Effect of time of sowing, crop seed rate and pre-emergence herbicides on annual ryegrass management in barley (Frances, SA)

Abstract
A field trial was undertaken at Frances in 2019 to investigate combinations of barley sowing time, seed rate and herbicide treatments to control annual ryegrass. The average seedbank of annual ryegrass (ARG) at the site was quite low (472 ± 143 seeds/m^2), which was reflected in low plant density at the site. ARG plant density was significantly influenced by the time of sowing (P=0.037), and herbicide treatment (P=0.009). There was a 37% reduction in ARG plant density between TOS 1 (20 plants/m^2) and TOS 2 (13 plants/m^2). Herbicide treatment had a significant effect on ARG plant density, with Boxer Gold showing lower efficacy on ARG than Treflan and Boxer Gold + Treflan. Unlike ARG plant density, ARG spike density was not influenced by time of sowing (P=0.171). ARG spike density was significantly influenced by barley seed rate (P=0.016), herbicide treatment (P=0.01) and the interaction between TOS and herbicide treatment (P=0.019). ARG spike density was 34% and 40% lower in medium and high seed rates respectively when compared to the low seed rate. These results suggest an improvement in ARG suppression from increasing barley competiveness with increased seed rate. Barley grain yield at the site averaged 6.6 t/ha. Herbicide treatment had a small (4-6%), but significant effect (P=0.009) on grain yield with Boxer Gold < Treflan ≤ Boxer Gold + Treflan for barley yield.

Introduction

Change in sowing time can have multiple effects on crop-weed competition. Delayed sowing can provide opportunities to kill greater proportion of weed seedbank before seeding the crop but 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 none of these studies have 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 in the low rainfall areas tend to be reluctant to increase their seed rate due to concerns about the negative impact of high seed rate on grain screenings.

This field trial at Frances was undertaken to investigate factorial combinations of sowing time, seed rate and herbicides on the management of annual ryegrass in barley.

Methods

This field trial investigated combinations of the following management tactics.

1. **Sowing time (2)**: mid May and early June
2. **Seed rate (3)**: 1x (200 seeds/m^2), 0.75x (150 seeds/m^2), 0.5x (100 seeds/m^2)
3. **Herbicides (3)**:

(i) Trifluralin 2 L/ha IBS
(ii) Boxer Gold 2.5 L/ha IBS
(iii) Boxer Gold 2.5 L/ha + Trifluralin 2 L/ha IBS

Variety: RGT Planet

Trial design: split plot design
Replicates: 3

Measurements: pre-sowing weed seedbank, crop density, weed density, ARG spike density, ARG seed production, barley grain yield.

Trial Management

Table 1. Key management operations undertaken.

Operation	**Details**
Location	Frances, SA/Vic
Seedbank soil cores	15 April, 2019
Plot size	1.26 m x 8 m
Seeding date	TOS 1: 15 May, 2019 TOS 2: 3 June, 2019
Fertiliser	At sowing – 18:13:0:10 + Impact @ 115 kg/ha
Variety	RGT Planet
Seeding rate	100 seeds/m^2 150 seeds/m^2 200 seeds/m^2
Herbicides	15 May and 3 June, 2019 (applied just before seeding) Trifluralin (480 g/L trifluralin) 2 L/ha IBS Boxer Gold (800 g/Lprosulfocarb120 g/L s-metolachlor) 2.5 L/ha IBS Boxer Gold (800 g/Lprosulfocarb120 g/L s-metolachlor) 2.5 L/ha + Trifluralin (480 g/L trifluralin) 2 L/ha IBS

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

In 2019, annual rainfall received at Frances was 32% below the long-term average and the growing season rainfall was 24% below the long-term average. The rainfall received in May was greater than the long-term average with all other months being well below the long-term average (Table 2).

Table 2. Rainfall received at Frances in 2019 and the long-term average for the site.

	Rainfall (mm)	
Month	**2019**	**Long-term rainfall**
Jan	0.4	22.2
Feb	9.6	21.3
Mar	12.4	24.0
Apr	7.6	35.8
May	70.2	52.6
Jun	41.4	59.7
Jul	59.0	65.6
Aug	45.6	65.9
Sep	50.8	57.5
Oct	19.0	49.4
Nov	28.0	34.8
Dec	5.4	29.6
Annual total	349.4	518.4
GSR total	293.6	386.5

Results and Discussion

Barley plant density

Barley seed rate had a significant effect on barley plant density (P<0.001). The trial protocols used resulted in the establishment three distinct levels of barley plant density (Figure 1). All barley densities were higher than targeted seed rate due to a conservative field factor being used.

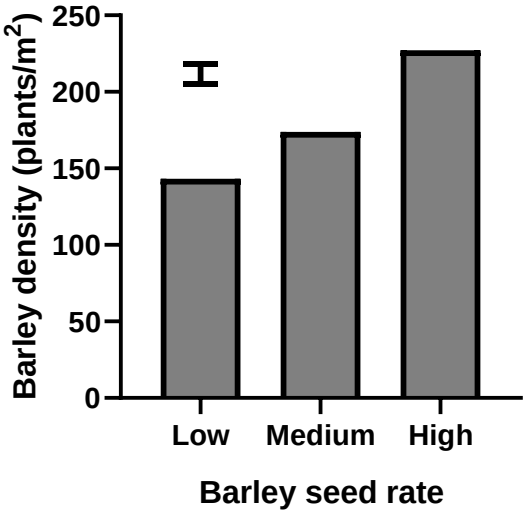

Figure 1. The effect of seed rate on barley plant density. The vertical bar represents the LSD (P=0.05).

Annual ryegrass plant density and seedbank

The average seedbank of annual ryegrass (ARG) at the site was quite low with 472 ± 143 seeds/m^2. ARG plant density was significantly influenced by the time of sowing (P=0.037), and herbicide treatment (P=0.009). There was a 37% reduction in ARG plant density between TOS 1 (20.4 plants/m^2) and TOS 2 (12.7 plants/m^2), which is fairly low for ARG. Herbicide treatment had a

significant effect on ARG plant density. Though not statistically significant, Treflan seemed to be more active on ARG than Boxer Gold at this site. The addition of Treflan to Boxer Gold provided a higher level of weed control than either herbicide alone (Figure 2).

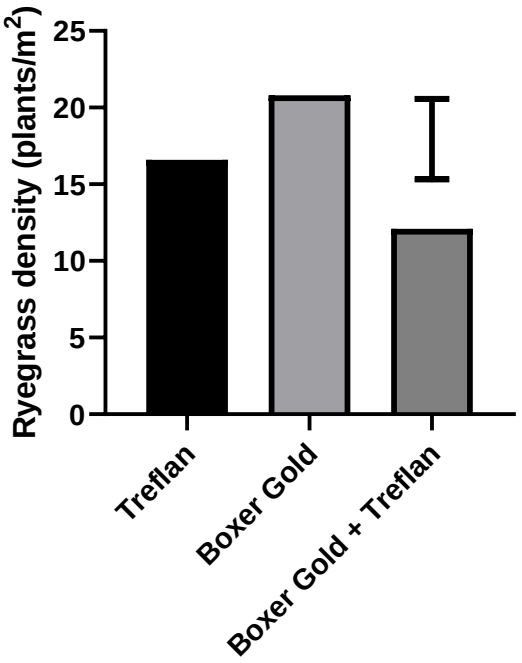

Figure 2. The effect of herbicide treatments on ARG plant density (P=0.009). The vertical bar represents the LSD (P=0.05).

Annual ryegrass spike density and seed production

Consistent with the results for plant density, ARG spike density was quite low at this site, ranging from 3 – 23 spikes/m^2 and with a site mean of only 7 spikes/m^2. Sowing time of barley did not significantly influence ARG spike density (P=0.171). However, ARG spike density was significantly influenced by barley seed rate (P=0.016), herbicide treatment (P=0.01) and the interaction between TOS and herbicide treatment (P=0.019). The low barley seed rate had significantly more ARG spikes than both the medium and high barley seed rate treatments that were 34% and 40% lower respectively (Figure 3). This result suggests that by increasing the seed rate of barley enhanced its competitiveness with ARG.

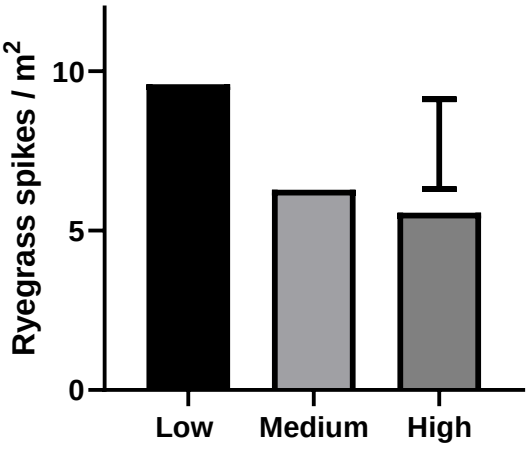

Figure 3. The effect of barley seed rate (P=0.016) on ARG spike density. The vertical bar represents the LSD (P=0.05).

Though only significant for the Boxer Gold treatment, herbicides tended to perform slightly better and consistently in TOS 1 (Figure 4). This trend suggests earlier sown barley was more effective in suppressing ARG spike density. However, there were no significant effects of treatments on ARG seed production (P>0.05).

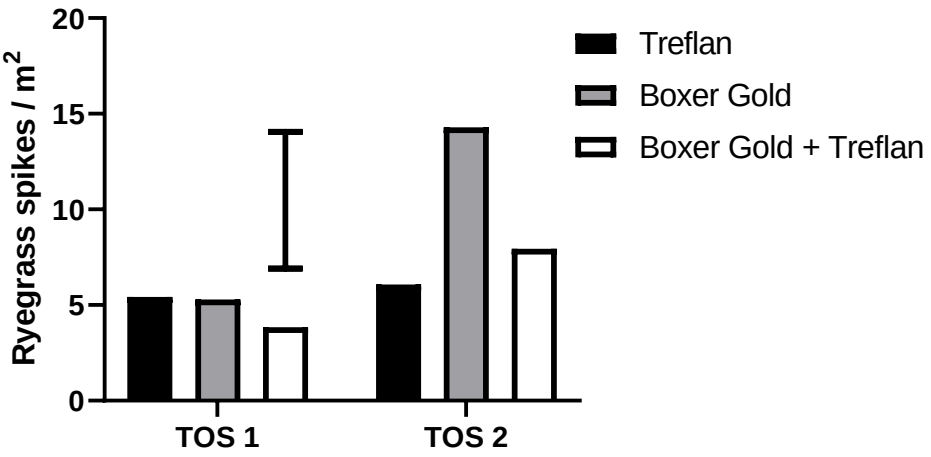

Figure 4. The effect of interaction between the time of sowing and herbicide treatments (P=0.019) on ARG spike production. The vertical bar represents the LSD (P=0.05).

Barley grain yield

Barley grain yield at Frances was not significantly influenced by the time of sowing (P=0.679) or barley seed rate (P=0.282). However, herbicide treatment (P=0.009) had a significant effect on grain yield. Averaged across all treatments, barley produced a grain yield of 6.6 t/ha (site mean yield). However, barley yield varied depending on the herbicide treatment (Figure 5). The Boxer Gold treatment yielded significantly lower than the Treflan and Boxer Gold + Treflan treatments that yielded 4% and 6% higher respectively. These yield differences were small, but statistically significant (P<0.05). Lower barley grain yield where Boxer Gold alone was used may be associated with its rapid degradation in the soil. The results for grain yield followed a similar trend to that seen for ARG plant density (Figure 2) and spike density (Figure 4). Where increased yield correlates with increased ARG control. Generally yield loss in cereals from ARG is predicted to be 0.2% grain yield loss / ARG plant/m^2. This would equate to an expected yield loss of <2% yield or perhaps even lower in a competitive barley crop as at this site.

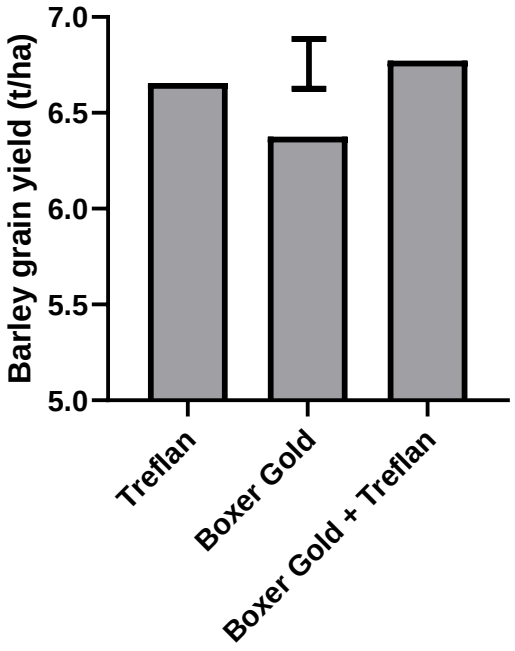

Figure 5. The effect of herbicide treatments (P=0.009) on barley grain yield. The vertical bar represents the LSD (P=0.05).