Control of winter weeds with glyphosate prior to direct drilling of winter cereals in Victoria

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SUMMARY

Seven field experiments were conducted in the southern Wimmera and Western District region of Victoria to determine the suitability of glyphosate as an aid to zero-tillage establishment of wheat and oats. Pre-sowing application of 0.50 - 0.75 kg ae/ha glyphosate resulted in control of *Lolium rigidum*, *Cryptostemma calendula*, *Hordeum leporinum* and *Erodium* sp. which was equivalent to that achieved by conventional pre-sowing cultivation techniques. Emergence, tillering and yields of direct drilled oat crops were within 75% of the conventionally sown crops. This study indicates that zero-tillage winter cropping following the use of glyphosate for pre-sowing weed control is feasible in these areas.

INTRODUCTION

Control of weeds by means of conventional cultivation prior to planting wheat, oats or barley in the higher winter rainfall areas (500 to 700 mm) of the southern Wimmera and Western District region of Victoria is not always desirable or possible. Early seed-bed preparation results in reduced utilization of pastures for grazing and in some years when there is a predominantly wet start to the season it is not possible to cultivate.

The purpose of this study was to determine the feasibility of an alternative winter crop establishment system for these areas. The alternative technique proposed is to control existing weed growth in mechanically undisturbed stubble or pasture situations with glyphosate and sow the crop directly with a triple disc system or other suitable zero-tillage planting device.

MATERIALS AND METHODS

Seven field experiments were established throughout the southern Wimmera and Western District region in 1977. Test location, situation, crop, plot size, number of replications, treatment and sowing date are presented in Table 1.

Sites were grazed prior to treatment. When regrowth had reached 4-5 cm in height glyphosate at rates of 0.125, 0.25, 0.36, 0.50 and 0.75 kg acid equivalent (ae) per ha was applied in 80-120 ℓ of water per ha. Untreated control strips were left between each plot.

Following application of herbicide treatments these experiments were sown by means of a triple disc drill. In experiments A, B, D, E and G it was possible to also obtain replicated crop yields from adjacent conventionally sown crops. All experiments were conducted according to a randomized block design.

Table 1. Location, situation, crop, plot size, number of replications, treatment date and sowing date for seven experiments

Experiment designation	Location	Situation	Crop	Plot size (m)	Replications	Treatment date	Sowing date
A	Haven	pasture to crop	Oats cv Swan	5.5 x 100	4	17/6/77	20/6/77
B	Mockinya	pasture to crop	Oats cv Coolibah	4.0 x 25	4	10/6/77	22/6/77
C	Mockinya	crop to crop	Wheat cv Zenith	4.0 x 30	2	14/6/77	22/6/77
D	Goroke	crop to crop	Wheat cv Egret	5.0 x 30	2	14/6/77	28/6/77
E	Hamilton	pasture to crop	Oats cv Swan	6.0 x 50	2	9/6/77	23/6/77
F	Lake Bolac	pasture to crop	Wheat cv Egret	5.0 x 30	2	16/6/77	14/7/77
G	Lake Bolac	crop to crop	Oats cv Swan	5.0 x 30	4	16/6/77	12/7/77

Weed control ratings were made 2 and 4 weeks after application. All ratings were visually estimated using a scale of 0 for no control and 100 for complete control when compared to an adjacent untreated control strip.

Crop ratings were made approximately 3 weeks after sowing, at tillering and at harvest. Crop establishment ratings were done by counting the number of plants emerged per metre of row length. Tillering assessments consisted of counting tillers per plant. Yields were determined by harvesting with a Poynter plot harvester. All crop measurements were subsampled four times within each replication.

RESULTS AND DISCUSSION

Average percent control of Wimmera ryegrass (*Lolium rigidum* Gaud.), capeweed (*Cryptostemma calendula* Druce.), barley grass (*Hordeum leporinum* Link.) and *Erodium* sp. is illustrated in Figure 1. After 2 weeks, browning of the foliage and general wilting of the treated plants was evident in all glyphosate treated plots. Four weeks after treatment the visible effects had stabilized and the maximum percent control was measurable. Subsequent observations indicated little change in all experiments except F where subsequent germinations and regrowth of ryegrass after 6 to 8 weeks invaded the entire area to the extent where the crop could not compete.

The average percent control of these four species increased with rate of glyphosate applied from 0.125 to 0.50 kg ae/ha. The weed control from applications of 0.50 and 0.75 kg ae glyphosate per ha averaged 90 to 97% which compared favourably with 88 to 97% average control resulting from conventional cultivation (Figure 1).

The speed of visible response to glyphosate treatment was faster for Wimmera ryegrass and barley grass than for capeweed or *Erodium*. After 14 days barley grass treated with 0.50 kg ae/ha glyphosate exhibited 85% of the result that was visible after 30 days. Wimmera ryegrass exhibited 62%; capeweed, 45%; and *Erodium*, 42%.

The only species present which exhibited tolerance to glyphosate at 0.125 to 0.75 kg ae/ha was subterranean clover (*Trifolium subterraneum*). Glyphosate treatment gave 8 to 27 % average control compared to 95% average control in the conventional cultivated situation.

Crop emergence counts and tillers per crop plant (Table 2) did not differ significantly ($P<0.05$) between any of the glyphosate treated plots and the conventionally cultivated areas. Neither wheat nor oats was able to establish well when direct drilled into untreated control plots. These data indicate that glyphosate has no adverse effects on either emergence or tillering of crop plants.

Full yield data for wheat were available from experiments C and D and for oats from A, B and G (Table 3). The plots of experiment E were lost due to the farmer harvesting the area before it was sampled. Additional yield data were available from the perimeter areas of experiments B and E which were treated with 0.36 kg ae/ha glyphosate prior to sowing. Yields in these areas were also determined by replicated samples. The perimeter of experiment B yielded 2200 kg/ha oats and that of experiment E

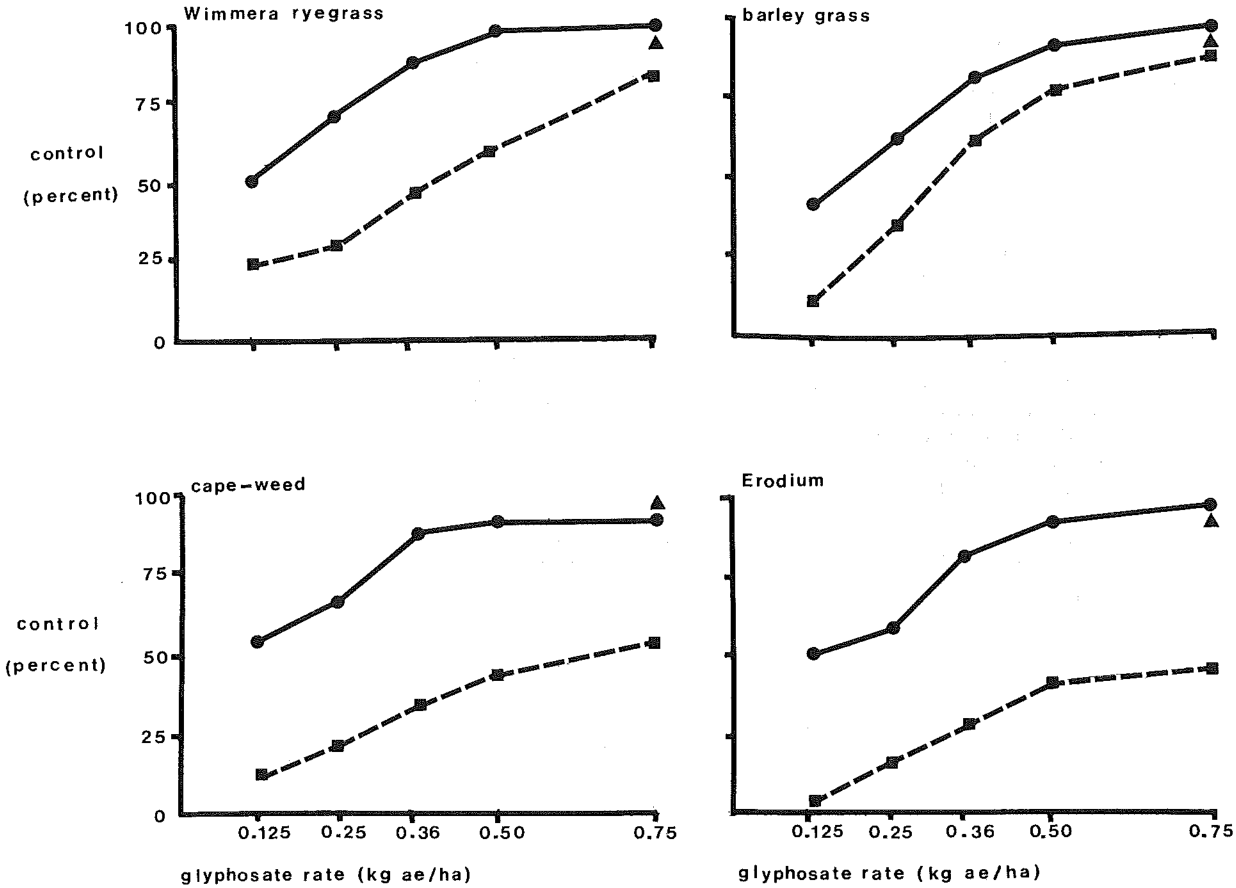

Figure 1. Average percent control of Wimmera ryegrass, barley grass, capeweed and erodium 2 weeks (– – –) and 4 weeks (—●—) after treatment with glyphosate compared to average percent control from conventional cultivation (▲).

Table 2. Crop emergence and tillers per plant for wheat and oats

Pre-sowing treatment	WHEAT Average No. of plants/m of row	WHEAT Average No. of tillers/ plant	OATS Average No. of plants/m of row	OATS Average No. of tillers/ plant
Glyphosate				
0.125 kg ae/ha	15.6	2.1	13.6	3.3
0.25	13.7	1.9	15.4	3.3
0.36	15.8	2.6	15.8	3.6
0.50	17.2	2.5	16.5	3.8
0.75	17.1	2.3	15.4	3.5
Conventional cultivation	17.4	5	20.9	3.8
Untreated (direct drilled)	1.5	0	8.7	0

900 kg/ha. The conventionally cultivated crop adjacent to Experiment E yielded 1100 kg/ha.

Trial C did not have a conventionally sown crop for comparison as the entire paddock was direct drilled.

Yields of both wheat and oats were affected by the general dry growing conditions which existed during the growing season throughout the southern Wimmera (experiments A to D). In the Western District region (experiments E to G) the dry conditions were broken once by a heavy rainfall period (125 to 225 mm) during July. This rainfall contributed substantially to the loss of the wheat crop to Wimmera ryegrass competition in experiment F. The Wimmera ryegrass recovered from the waterlogged soil conditions that resulted whereas the crop did not.

The yield data for wheat in these experiments (Table 3) is less convincing than that for oats. The only significant difference ($P<0.05$) in the wheat yields was in experiment D where the conventionally cultivated area out-yielded all glyphosate direct drilled plots.

The effect of plot size should not be underestimated even though large scale glyphosate treated direct drilled areas were not available for wheat in the study area.

In the northern Wimmera at Warracknabeal under very dry conditions an experiment demonstrated that wheat yields averaged 150 kg/ha in plots that were direct drilled following glyphosate treatment at 0.36 kg ae/ha. The perimeter of this experiment treated at the same rate averaged 200 kg/ha and the conventionally cultivated and sown area averaged 230 kg/ha.

Table 3. Yield of wheat and oats for direct drilled plots and adjacent conventionally sown areas

	WHEAT kg/ha		OATS kg/ha		
Experiment	C	D	A	B	G
Treatment glyphosate					
0.125 kg ae/ha	70	130	380	-	200
0.25	190	290	610	1100	1000
0.36	210	360	820	1100	1100
0.50	410	380	990	-	1200
0.75	290	490	1170	1400	1200
Conventional cultivation	-	1840	1150	2400	1600

Yield data for oats in experiment G showed a significant difference ($P<0.05$) between the low rate treatment (0.125 kg ae/ha) and conventional cultivation. Results for experiments A and B did not differ significantly.

In both the wheat and oats experiments a trend of increased yields with increasing rates of applied glyphosate was noted. This suggests a relationship between degree of weed control, treatment rates and resultant yield despite the lack of statistical significance.

Further investigations are being done to determine the minimum plot size which will yield comparable to large scale sowing when harvested in the same manner.

These data clearly demonstrate that it is possible to establish and grow a crop of oats by means of direct drilling following application of glyphosate. The yields obtained are comparable to crops sown by means of conventional cultivation. Further work is being conducted to develop this technique to a commercially acceptable level.