one such product, Freeway, developed specifically for addition to glyphosate herbicide to improve gorse and bracken (*Pteridium esculentum*) control.

METHODS

Since it was not feasible to do a large series of spray/rainfastness trials on mature gorse in the field, 2-year-old gorse and broom plants raised from seed in pots were used instead.

Plants were raised in pots (5/pot) containing soil (6.5 litres) to approximately 60 cm (gorse) and 70 cm (broom). Both species had gone through a flowering-seeding cycle 18 months from sowing and had commenced the new season's growth after the gorse had flowered, but before broom had flowered again.

On the day before spraying, each pot was examined, plant health recorded, and the plants watered thoroughly. All plants were reassessed 48 weeks after spraying and were recorded as dead, desiccated, or healthy.

The experiment was divided into two parts. A factorial trial tested the results of no herbicide/no additive; glyphosate (Glyphosate 360) alone at two rates (2.16 and 3.24 kg/ha) and glyphosate at the two rates with either 0.5% v/v Silwet L-77 or 0.5% v/v Freeway. Each treatment was subjected to six rainfall lag periods of 0, 0.5, 1, 2, 6, and 24 hours. The second trial tested the effects of Freeway concentration.

Proc. 45th N.Z. Plant Protection Conf. 1992: 247-250

Glyphosate at 2.16 kg was used with Freeway rates of 0, 0.25, 0.5, and 1.0% v/v. Each treatment was again tested at six rainfall lag periods. Five pots (replicates) of gorse and broom were used for each treatment.

Rainfall was simulated by using a Nylex Water Wave system operated at 386 kPa to produce 1000 µm droplets. Spray was directed upwards to 5 m so that droplets were near terminal velocity when they reached the foliage of the plants. The rainfall of 50 mm was applied at the appropriate lag time after spraying.

The herbicide was applied at a pressure of 275 kPa using a 2 m boom spray unit fitted with six 730077 nozzles to give the equivalent total spray volume of 300 litres/ha. Spraying commenced at 8:30 am and was completed by 9:00 am on 22 November 1989. Conditions were clear, sunny, and calm, and plant foliage was dry (no dew). During spraying the temperature rose from 9°C to 12°C and humidity dropped from 87% to 68%. Within an hour of spraying, on-shore easterly winds developed and 8/8 cloud caused a temperature drop and associated rise in humidity.

All data were processed using the SAS package. Analyses included normality testing of data, analysis of variance, and multiple comparison test of means.

RESULTS AND DISCUSSION

Gorse control with glyphosate alone was ineffective (21%) (Table 1). The addition of Silwet L-77 (0.5% v/v) improved overall control significantly (to 87% and 100% with 2.16 and 3.24 kg/ha glyphosate, respectively). The use of Freeway improved glyphosate activity against gorse, but was more effective with the higher rates of surfactant (0.5% and 1.0% v/v). The lowest rate (0.25% v/v), while significantly improving the control of gorse with glyphosate (2.16 kg/ha), did not give adequate gorse control when "rain" fell within 2 hours of application. Gaskin (1991) noted that the higher surfactant concentration (0.5% v/v) promoted increased uptake of glyphosate. It may be that at this rate stomatal flooding was occurring and Freeway's ability to enhance spreading and promote faster drying of the spray formulation (Gaskin 1991) aided rainfastness.

TABLE 1: Percent gorse and broom mortality 48 weeks after application of glyphosate and surfactant, ignoring rain-lag effect

Herbicide rate: Treatment	2.16 kg glyphosate		3.24 kg glyphosate	
	gorse	broom	gorse	broom
Herbicide alone	21 b*	5 a	21 b	28 b
+ Silwet L-77 (0.5%)	87 d	56 b	100 c	97 c
+ Freeway (0.25%)	54 c	75 c	—	—
+ Freeway (0.5%)	89 de	86 cd	100 c	92 c
+ Freeway (1.0%)	100 e	89 d	—	—
Unsprayed Control	0 a	0 a	0 a	0 a

* within each column, data sharing common postscripts are not significantly different at 5% level.

A comparison between Silwet L-77 and Freeway at 0.5% v/v indicated that there were no significant differences between percentage plant mortality resulting from spray application. Increasing the rate of Freeway to 1% v/v did achieve total gorse control when using the lower rate (2.16 kg/ha) of glyphosate.

Mortality in relation to rain-lag (Table 2) indicates again there was little difference between surfactant type on a rate-for-rate basis. Like earlier work (Balneaves and Fredric 1988; Balneaves 1990; Balneaves in press) rainfall applied within 0.5 - 1.0 hour after spraying did not reduce glyphosate efficacy when used with Silwet L-77 and Freeway.

Broom was harder to control than gorse (Table 1). At the lower rate of glyphosate (2.16 kg/ha) control of broom was relatively poor when Silwet L-77 (0.5%v/v) was used (56%). When Freeway was used, control was 75%, 86%, and 89%, respectively

for the three rates of surfactant (0.25, 0.5, and 1.0%, respectively).

At the highest rate of glyphosate (3.24 kg/ha) there was no difference ($P \leq 0.05$) between mortality of broom resulting from the addition of either Silwet L-77 or Freeway (97% and 92% mortality, respectively).

Time-lag between spraying and onset of rain seems to be important and these data (Table 2) suggest that a minimum of 1 hour rain-free period after spraying would be desirable when striving to control broom with glyphosate and Silwet L-77 or Freeway.

TABLE 2: Percent gorse and broom mortality 48 weeks after application of glyphosate with and without surfactant and followed by different rain-lag intervals.

Rainlag intervals (hours)	Gorse		Broom		Surfactant used
	glyphosate 2.16 kg/ha	glyphosate 3.24 kg/ha	glyphosate 2.16 kg/ha	glyphosate 3.24 kg/ha	
0	0 a*	11 a	0 a	0 a	Nil
0.5	0 a	11 a	0 a	17 b	
1	11 b	11 a	0 a	33 c	
2	11 b	22 b	0 a	30 c	
6	22 c	22 b	17 a	33 c	
24	33 d	33 c	17 b	50 d	
0	33 a	100 a	33 a	83 a	Silwet L-77 0.5% v/v
0.5	89 b	100 a	33 a	100 b	
1	100 c	100 a	33 a	100 b	
2	100 c	100 a	33 a	100 b	
6	100 c	100 a	33 a	100 b	
24	100 c	100 a	100 b	100 b	
0	0 a		50 a		Freeway 0.25% v/v
0.5	11 b		83 b		
1	11 b		87 b		
2	100 c		100 c		
6	100 c		100 c		
24	100 c		100 c		
0	33 a	100 a	17 a	67 a	Freeway 0.5% v/v
0.5	100 b	100 a	100 b	83 b	
1	100 b	100 a	100 b	100 c	
2	100 b	100 a	100 b	100 c	
6	100 b	100 a	100 b	100 c	
24	100 b	100 a	100 b	100 c	
0	100 a		67 a		Freeway 1.0% v/v
0.5	100 a		67 a		
1	100 a		100 b		
2	100 a		100 b		
6	100 a		100 b		
24	100 a		100 b		

* within each bracket of data means sharing common postscripts are not significantly different at the 5% level.

CONCLUSION

Both gorse and broom mortality were greatly improved with the addition of either Silwet L-77 or Freeway to the spray solution with glyphosate. Freeway at 0.25% v/v was not as effective as 0.5% v/v or greater where rainfall occurred within 2 hours of application. At the 0.5% v/v concentration, Freeway proved to be as effective as 0.5% v/v Silwet L-77 when used with glyphosate to control 2-year-old gorse and broom.

A 1-hour interval between spraying and onset of rain is important to ensure good control of weeds when applying glyphosate with either Silwet L-77 or Freeway (0.5% v/v).

REFERENCES

- Balneaves, J.M., 1986. Seasonal effects of glyphosate and Silwet M applied to native gorse. *Proc. 39th N.Z. Weed and Pest Control Conf.*: 74-77
- Balneaves, J.M., 1990. Surfactant Silwet L-77 aids rainfastness of glyphosate when applied to gorse (*Ulex europaeus*). *Australian Weeds Research Newsletter No.39*: 25-28.
- Balneaves, J.M., (in press). Silwet L-77 enhances rainfastness of glyphosate and metsulfuron-methyl when applied to gorse and Scotch broom. *Plant Protection Quarterly*.
- Balneaves, J.M. and Fredric, B.J., 1988. Silwet M improves performance of glyphosate on gorse. *Proc. 41st N.Z. Weed and Pest Control Conf.*: 146-148.
- Gaskin, R.E. and Zabkiewicz, J.A., 1991. A comparison between two commercial organosilicone surfactants; their effects on uptake and translocation of glyphosate in gorse (*Ulex europaeus*). *Proc. 44th N.Z. Weed and Pest Control Conf.*: 109-111.