SILWET M IMPROVES PERFORMANCE OF GLYPHOSATE ON GORSE

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SUMMARY

Gorse seedlings were sprayed with combinations of glyphosate and Silwet M, followed by artificial "rain" at different intervals, to evaluate field effectiveness of the sprays. Silwet M enhanced herbicide effectiveness as measured by reduced growth in surviving plants and increased plant mortality even when "rain" fell soon after application. A high concentration of Silwet M (0.5% v/v) was needed when a low rate of glyphosate was used.

INTRODUCTION

Surfactants added to the herbicide glyphosate promote wetting by reducing interfacial tension, and improve cuticle penetration and translocation of the active herbicide (Grossbard and Atkinson 1985). Foliar uptake of glyphosate in perennial ryegrass (*Lolium perenne*) improved with the addition of the wetting agent Silwet L-77 (Bishop and Field 1987). This combination gave full season control of perennial ryegrass and also reduced the length of the critical period needed between spray and onset of rain. When heavy rain fell within 1 hour of mature gorse (*Ulex europaeus*) being sprayed with different combinations of glyphosate and the wetting agent Silwet M only gorse sprayed with both materials showed signs of desiccation (Balneaves 1986). This suggested that Silwet M improved rainfastness as well as improving the herbicide's effectiveness. The experiment described here was designed to confirm and quantify this observation.

METHODS

Since a large series of trials on mature gorse in the field was not feasible, gorse seedlings were raised in pots (5/pot) containing standard potting mix. The seedlings were hardened off by restricting water supply so that they had mature spine formation. Seedling height at treatment was approximately 25 cm. On the day before spraying, health and height of each seedling were recorded and plants were watered thoroughly.

All plants were reassessed for health 24 weeks after spraying and recorded as either dead, desiccated, or healthy. All surviving plants were measured for height response.

The experiment was divided into two parts. A factorial trial tested the effects of control (no herbicide/no additive); glyphosate (Roundup) alone; Silwet M (Pulse) alone; and the herbicide/additive in combination. Glyphosate was applied at an anticipated sublethal rate (2.7 kg/ha) to enable detection of differences attributable to the additive. Silwet M was used at the then recommended concentration of 0.2% of total spray volume (TSV). 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 Silwet M concentration. Additive rates were: 0, 0.05, 0.1, 0.2, 0.3, and 0.5% v/v. Each treatment was again tested at six rainfall lag periods.

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 or the ground. The rainfall of 50 mm was applied after the appropriate lag time following spraying.

The herbicide was applied at a pressure of 275 kPa using a 2 m boom spray unit fitted with 6 × 730077 nozzles to give the equivalent TSV of 300 litres/ha. Spraying began at 8.35 am and was completed by 9.05 am. Conditions were clear, sunny, and calm, and gorse foliage was dry (no dew). During spraying the temperature rose from

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19.5°C to 22.5°C and humidity dropped from 88% to 68%. Within an hour of spraying, on-shore easterly winds developed and 8/8 cloud caused a temperature drop and an 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. A full breakdown of analysis methods and results is available on request (Balneaves *et al* 1986).

RESULTS AND DISCUSSIONS

All treatments, including the 0.2% Silwet M on its own, suppressed mean plant growth when there was no "rain" for 24 hours (Fig. 1). With "rain" 6 hours or less after spraying, Silwet M alone and glyphosate plus Silwet M were the only effective treatments ($P < 0.01$). The use of Silwet M with glyphosate significantly improved the herbicide's efficacy ($P < 0.05$), and the effectiveness improved with increasing rainfall lag time.

Greater suppression in height growth was achieved by spraying with Silwet M alone than with the sublethal rate of glyphosate (Fig. 1). Height growth suppression caused by the combined herbicide and surfactant was less than expected, perhaps reflecting the sublethal concentration of glyphosate used. At this concentration most plants survived spraying (Table 1).

The efficacy of the treatments increased with increasing concentrations of Silwet M, with the highest concentration (Silwet M 0.5% v/v) being the most effective in suppressing growth of gorse ($P < 0.01$) (Fig. 1). Although Silwet M at all concentrations suppressed height growth more effectively than glyphosate alone, only glyphosate combined with $> 0.2\%$ Silwet M killed gorse effectively (Table 1). At the sublethal level of glyphosate used, concentrations of Silwet M higher than the recommended 0.2% v/v were needed for effective control.

The use of Silwet M at the recommended rate (0.2% v/v) significantly improved suppression of gorse height growth when rainfall occurred 2 hours after spraying, whereas the higher concentrations were effective at suppressing growth even when rainfall occurred within 0.5 hour of spraying (Table 1). Glyphosate/Silwet M at 0.5% v/v killed 32% and reduced the vigour of 48% of the plants even with rain immediately after spraying.

TABLE 1: Gorse survival (%) 24 weeks after application of glyphosate (2.7 kg ai/ha) × Silwet M × rain lag treatments (25 gorse plants/treatment).

Rain lag (hrs)	Unsprayed control			0.2% Silwet M			glyphosate			0.05			0.1			0.2			0.3			0.5		
	H	uh	D	H	uh	D	H	uh	D	H	uh	D	H	uh	D	H	uh	D	H	uh	D	H	uh	D
0	100 ^A	-	-	100 ^A	-	-	100 ^A	-	-	100 ^A	-	-	100 ^A	-	-	100 ^A	-	-	72	24	4 ^D	20	48	32 ^D
0.5	100 ^A	-	-	88 ^B	12	-	100 ^A	-	-	100 ^A	-	-	92 ^A	-	8	28 ^B	60	12	8	60	32 ^C	-	56	44 ^C
1	100 ^A	-	-	100 ^A	-	-	100 ^A	-	-	96 ^A	-	4	68 ^B	24	8	18 ^C	60	32	-	64	36 ^{BC}	-	56	44 ^C
2	100 ^A	-	-	100 ^A	-	-	100 ^A	-	-	84 ^B	8	8	32 ^C	60	8	- ^D	78	22	-	60	40 ^B	-	40	60 ^B
6	100 ^A	-	-	100 ^A	-	-	100 ^A	-	-	72 ^C	24	4	4 ^D	92	4	- ^D	76	24	-	60	40 ^B	-	40	60 ^B
24	100 ^A	-	-	60 ^C	36	4	72 ^B	24	4	20 ^D	72	8	- ^E	84	16	- ^D	68	32	-	48	52 ^A	-	28	72 ^A

H = Healthy plants

uh = desiccation of plant material with some regrowth

D = Dead plants

¹ Working down the columns of figures, those sharing a common letter are not significantly different ($P > 0.001$)

Some workers have reported that a 6-8 hour rain-free period is needed before enough active ingredient penetrates to give acceptable performance of glyphosate (Grossbard and Atkinson 1985). The physiological and environmental conditions during the period between herbicide application and onset of rain are critical. It is likely that any factor that slows entry of glyphosate into the plant will prolong the vulnerability of the glyphosate treatment to rainfall in the post application period.

Manipulation of the spray formulation by adding Silwet M appears to reduce the risk of diminished glyphosate activity.

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