Effect of combinations of sowing time, seed rate and herbicides on brome grass management in wheat (Farrell Flat, SA)

Key messages

- Brome grass panicle density was significantly influenced by the time of sowing of wheat (P=0.034) and herbicide treatments (P<0.001). Three week delay in sowing reduced brome grass panicles from 538 panicles/m^2 in TOS 1 to 321 panicles/m^2 in TOS 2 (40% reduction).
- The trends observed in brome grass panicle density were reflected in its seed production. The delay in crop sowing resulted in 21% reduction in brome seed set with 7392 seeds/m^2 in TOS 1 as compared to 5807 seeds/m^2 in TOS 2 (P=0.025). Rexade provided significantly better seed set reduction (62%) in brome than Trifluralin + Avadex Xtra but was inferior to the Intervix treatments (91-94% reduction).
- Three week delay in sowing at this site resulted in 29% higher wheat grain yield in TOS 2 (2.198 t/ha) than in TOS 1 (1.703 t/ha). This improvement in wheat yield by delayed crop sowing was associated with 84% reduction in brome plant density in TOS 2 compared to TOS 1.
- Trifluralin + Avadex Xtra, used in this trial as the control, produced 1.439 t/ha wheat yield, which was a reflection of its low efficacy against brome grass. Rexade, which only had a moderate efficacy on brome, increased wheat grain yield by 45% compared to Trifluralin + Avadex Xtra. The highest wheat yield and the lowest weed seed set in this trial was observed where Intervix post-emergent was used after pre-emergent application of Trifluralin + Avadex Xtra (2.214 t/ha).

Background

Brome grass (*Bromus diandrus*) is a major problem on sandy textured soils in southern and Western Australia, reducing revenue for grain growers of $22.5m each year (Llewellyn et al 2016). Brome grass is one of the most competitive weeds, with an aggressive root system removing nitrogen, phosphorus and moisture from the soil that would otherwise be used by the crop. When developing management plans for brome grass, it is important to consider control options over at least three seasons (Kleemann and Gill 2009), including crop type, variety, herbicides, crop competition, harvest weed seed control and fallow management.

A field trial was undertaken in 2021 at Farrell Flat in SA to investigate the effects of time of sowing, crop plant density and herbicide treatments on brome grass control in wheat. Hammer CL Plus was selected for this trial because Clearfield® crops provide an excellent opportunity to achieve selective control of brome grass in wheat.

Methods

This field trial was established in a split plot design and investigated combinations of the wheat sowing time, seed rate and herbicides for brome grass control.

Table 1. Management details.

Operation	**Details**
Location	Farrell Flat, SA
Seedbank soil cores	April, 2021

Plot size	1.8 m x 10 m
Seeding date	TOS 1: 28 May 2021; TOS 2: 21 June 2021
Seeding rate	100, 150 and 200 seeds/m^2
Herbicide treatments	1. Knockdown only (glyphosate 540 g/ha) at 2 L/ha 2. Rexade 100 mL/ha at brome GS11-14 3. Intervix 750 mL/ha at GS13 4. Trifluralin (480 g/L) at 2 L/ha + Avadex Xtra 2 L/ha Fb Intervix 750 mL/ha at GS 13
Replicates	3
Variety	Hammer CL Plus
Seeder	Knife points, press wheels, 22.5cm row spacing

All data collected during the growing season was analysed using the Analysis of Variance function in GenStat version 20.0.

Measurements: pre-sowing weed seedbank, crop density, weed density, brome panicle density, brome seed production, wheat grain yield.

In 2021 autumn rainfall at Farrell Flat was well below the long-term average. In April, the site only received 2.6 mm rain as compared to the long-term average of 32.8 mm. The dry weather continued through the first 3 weeks of May which received only 10.6 mm rain. However, good rainfall was received on 25-26 May (20 mm), which created suitable soil moisture conditions for sowing the crop on 28 May. However, dry soil conditions right up to crop sowing meant there was very little brome grass establishment for the knockdown herbicide treatment in TOS 1. Good rainfall continued through June and July which were well above the long-term average. Rainfall in spring (Sep – Oct) was below average, but November received much higher rainfall than the average for the site. However, the crop had reached maturity by November and is unlikely to have taken advantage of this late rainfall.

Table 2. Rainfall received at Farrell Flat in 2021 and the long-term average for the site.

	Rainfall (mm)	
Month	**2021**	**Long-term average**
Jan	8.4	22.8
Feb	4.6	20.3
Mar	13.2	18.4
Apr	2.6	32.8
May	31.0	50.5
Jun	68.8	58.1
Jul	116.2	58.2
Aug	50.8	61.2
Sep	20.6	53.0
Oct	28.6	43.0
Nov	86.0	27.9
Dec	5.6	25.9

Annual total	436.4	471.4
GSR total	318.6	356.8

Results and Discussion

Wheat plant density

As expected, wheat plant density was significantly (P<0.001) affected by wheat seed rate. Crop density ranged from 107 plants/m^2 at 100 seeds/m^2 to 166 plants/m^2 at 200 seeds/m^2. Wheat plant density achieved in this trial was suitable for achieving high yields and good competitive effects on brome grass.

Brome grass panicle density

This trial site had a large seedbank of brome grass (6642 ± 295 brome seeds/m^2), which was reflected in brome grass plant densities of >1000 plants/m^2 in ineffective herbicide treatments such as Trifluralin + Avadex Xtra. Brome grass panicle density was significantly influenced by the time of sowing of wheat (P=0.034) and herbicide treatments (P<0.001). Three week delay in sowing reduced brome grass panicles from 538 panicles/m^2 in TOS 1 to 321 panicles/m^2 in TOS 2 (40% reduction). Herbicide treatments also had a significant effect on brome panicle density (P<0.001; Table 3). Pre-emergent treatment of Trifluralin + Avadex Xtra (control) was the least effective option for brome grass control with 803 panicles/m^2. Post-emergent Intervix after pre-emergent Trifluralin + Avadex Xtra reduced brome panicle density by 82% (141 panicles/m^2) as compared to the control. Application of Intervix post-emergent was unable to prevent brome grass from producing panicles (Table 3), which is different from other trials undertaken in this project. Lower efficacy of Intervix in this trial than observed in other trials may be related to extremely high brome plant density at this site and possibly from a short delay in spraying due to COVID related lockdown.

Table 3. Effect of herbicide treatments on brome grass panicle density. Means followed by different letters represent significant differences (P=0.05).

Herbicide treatment	**Brome grass panicles/m^2**
Trifluralin 2 L/ha + Avadex Xtra 2 L/ha	803 c
Rexade 100 mL/ha at GS13 brome	554 b (31%)[1]
Intervix 750 mL/ha at GS13 brome	221 a (72%)
Trifluralin 2 L/ha + Avadex Xtra 2 L/ha Fb Intervix 750 mL/ha at GS13 brome	141 a (82%)
P	<0.001

[1] Values in brackets are % seed set reduction relative to Trifluralin + Avadex Xtra treatment.

Brome grass seed production

The trends in brome grass panicle density were reflected in its seed production. The delay in crop sowing resulted in a 21% reduction in brome seed set with 7392 seeds/m^2 in TOS 1 as

compared to 5807 seeds/m^2 in TOS 2 (P=0.025). It is interesting to note that delay in crop sowing reduced brome seed set by 21% as compared to 40% reduction in brome panicle density.

Brome grass seed production was significantly influenced by the herbicide treatments (P<0.001). As seen previously for brome panicle density, Trifluralin + Avadex Xtra was the least effective treatment, which allowed a large build-up in brome seedbank (Table 4). Rexade provided significantly greater seed set reduction (62%) than Trifluralin + Avadex Xtra but was inferior to the Intervix treatments (91-94% reduction). However, brome seed set of 965-1635 seeds/m^2 in Intervix treatments would allow reinfestation in crops sown over the next 2-3 seasons. Therefore, effective management of large infestations such as that present at the trial site would need a multi-year plan.

Table 4. Effect of herbicide treatments on brome grass panicle density. Means followed by different letters represent significant differences (P=0.05).

Herbicide treatment	**Brome grass seeds/m^2**
Trifluralin 2 L/ha + Avadex Xtra 2 L/ha	17295 c
Rexade 100 mL/ha at GS13 brome	6503 b (62%)[1]
Intervix 750 mL/ha at GS13 brome	1635 a (91%)
Trifluralin 2 L/ha + Avadex Xtra 2 L/ha Fb Intervix 750 mL/ha at GS13 brome	965 a (94%)
P	<0.001

[1] Values in brackets are % seed set reduction relative to Trifluralin + Avadex Xtra treatment.

Wheat grain yield

Three week delay in sowing at this site resulted in 29% greater wheat grain yield in TOS 2 (2.198 t/ha) compared to TOS 1 (1.703 t/ha). This improvement in wheat yield by delayed crop sowing was associated with reduced weed competition due to 84% reduction in brome plant density in TOS 2 compared to TOS 1.

Trifluralin + Avadex Xtra used in this trial as the control produced 1.439 t/ha wheat yield, which was a reflection of its low efficacy against brome grass (Table 5). Rexade, which only had moderate efficacy on brome (Table 4), increased wheat grain yield by 45% as compared to Trifluralin + Avadex Xtra. The highest wheat yield and the lowest weed seed set in this trial was observed where Intervix post-emergent was used after pre-emergent application of Trifluralin + Avadex Xtra (2.214 t/ha). Even though Rexade provided good yield improvement in this trial, seed set of brome in this treatment was significantly greater than the Intervix treatments.

Wheat grain contamination

Brome seed contamination of wheat grain (brome seeds/kg wheat) was significantly influenced by time of sowing (P=0.006, transformed data) and herbicide treatment (P<0.001). There was a significant interaction between time of sowing and herbicide treatment on grain contamination (P=0.002) (Table 7). Delayed seeding of wheat reduced brome contamination especially in Trifluralin + Avadex Xtra (50%) and Rexade (91%)

treatments. However in the Intervix treatments, time of sowing did not significantly reduce brome contamination as the herbicide treatment was highly effective at controlling brome at both seeding times.

Table 5. Effect of herbicide treatments on wheat grain yield. Means followed by different letters represent significant differences (P=0.05).

Herbicide treatment	**Wheat grain yield (t/ha)**
Trifluralin 2 L/ha + Avadex Xtra 2 L/ha	1.439 b
Rexade 100 mL/ha at GS13 brome	2.083 a (45%)[1]
Intervix 750 mL/ha at GS13 brome	2.066 a (44%)
Trifluralin 2 L/ha + Avadex Xtra 2 L/ha Fb Intervix 750 mL/ha at GS13 brome	2.214 a (54%)
P	<0.001

[1] Values in brackets are % in grain yield relative to Trifluralin + Avadex Xtra treatment.

Table 7. Interaction between time of sowing and herbicide treatment on grain brome contamination. Means followed by different letters represent significant differences (P=0.05, transformed data).

Herbicide treatment	**Brome contamination *(brome seeds / kg grain)***	
	TOS 1	**TOS 2**
Trifluralin 2 L/ha + Avadex Xtra 2 L/ha	11382 c	5738 b
Rexade 100 mL/ha at GS13 brome	4057 b	384 a
Intervix 750 mL/ha at GS13 brome	74 a	22 a
Trifluralin 2 L/ha + Avadex Xtra 2 L/ha Fb Intervix 750 mL/ha at GS13 brome	262 a	0 a
P	0.002	