CONTROL OF RIGID BROME (*BROMUS RIGIDUS*) IN BARLEY USING TILLAGE, TRIFLURALIN AND METRIBUZIN

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Summary. Three cultivations prior to sowing barley markedly increased rigid brome control compared to direct drilling or one cultivation, in three trials. In the same trials trifluralin 0.4 - 0.8 kg a.i./ha was much more effective in controlling brome in direct drilled plots compared to those that had three cultivations, with one cultivation intermediate. Over five trials the level of control with trifluralin at 0.4, 0.6 and 0.8 kg/ha was 39%, 47% and 52% respectively, resulting in a 19% yield increase. Metribuzin at 0.14 and 0.22 kg a.i./ha applied under good conditions in three trials, either pre-emergence or at the 2 to 3 leaf stage of rigid brome, resulted in 48% and 63% control respectively, and 64% and 84% yield increases respectively. Rigid brome rapidly increased in resistance to metribuzin applied beyond the 2 to 3 leaf stage.

INTRODUCTION

In South Australia rigid brome (*Bromus rigidus* Roth) is a problem in cereal cropping on sandy soils in areas of the mid-North and South East. The efficacy of chemical control of annual broadleaf weeds, annual ryegrass and wild oats, and the trend towards minimum tillage have exacerbated the problem by increasing selection pressure for species such as *Bromus* that survive these management measures. Other *Bromus* spp. occur relatively commonly in South Australia, particularly *B. diandrus* Roth, *B. rubens* L. and *B. mollis* L. *B. rigidus*, in our experience, is the most significant and widespread species in cereal cropping in the mid-North and South-East.

Current systems for brome grass control in cereal crops in Southern Australia rely on control in the previous season through use of a grass-selective herbicide in a grain legume crop or by spray topping in pasture; as well as on tillage and/or use of non selective herbicides prior to seeding the cereal crop.

Because *Bromus* spp. are a problem in farming systems in many areas of Southern Australia there have been active programs of research on these weeds at several centres (2). Our work has the aim of augmenting the options available for brome grass control in cereal cropping systems, by examining the effect of tillage and two herbicides commercially available in Australia that have shown significant activity against the weed in barley. Unfortunately metribuzin, at the rates that are active on brome grass, can damage wheat varieties (1) and likewise trifluralin at rates above 0.4 kg/ha. Hence the work has so far concentrated on rigid brome control in barley.

This paper presents the combined results of a number of trials that examined the effects of tillage, trifluralin and metribuzin on control of rigid brome in barley grown in the northern cereal zone of South Australia.

METHODS

Tillage/trifluralin efficacy trials. One field experiment was conducted in 1988 and two in 1989 on calcareous sand or sandy loam soils. Treatments consisted of one cultivation, three cultivations or direct drilling in combination with nil herbicide or trifluralin at 0.4, 0.6 or 0.8 kg/ha (as 1, 1.5 and 2L of a 400 g/L e.c. formulation, various brands) in a split-plot design (cultivations - main plots, trifluralin rates - sub plots) with three or four replicates. The trifluralin was incorporated by sowing, 0.19 kg/ha paraquat plus 0.11 kg/ha diquat (as 1.5L/ha Sprayseed®) was applied 5-7 days before sowing in the direct drilled plots, and cultivations were carried out using tyne scarifier equipment followed by covering harrows. All plots in each experiment were sown on the same date. Rigid brome populations were measured by counting three quadrats ($0.25m^2$) per plot 4-5 weeks after trifluralin application and crop

tolerance was assessed using the European Weed Research Council (EWRC) rating system at the same time. Crop yield was measured by harvesting 1.25m x 10m from each plot using a Hege harvester. Full site and experimental details are available from the senior author.

Trifluralin and metribuzin efficacy trials. In addition to the above trials, field experiments including trifluralin or metribuzin treatments were carried out in 1987, 1988 and 1989 on calcareous sand or sandy loam soils, utilising farmer-sown barley crops. The treatments included nil herbicide; 0.4,0.6 and 0.8 kg trifluralin/ha incorporated before or by sowing; and 0.14 and 0.22 kg/ha metribuzin (as 300 ml and 450 ml/ha Sencor® 480SC) applied post-planting pre-emergence, at the 2 to 3 leaf stage or 5 leaf stage of barley; in randomised complete block designs with three or four replicates. In the experiments involving trifluralin, rigid brome populations, crop tolerance and crop yield was assessed using the techniques stated above. In the three experiments involving metribuzin rigid brome populations were measured using one quadrat per plot with each treatment replicated six times per block in two of the experiments. Crop yield was measured by hand harvesting $1m^2$ from each plot. Full site and experimental details are available from the senior author.

Analyses and presentation of combined results. Results are expressed as percentages, as defined and shown in the tables in the following section. For the purposes of analyses of the combined results, the results of each experiment were used as replicates in two-way analyses of variance. After conversion of the results to percentages, no further transformation was necessary to normalise the data.

RESULTS AND DISCUSSION

Table 1 shows that the level of rigid brome control from three cultivations was much greater than from the direct drilled plots or those that had only one cultivation. However the table also shows that trifluralin was much more active in the direct drilled treatments than in the treatments involving three cultivations, with one-cultivation intermediate. Overall, the level of rigid brome control in the direct drilled plus trifluralin plots was similar to those that had three cultivations. We hypothesise that the trifluralin in the direct drilled plots was in contact with a higher proportion of germinating brome grass seed at toxic concentrations than in the plots that had three cultivations, because the seed was more evenly distributed through the soil profile by the three cultivations.

Table 2 shows that the increase in trifluralin from 0.4 to 0.8 kg/ha increased control by 13% but there was not a significant increase in yield . It is difficult to understand why there was not a corresponding increase in yield as the EWRC crop tolerance data from the experiments indicated that all rates were safe on barley. Rigid brome shows a staggered germination pattern in cereal crops and later germinations not controlled by trifluralin may be responsible for the lack of increased yield over the range of trifluralin rates. We conclude that, at the rates used, there is no benefit to be gained in terms of yield increase from additional trifluralin above 0.4 kg/ha, although short-term increases in control are likely. Data from other trials confirm this conclusion. Overall, our experience has been that the performance of trifluralin is erratic, varying from 3-10% in some trials to 70-80% in others, especially at 0.4 kg/ha. Until further research and experience defines conditions under which more reliable results can be achieved, we believe that it is inadvisable to recommend the use of trifluralin for rigid brome control in barley, except in direct drilled situations.

Table 1. Mean control of rigid brome using tillage and trifluralin and yield of barley (three experiments).

trifluralin (kg/ha):	Rigid brome % 0	mean 0.4,0.6,0.8	% decrease	Barley yield 0	mean 0.4,0.6,0.8	% increase
1 Cultivation + sowing	100[a]	74	26	100 [b]	125	25
3 Cultivations + sowing	63	51	12	147	167	20
Direct drilled + 0.19 kg/ha paraquat +0.11 kg/ha diquat	105	55	50	113	137	24
(lsd, P=0.05)	<	(24)	>	<	(15)	>

[a] 152 plants/m2 [b] 0.81 t/ha

Table 2. Mean control of rigid brome with three rates of trifluralin and yield of barley (five experiments).

Rate of trifluralin(kg/ha)	Rigid brome % control[a]	Yield(t/ha) % increase[a]
0.4	39	18
0.6	47	18
0.8	52	22
(lsd, P=0.05)	(4)	(N.S.)

[a] As related to the nil herbicide treatment - mean 131 plants/m^2 and 1.22 t/ha

In all trials involving metribuzin the herbicide was applied under moist topsoil conditions, which optimises activity. Table 3 shows that, beyond the 2 to 3 leaf stage, rigid brome rapidly becomes resistant to metribuzin at the rates used. Under good topsoil moisture conditions we conclude that 0.22 kg/ha metribuzin applied from post-planting pre-emergence to the 2 to 3 leaf stage of rigid brome will give a reasonably satisfactory level of control with a good yield increase in barley. No phytotoxicity problems were encountered on the light soil types with metribuzin used at 0.22 kg/ha.

Table 3. Mean control of rigid brome with two rates of metribuzin at three growth stages and yield of barley (three experiments).

Time of application (rigid brome)	Rigid brome, % control[a]		Yield, % increase[a]	
	0.14 kg/ha	0.22 kg/ha	0.14 kg/ha	0.22 kg/ha
PPPE[b]	51	63	76	79
2-3 leaf	44	62	52	89
5 leaf	18	25	33	52
(lsd,P=0.05)	(10)		(23)	

[a] As related to the nil herbicide treatment - mean 219 plants/m^2 and 0.61 t/ha.
[b] Post-planting pre-emergence

The marked increases in yields from metribuzin at both rates at the earlier stages of application are surprising compared to the relative lack of yield increase from the trifluralin treatments. This may be due to a combination of greater activity of metribuzin against germinating rigid brome and longer residual activity against later germinations. Practically all rigid brome plants that were counted in the metribuzin treatments exhibited phytotoxicity symptoms whereas the populations counted in the trifluralin treatments were relatively healthy, indicating that rigid brome was less able to compete in the early stages of crop growth when treated with metribuzin compared to trifluralin.

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