PHALARIS AND TALL FESCUE SEED PRODUCTION: VOLUNTEER CONTROL AND HERBICIDE TOLERANCE

K. REDDY, M.P. ROLSTON and W.J. ARCHIE

AgResearch, P.O. Box 60, Lincoln

ABSTRACT

Experiments in grass seed crops investigated the control of volunteers in phalaris (*Phalaris aquatica*) and tolerance of phalaris seed crops to four herbicides and tall fescue (*Festuca arundinacea*) to eight herbicides. Atrazine at 2040 g/ha gave 94% control of volunteer phalaris and both atrazine at 2040 g/ha and ethofumesate at 2000 g/ha showed good tolerance with phalaris seed yields of 760 and 750 kg/ha compared to untreated control which had a seed yield of 620 kg/ha. Tall fescue seed yields showed good tolerance to terbuthylazine at 750 g/ha, proflam at 65 g/ha, chlorpropham at 1200 g/ha, diuron at 1800 g/ha and oxyfluorfen at 288 g/ha with seed yields of 2580-2730 kg/ha compared to untreated of 2200 kg/ha. In the second year, burn treatments with metolachlor at 1920 g/ha gave 88 % volunteer control with a seed yield of 1380 kg/ha compared with untreated control of 1090 kg/ha.

Keywords: *Festuca arundinacea*, herbicide, *Phalaris aquatica*, seed, tall fescue, volunteer control.

INTRODUCTION

Phalaris (*Phalaris aquatica*) and tall fescue (*Festuca arundinacea*) are now important forage species in New Zealand agriculture because of their ability to grow well and survive in drought prone areas. Tall fescue is also an important turf grass with seed exports to the USA markets.

Phalaris and tall fescue seed crops can be harvested for six consecutive seasons under the New Zealand seed certification scheme. Volunteer crop seedlings are generally the most common weed occurring in high densities in established phalaris paddocks grown for seed because of the ease with which seedheads shatter at harvest (Reddy *et al.* 1993). Volunteer seedlings increase competition, reduce seed yields and contribute to genetic drift in the crop as they are a lower generation than the parent crop. In New Zealand many tall fescue and phalaris seed growers use atrazine to remove annual grasses, volunteer and broadleaf weed seedlings (Rolston and Archie 1990). Seed growers are concerned at the potential for herbicide residues from atrazine to affect subsequent crops, while in some areas of Canterbury, there are increasing concerns about triazine residues in soil and groundwater. In Oregon oxyfluorfen and pendimethalin have been shown to be effective alternatives to atrazine for use in tall fescue seed crops (Mueller-Warrant *et al.* 1995).

This paper reports on crop tolerance trials to determine a range of herbicides suitable for use in established phalaris and tall fescue seed crops for the control of volunteer seedlings in order to identify alternative herbicides to atrazine.

MATERIALS AND METHODS

In all trials herbicides were applied from a compressed gas backpack sprayer with a 2.0m wide boom with 4 nozzles, applying the treatments at 250 litre/ha and 200 kPa. Seedling control and crop damage were visually assessed. Dry matter and tiller densities were assessed from 0.25m² quadrats, and seed yield components were based on 20 seed heads per plot. Crops were harvested by cutting 1.0 m² quadrats from each plot which were air-dried in hessian bags before being threshed, cleaned in a screen-air separator and weighed to give seed yield. Data analysis was undertaken with Genstat.

Trial 1. *Phalaris* volunteer control and herbicide tolerance

The trial was sown in autumn 1994 with *phalaris* (*Phalaris aquatica*) cv. Grasslands Maru on Wakanui silt loam on a seed grower's farm at Lowcliff, Ashburton. The trial was conducted in 1995 on a second year crop. The residues from the first crop harvest were burnt in autumn before the application of herbicides.

Four herbicides were applied on 8 May 1995 using a factorial randomised complete block design with four replications and a plot size of 8m x 5m. The herbicide treatments and application rates used were; atrazine (Gesaprim 500) at 2000 g/ha; ethofumesate (Nortron) at 2000 g/ha; simazine (Gesatop 500) at 1800 g/ha and TCA + 2,2-DPA (Teedal) at 4410 + 770 g/ha. The crop was evaluated on 4 October and 20 December, and harvested for seed yield on 24 January 1996.

Trial 2. Tall fescue herbicide tolerance

The second and third trials were sown in 1995 with an amenity tall fescue (*Festuca arundinacea*) cv. SF19 on a seed grower's farm at Geraldine. Trial 2 was conducted in 1996/97 season on a second year crop. After the harvest of the first crop, the straw residues were bailed in summer. Eight herbicides were applied on 21 February 1996 in a factorial randomised complete block design with four replications and a plot size of 20 m². The herbicide treatments and application rates used were; atrazine at 510 g/ha, terbutylazine (Gardoprim) at 750 g/ha, prodiamine (Barricade) at 65 g/ha, chlorpropham (Chloro-IPC at 1200 g/ha, diuron (Karmex) at 1800 g/ha, metolachor (Dual) at 1920 g/ha, pendimethalin (Stomp) at 2600g/ha and oxyfluorfen (Goal XL) at 288 g/ha.

Trial 3. Tall fescue volunteer control and herbicide tolerance

The third trial was conducted in 1997/98 season on a third year crop in the same paddock as that of trial 2, after seed harvest straw residues were either bailed or burnt in summer. The three most promising herbicides were applied in February 1997, using a split plot design with main plots being either straw residue baled or burnt treatments. The herbicide treatments and application rates used were; terbutylazine at 1000 g/ha, chlorpropham at 1200 g/ha, simazine at 1020 g/ha and metolachlor at 1920 g/ha.

RESULTS AND DISCUSSION

Phalaris

Before treatment application, the average volunteer density was 1730 seedling/m². All herbicide treatments gave good to excellent control of volunteer *phalaris* seedlings with atrazine proving most effective, followed by TCA + 2,2-DPA (Table 1). However the TCA + 2,2-DPA treatment resulted in significant crop damage resulting in significantly lower dry matter and crop tiller densities in October (Table 1). Before application of treatments, the crop averaged 1570 plants/m². The crop had recovered from these effects by the December samplings (Table 1).

TABLE 1: Percentage volunteer seedling control, crop damage, dry matter and tiller population in *phalaris* treated with herbicides.

Treatment	Rate (g ai /ha)	Seedling control (%)	Crop damage (%)	Dry matter (kg/ha) ¹	Tillers (No/m ²) ¹	Dry matter (kg/ha) ²	Tillers (No/m ²) ²
Control	0	0	0	1890	4720	12940	1400
Atrazine	2000	94	8	1390	2910	15150	1480
Ethofumesate	2000	44	0	1410	3920	13310	1530
Simazine	1275	67	3	1400	3130	13890	1870
TCA + 2,2-DPA	4410 + 770	85	65	538	1030	13660	1570
LSD (<0.05)		9	1.4	134	141	1219	187

¹Sampled on 4 October

²Sampled on 20 December

Atrazine, ethofumesate and simazine treated plots had 18 %, 15 % and 14 % more seedheads than the untreated control, respectively, whereas TCA + 2,2-DPA had 4% less seedheads than the control plots (Table 2) largely due to the significant crop injury in October (Table 1). However, even with the high initial level of crop damage from TCA + 2, 2 DPA, there was no final reduction in seed yield. Seed yields of atrazine and ethofumesate were also 21 and 22% higher than the untreated control, representing an increase of between 135 and 143 kg/ha. Florets per panicle and side branches per panicle were not affected by the treatments (Table 2).

TABLE 2: Seed yield and seed head components of phalaris treated with different herbicides.

Treatment	Rate (g/ha)	Seedheads (/m ²)	Florets (/panicle)	Side branches (/panicle)	Seed yield (kg/ha)
Control		794	557	15.6	618
Atrazine	2000	938	524	18.0	761
Ethofumesate	2000	914	556	18.2	753
Simazine	1275	892	534	19.1	611
TCA + 2,2-DPA	4410 + 770	761	508	16.7	687
LSD (<0.05)		95	78	3.7	84

Tall fescue

In tall fescue, control of volunteer tall fescue seedlings and consequent removal of competition resulted in significant yield responses. The mean seed yield of the untreated control was 2200 kg/ha. Five herbicides resulted in significantly higher seed yields (average 2660 kg/ha) than either the untreated control or atrazine (Table 3). Tall fescue had good tolerance to prodiamine, chlorpropham, diuron, terbuthylazine and oxyfluorfen. These results show that atrazine could be replaced with other herbicides to achieve the same or even better results.

TABLE 3: Seed yield of second year tall fescue treated with different herbicides.

Herbicide	Rate (g ai/ha)	Seed yield (kg/ha)
Untreated control	0	2200
Atrazine	510	2150
Prodiamine	650	2710
Chlorpropham	1200	2700
Diuron	1800	2580
Metolachor	1920	2410
Terbuthylazine	750	2730
Oxyfluorfen	288	2580
Pendimethalin	2600	2360
LSD (<0.05)		350

In the third year tall fescue seed crop, volunteer control tended to be higher in baled plots, while seed yields from burnt plots tended to be higher. This suggests that carbon from the burning may have partially inactivated the herbicides (Rolston *et al.* 1979) (Table 4). Seed yields were lower than the previous year because of drought conditions.

TABLE 4: Tall fescue volunteer seedling control and seed yields (kg/ha) where straw was burnt or baled after harvest, and before herbicide application.

Treatments	Rate	Volunteer Control (%)		Seed Yield	
		Burnt	Baled	Burnt	Baled
untreated control	0	21	0	1090	920
Chlorpropham + simazine	1200 + 1020	69	86	1160	1040
Metolachlor	1920	88	88	1380	990
Terbuthylazine	1000	50	78	1120	1090
LSD (<0.05)		23		172	

CONCLUSION

In multi-year harvest seed crops of established phalaris and tall fescue, volunteer crop seedlings establishing from seed lost during harvest was reduced by 70-90% with herbicides with little crop damage. The herbicides evaluated all showed reasonable to good control of volunteers, thus reducing the potential for genetic drift during the different generations grown during multiplication of a cultivar. In phalaris, the best herbicide treatment (increased seed yield and volunteer control) was atrazine followed by ethofumesate. In tall fescue, chlorpropham, metolachlor, terbuthylazine, diuron and proflaminate all showed promise with reasonable volunteer control, although seed yields were often similar to the untreated control. The herbicide treatments often (but not always) enhanced seed yield, and this increase was generally associated with more seed heads and/or a reduction in seedling volunteers. The trials demonstrated that several herbicides can be used as alternatives to atrazine, especially in tall fescue. Alternative non-triazine herbicides would include chlorpropham, diuron, metolachlor and oxyfluorfen. However all the non-triazine alternatives are more expensive than atrazine, but could be used where atrazine residues are of concern.

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