Effect of combinations of sowing time, seed rate and herbicides on brome grass management in faba beans (Riverton, SA)

Abstract

A field trial was undertaken at Riverton in 2020 to investigate combinations of faba bean sowing time, seed rate and herbicide treatments to control brome grass. Three week delay in sowing caused a 95% reduction in brome grass plant density in faba beans. Riverton population of brome grass has been shown by our previous research to have a low level of seed dormancy. It appears excellent rainfall at the site in April and good follow-up rains were highly suitable for stimulating seedling emergence from the seedbank. The general trend of lower brome plant density in TOS 2 than in TOS 1 was also reflected in brome panicle density, which is the major driver of its seed production. This trend was particularly clear where only pre-emergent herbicides were used for weed control. The application of Verdict® eliminated brome panicle production and seed set. There was a significant effect of faba bean seed rate (crop density) on brome grass seed production. Increasing competition from faba beans reduced brome grass seed set by more than 50% as crop seed rate increased from 20 to 40 seeds/m^2. Faba bean grain yield was only influenced by the main factors time of sowing ($P<0.001$), seed rate ($P<0.001$) and herbicide treatments ($P=0.007$). Earlier sown faba bean produced significantly greater yield than the crop sown 3 weeks later. Faba bean seed rate also resulted in a significant increase in grain yield as seed rate increased from 20 to 40 seeds/m^2. As a result of the low brome grass density at the site, the increase in grain yield in response to weed control were small but significant ($P=0.007$). The combination of pre-emergent propyzamide followed by post-emergent application of Verdict significantly increased faba bean yield compared to pre-emergent propyzamide alone.

Introduction

Delayed sowing can provide opportunities to kill more weeds before seeding the crop but later sown crops can be less vigorous so the weeds that establish in late sown crops can be more competitive on per plant basis. This is one of reasons why farmers who have adopted early seeding have reported excellent results in crop yield and weed suppression. Therefore, it is important to investigate sowing time in combination with other practices across different rainfall zones. The review of Widderick et al. (2015) also recommended research on sowing time in many crops. Delayed sowing can also reduce crop yield so the gains made in weed control may be completely nullified by the yield penalty.

There has been some research already on crop seed rate on weed suppression but these studies have not investigated the benefits of higher crop density in factorial combinations with sowing time and herbicide treatments. Crop seed rate is an easy tactic for the growers to adopt provided they are convinced of its benefits to weed management and profitability. Furthermore, growers tend to be reluctant to increase their faba bean seed rate due to its large seed size and concerns about the negative impact of high seed rate on foliar fungal disease pressure.

This field trial was undertaken at Riverton in 2020 to investigate factorial combinations of sowing time, seed rate and herbicides on the management of brome grass in faba beans.

Methods

This field trial investigated combinations of the following management tactics.

1. **Sowing time (2)**: early May and late May
2. **Seed rate (3)**: 1x (40 seeds/m^2), 0.75x (30 seeds/m^2), 0.5x (20 seeds/m^2)
3. **Herbicides (4)**:

   (i) Simazine (900DF) 1.1 kg/ha + Trifluralin 0.8 L/ha IBS
   (ii) Simazine (900DF) 1.1 kg/ha + Trifluralin 0.8 L/ha IBS fb Verdict 75 mL/ha POST
   (iii) Propyzamide 2.0 L/ha IBS
   (iv) Propyzamide 2.0 L/ha IBS fb Verdict 75 mL/ha POST

Variety: Bendoc

Trial design: split plot design

Replicates: 4

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

Trial Management

Table 1. Key management operations undertaken.

Operation	**Details**
Location	Riverton, SA
Seedbank soil cores	April 2020
Plot size	1.5 m x 10 m
Seeding date	TOS 1: 7 May, 2020 TOS 2: 28 May, 2020
Fertiliser	At sowing – DAP (18:20:0:2) @ 120 kg/ha
Variety	Bendoc faba beans
Seeding rate	20, 30 and 40 seeds/m^2
Herbicides	Pre-Emergent herbicides 6 May and 28 May, 2020 (applied immediately before seeding IBS), Post Emergent (POST) herbicides 15 July (TOS 1) and 3 August (TOS 2). POST applied when faba beans 4-5 node and brome grass GS 13 to 24.

All data collected during the growing season was analysed using the Analysis of Variance function in GenStat version 19.0.

In 2020, annual rainfall received at Riverton was 51.8 mm below the long-term average but the growing season rainfall was only 10.1 mm below the long-term average. Rainfall received at the site in April was more than double the long-term average for the site but May and July were well below the average (Table 2). Overall it was a good growing season at Riverton for crop production.

Table 2. Rainfall received at Riverton in 2020 and the long-term average for the site.

	Rainfall (mm)	
Month	**2020**	**Long-term mean**
Jan	10.4	21.9
Feb	27.8	20.8
Mar	3.8	22.6
Apr	90.4	40.1
May	37.2	57.6
Jun	52.6	63.6
Jul	20.8	63.6
Aug	79.8	67.0
Sep	52.2	58.7
Oct	54.6	47.1
Nov	14.6	34.1
Dec	28.4	27.3
Annual total	472.6	524.4
GSR total	387.6	397.7

Results and Discussion

Faba bean plant density

As expected seed rate had a significant effect on faba bean density (P<0.001) and actual plant density exceeded target faba bean densities by 19 to 32%. Sowing time did not have a significant effect (P=0.447) on faba bean establishment. Herbicide treatments also did not influence faba bean density (P=0.305), which indicates safety of the pre-emergence herbicides used in this trial.

Brome grass seedbank and plant density

The average seedbank of brome grass at the site was 278 ± 67 seeds/m^2, which is a moderate level of infestation. The first brome grass plant density assessment, which was undertaken at 30 days after sowing and prior to the application of the post-emergence herbicides, showed a significant effect of sowing time (P<0.001). Three week delay in sowing caused a 95% reduction in brome grass plant density in faba beans (Figure 1). Riverton population of brome grass has been shown by our previous research to have a low level of seed dormancy. It appears excellent rainfall at the site in April and good follow-up rains were highly suitable for stimulating seedling emergence from the seedbank. There were no significant differences detected between the different pre-emergence herbicides at this stage (P=0.629).

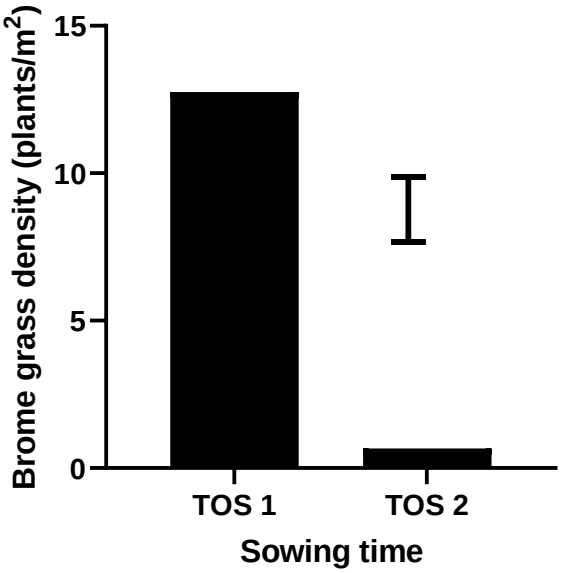

Figure 1. Effect of faba bean sowing time on in-crop brome grass density at 30 days after sowing (P<0.001). The vertical bar represents the LSD (P=0.05).

The 2nd assessment of brome grass plant density at 4 weeks after the application Verdict revealed strong interaction between the time of sowing and herbicide treatments. As shown in the previous assessment, delay in crop sowing had a significant effect on brome grass plant density. This trend can be seen very clearly for the treatments where only the pre-emergent herbicides were used (Table 3). In these treatments, TOS 2 faba beans had 90-95% less brome grass plant density than TOS 1. These results also indicate weaker performance of propyzamide on brome grass than the combination of simazine + Treflan.

Table 3. The effect of interaction between faba bean sowing time and herbicide treatments on in-crop brome grass plant (P<0.001) and panicle density (P<0.001).

Herbicide treatment	Brome grass (plants/m^2)		Brome (panicles/m^2)	
	TOS 1	TOS 2	TOS 1	TOS 2
Propyzamide	23.2	1.1	29.4	2.1
Propyzamide Fb Verdict	0.17	0.0	0.2	0.0
Simazine + Treflan	12.2	1.2	17.8	1.2
Simazine + Treflan Fb Verdict	0.17	0.08	0.0	0.0
LSD (P=0.05)	5.06		6.93	

Brome grass panicle density and seed production

The general trend of lower brome plant density in TOS 2 than in TOS 1 was also reflected in brome panicle density (Table 3), which is the major driver of its seed production. This trend was particularly clear where only pre-emergent herbicides were used for weed control. The application of Verdict® eliminated brome panicle production. The trends observed in brome grass panicle density were also reflected in its seed production, with no seed set where

Verdict was used. As group A resistance in brome grass is still fairly low (<10%), growers can make use of these herbicides to drive down its seedbank in break crops.

Table 4. The effect of interaction between faba bean sowing time and herbicide treatments (P<0.001) on brome grass seed production.

Herbicide treatment	Brome grass (seeds/m^2)	
	TOS 1	TOS 2
Propyzamide	1569	119
Propyzamide Fb Verdict	0.0	0.0
Simazine + Treflan	967	124
Simazine + Treflan Fb Verdict	0.0	0.0
LSD (P=0.05)	393	

There was significant effect of faba bean seed rate (crop density) on brome grass seed production (Figure 2). Increasing competition from faba beans reduced brome grass seed set by more than 50% as crop seed rate increased from 20 to 40 seeds/m^2. Farmers are generally reluctant to use higher seed rates of faba beans due to increased costs and the need for more frequent refilling of the seeder but the results reported here clearly show the benefits of extra weed suppression by higher crop density. There are also concerns about the increased risk of foliar diseases at the higher crop densities.

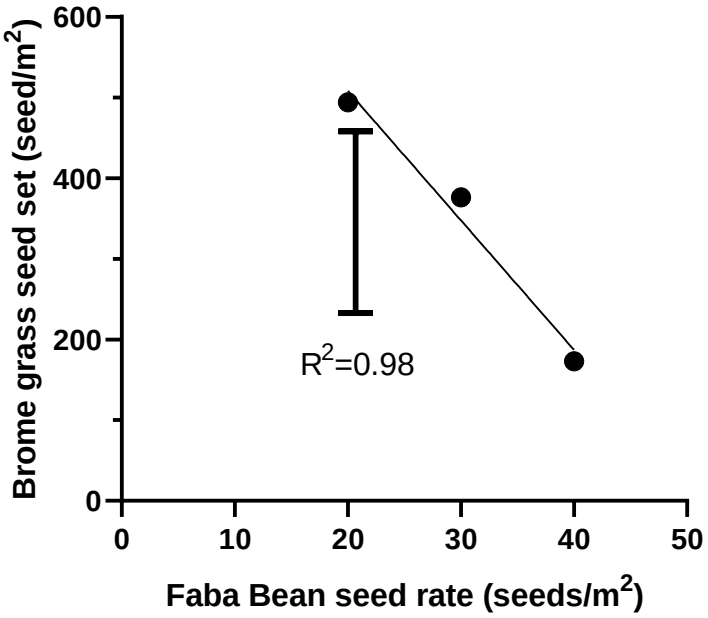

Figure 2. Effect of faba bean seed rate on brome grass seed production (P=0.03). The vertical bar represents the LSD (P=0.05).

Table 5. The effect of interaction between faba bean seed rate and herbicide treatments on brome grass seed production.

Herbicide treatment	Brome grass (seeds/m^2)		
	SR20	SR30	SR40
Propyzamide	1391	800	342
Propyzamide Fb Verdict	0	0	0
Simazine + Treflan	584	704	349
Simazine + Treflan Fb Verdict	0	0	0
P			0.038
LSD (P=0.05)			467

Faba bean grain yield

Faba bean grain yield was only influenced by the main factors time of sowing (P<0.001), seed rate (P<0.001) and herbicide treatments (P=0.007). There were no interactions detected between these management factors under investigation. Earlier sown faba bean produced significantly greater yield than the crop sown 3 weeks later (Figure 3), which was related to the differences in branching and pod set. Faba bean seed rate also resulted in a significant increase in grain yield as seed rate increased from 20 to 40 seeds/m^2 (Figure 4). As a result of the low brome grass density at the site, the increase in grain yield in response to weed control were small but significant (P=0.007). The combination of pre-emergent propyzamide followed by post-emergent application of Verdict significantly increased faba bean yield compared to pre-emergent propyzamide alone (Table 6).

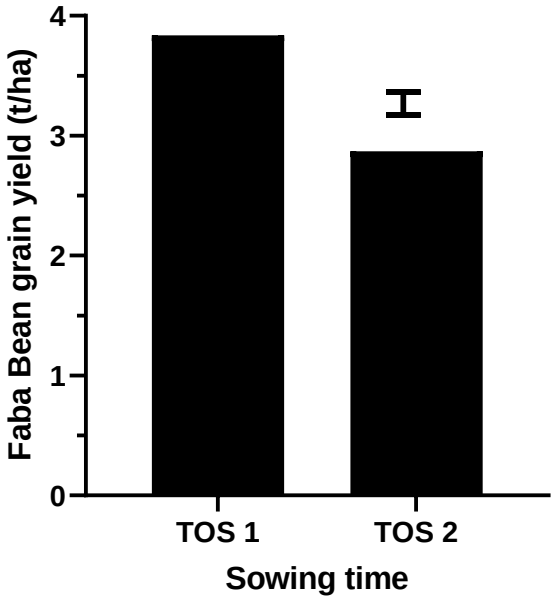

Figure 3. Effect of faba bean sowing time on grain yield (P<0.001). The vertical bar represents the LSD (P=0.05).

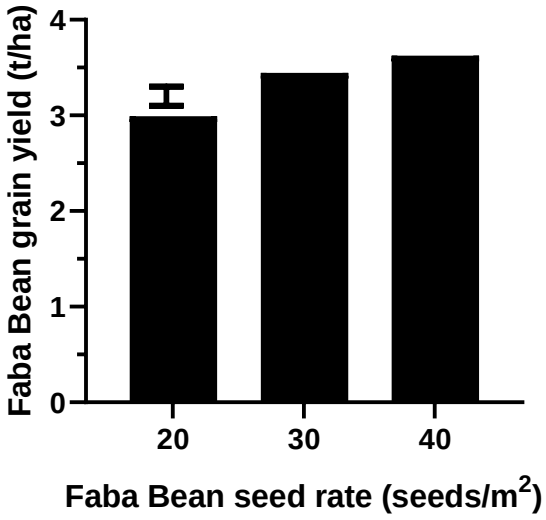

Figure 4. Effect of faba bean seed rate on its grain yield (P<0.001). The vertical bar represents the LSD (P=0.05).

Table 6. Effect of herbicide treatments on faba bean grain yield (P=0.007).

Herbicide treatment	Faba bean grain yield (t/ha)
Propyzamide	3.202
Propyzamide Fb Verdict	3.482
Simazine + Treflan	3.315
Simazine + Treflan Fb Verdict	3.416
LSD (P=0.05)	0.166