IMPROVED GRASS CONTROL BY GLYPHOSATE USING AMMONIUM SULPHATE OR SURFACTANT

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SUMMARY

Glyphosate (commerical formulation containing surfactant) alone at 0.54 and 1.08 kg ai/ha, and with ammonium sulphate (AS) at 5 kg/ha or non-ionic surfactant (0.5% V/V) was applied on 11 occasions in the spring of 1980 and 1981 to grass dominant pastures containing perennial ryegrass (*Lolium perenne*) and other grasses. Grass control was positively correlated with the degree of necrosis 2 and 4 weeks after application. Control of grasses was variable suggesting temporary tolerance to glyphosate can occur. AS enhanced the phytotoxicity of glyphosate especially at the high rate. The surfactant significantly enhanced glyphosate phytotoxicity at both rates and was on average more effective than AS.

INTRODUCTION

Glyphosate at rates of 0.5 to 1.0 kg ai/ha normally controls perennial ryegrass. However, tolerance to glyphosate at rates of 1.0 to 2.0 kg ai/ha, occurs in ryegrass between late August and early November, developing in the lower North Island first and later in the South Island, and lasts up to 1 month in any region (G.C. Atkinson pers comm). It is thought that the temporary tolerance is due to reduced absorption of glyphosate by the plant.

A number of reports suggest that ammonium sulphate (AS) can enhance glyphosate activity (Turner and Loader 1980; O'Sullivan *et al* 1981; Sharma and Sundar 1981), although Moshier (1980) reported no response. Surfactant (additional to that formulated with commerically available glyphosate) can also enhance the phytotoxicity of glyphosate (Coupland and Peabody 1981; O'Sullivan *et al* 1981; Troutman *et al* 1981).

METHOD

The phytotoxic effects of glyphosate with AS or additional surfactant applied to ryegrass pastures at different dates in spring was determined in two experiments established at Grasslands Division, Palmerston North in 1980 and 1981. In each year the areas sprayed at different dates were adjacent to each other, and within each area the treatments were applied in three randomised blocks. Treatments included glyphosate as the isopropylamine salt (Roundup) alone at 0.54 and 1.08 kg ai/ha, and with additives, either ammonium sulphate (analytical grade 99.5% pure), or with non-ionic surfactant containing nonylphenyl ethoxylates (Agral LN) at 0.5% V/V.

Plots were visually scored for necrosis at two-week intervals after spraying. Twelve weeks after spraying, one (1980) or two (1981) 0.23m^2 quadrats were cut from each plot and the dry matter yield and botanical composition determined.

1980 Experiment

Each block was split as either mown to 5 cm 2 weeks before spraying or left unmown from 5 August. Treatments were applied to plots 1.5 x 2.5 m on five occasions at 14 day intervals from August 18 to October 13, in 260 litres water/ha at 220 kPa. AS was added at 3 kg/ha on August 18, and at 5 kg/ha on subsequent dates. The pasture comprised ryegrass 46%, other grasses (predominantly *Poa annua*) 41%, white clover (*Trifolium repens*) 7% and broadleaf species (*Bellis perennis, Mentha pulegium*) 6%.

1981 Experiment

All plots were sprayed on July 1 with dicamba at 0.4 kg ai/ha to control white clover. Twelve to 16 days before the plots were sprayed with glyphosate they were grazed with sheep to a height of 3 cm. Glyphosate was applied on six occasions at 13 to 20 day intervals from August 25 to November 12. Treatments included an unsprayed control. The treatments were applied in 200 litres/ha water at 220 kPa, to plots 1.5 x 4m.

The pasture had been established 4 years previously with 'Grassland Nui' perennial ryegrass. It comprised ryegrass 72%, other grasses (predominantly *Agrostis*) 16%, legumes 4% and broadleaf species 8% (including *Mentha pulegium, Bellis perennis* and *Gnaphalium* sp).

RESULTS AND DISCUSSION

In these experiments, at 12 weeks after spraying with glyphosate, visually acceptable grass control was achieved on plots where grass dry matter yields were less than 1100 kg/ha. In both years the control of grasses was significantly better with the higher rate of glyphosate (Table 1).

TABLE 1: Dry matter yields of all grasses and ryegrass 12 weeks after glyphosate treatment applied.

Glyphosate Rate kg ai/ha	kg/ha			
	1980		1981	
	all grass	ryegrass	all grass	ryegrass
0.54	1530	1120	1630	1480
1.08	920	720	530	490
LSD 5%	70	52	248	215

In both experiments, within 2 weeks of spraying necrosis of grasses had begun. Regrowth from partially necrotic tillers occurred 4-6 weeks after spraying and the amount of regrowth on each plot was closely correlated ($r = 0.71$ to 0.94) with the degree of necrosis that occurred at 2-4 weeks after glyphosate application. Thus in plots where grasses developed mild necrosis (yellow coloured) more regrowth occurred than where grasses were very necrotic (orange-brown).

TABLE 2: Dry matter yields (kg/ha) of all grasses and ryegrass averaged over all glyphosate treatments 12 weeks after application and in parenthesis as percent reduction in dry matter (1981 Experiment).

Application Date 1981	All grass		Ryegrass	
	untreated	treated	untreated	treated
August 25	6160	1850 (70)	5630	1620 (71)
September 8	4850	1070 (78)	4160	1020 (75)
September 21	4610	2180 (53)	3560	1580 (56)
October 9	3270	910 (72)	2290	750 (67)
October 29	1730	1100 (36)	1550	830 (46)
November 12	1050	560 (47)	960	460 (52)

There were no significant differences between mown and unmown treatments in spring 1980. In 1981 the amount of grass growth in untreated plots declined with each subsequent application date (Table 2). However, the growth on glyphosate plots varied,

most grass regrowth occurring after early to mid September applications in spring 1980 (Fig. 1) and mid September in 1981 (Table 2). The failure of glyphosate to control grasses adequately at all dates is evidence that grasses can exhibit temporary tolerance to glyphosate and support observations made in previous seasons.

The significant regrowth of grasses on September 21, 1981 (Table 2) was not associated with rain reducing herbicide activity as no rain fell in the period 6 h before to 18 h following application. At the site, elongation of the reproductive stem of ryegrass occurred in mid September. Maximum grass regrowth following glyphosate application coincided with stem elongation of ryegrass, but there is no proof that stem elongation causes tolerance.

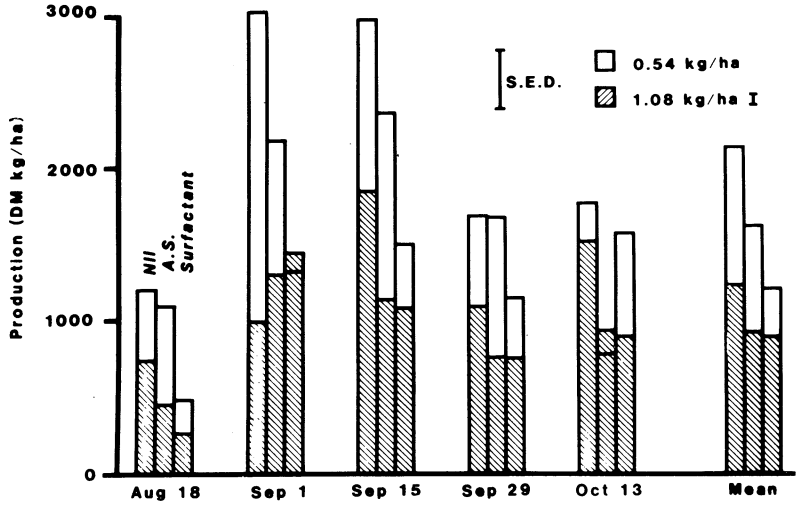

Fig. 1: Effect of glyphosate without additive (Nil) and with ammonium sulphate (AS) and non-ionic surfactant on dry matter yield 12 weeks after treatment for all grasses.

Both additives enhanced the phytotoxicity of glyphosate to grasses. However, the effect of the two additives varied during the season. At the low glyphosate rate the control of grasses with AS was significantly better than with no additive on 3 out of 5 applications, and significantly poorer than surfactant on 4 out of 5 applications (Fig. 1). However, at the higher glyphosate rate AS was significantly poorer than surfactant only on August 18, 1980. Both AS and surfactant were proportionately more effective at the lower glyphosate rate. This is similar to a previous report where AS enhanced the activity of glyphosate applied at 0.42 and 0.84 kg ai/ha, but not at 1.26 kg ai/ha (Sharma and Sundar 1981).

TABLE 3: Dry matter yields of all grasses and ryegrasses averaged over six applications (1981 experiment).

Treatment	kg/ha rate	all grass	ryegrass
untreated	—	3610 a	3030 a
glyphosate	0.54	1630 b	1450 b
glyphosate + surfactant	0.54	1180 c	1010 c
glyphosate	1.08	530 d	480 d

In spring 1980 the addition of surfactant to the low rate of commercial glyphosate resulted in grass control similar to that from doubling the rate of glyphosate (Fig. 1). However, in spring 1981, although surfactant significantly increased the phytotoxicity of the low rate of glyphosate, doubling the rate of glyphosate was more effective (Table 3).

In general better control of regrowth is also obtained by applications made in late spring (October in the lower North Island) than at earlier times (Table 2, Fig. 1).

The results from both years suggest that grass control by spring applications is improved by increasing the rate of glyphosate used, and by adding non-ionic surfactant or AS. The price in March 1983 for glyphosate was $72/kg; for ammonium sulphate $0.35, $9, and $33/kg respectively for fertiliser, technical and analytical grades; and for non-ionic surfactant $1.40/litre. In this trial analytical grade of AS was used and the effectiveness of lower grades is not known. However, even if fertiliser AS is effective the cost/ha would be similar to that of the surfactant used in these experiments. The use of extra surfactant has a low cost/ha and will increase the reliability of grass control from spring applications of glyphosate.

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