Effect of sowing time x seed rate x herbicides on ryegrass management in wheat

RESEARCH

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Location
Minnipa - Bruce Heddle
Rainfall
Av. Annual: 283 mm
Av. GSR: 202 mm
2018 Total: 244 mm
2018 GSR: 186 mm
Paddock History
2018: Medic pasture surrounding, wheat trial
2017: Wheat
2016: Canola
2015: Medic
2014: Wheat
Yield
Potential: 2.6 t/ha (top yielding plot across both trials
Soil Type
Grey calcareous loam
Plot Size
1.5 m x 10 m x 3 reps
Trial Design
Experimental, split, split plot
Yield Limiting Factors
Anuual ryegrass and dry start to season

Key messages

- **Annual ryegrass (ARG) plant density and wheat grain yield at Minnipa was influenced by time of sowing, herbicide treatment and the interaction between time of sowing and herbicide.**
- **There was a significant impact of delayed seeding to late June, with a reduction in ARG plant density and higher efficacy of pre-emergence herbicides measured.**
- **There were large benefits of delayed sowing on weed control. However, these benefits came at a significant cost in wheat grain yield.**

Why do the trial?

Change in sowing time can have multiple effects on crop-weed competition. Delayed sowing can provide opportunities to kill a greater proportion of the weed seedbank before seeding the crop, but weeds that establish in late sown crops can be more competitive on a per plant basis. This is one of the 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) has 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 Minnipa was undertaken to investigate factorial combinations of sowing time, seed rate and herbicides on the management of annual ryegrass in wheat.

How was it done?

Measurements taken were pre-sowing weed seedbank, crop density, weed density, ARG spike density, ARG seed production, wheat grain yield.

All data collected during the growing season was analysed using the Analysis of Variance function in GenStat version 15.0.

What happened?

In 2018, annual rainfall received at Minnipa was 14% below the long-term average of 283 mm and the disparity for the growing season rainfall from the long-term average of 202 mm was only 8%. The 86 mm of rainfall received in August was more than double the long-term average and rainfall in October (29 mm) and November (30 mm) was also greater than the long-term average.

Wheat plant density

There was a significant interaction between sowing time and wheat seed rate (Figure 1). At the low seed rate, both sowing times produced an identical plant density (64-68 plants/m^2), which was 32-36% below the target density. However, the gap from the target seed rate increased to 37% at the highest seed rate in TOS 1 and 47% in TOS 2. Lower than expected crop establishment in this trial appeared to be related to below average rainfall at the site in May and June.

Table 1 Key trial treatments and management operations undertaken at Minnipa in 2018

Operation	Details
Location	Minnipa, SA
Seedbank soil cores	8 April 2018
Plot size	1.5 m x 10 m
Trial design	Split plot x 3 replicates
Seeding date	TOS 1: 11 May 2018 TOS 2: 25 June 2018
Fertiliser	Applied at sowing, DAP (18:20) @ 60 kg/ha
Variety	Scepter wheat
Seeding rate x 3	100 seeds/m^2 150 seeds/m^2 200 seeds/m^2
Herbicides x 3	11 May and 25 June, 2018 (applied just before seeding) Sakura 118 g/ha + Avadex 1.6 L/ha IBS Control (knockdown treatment only)

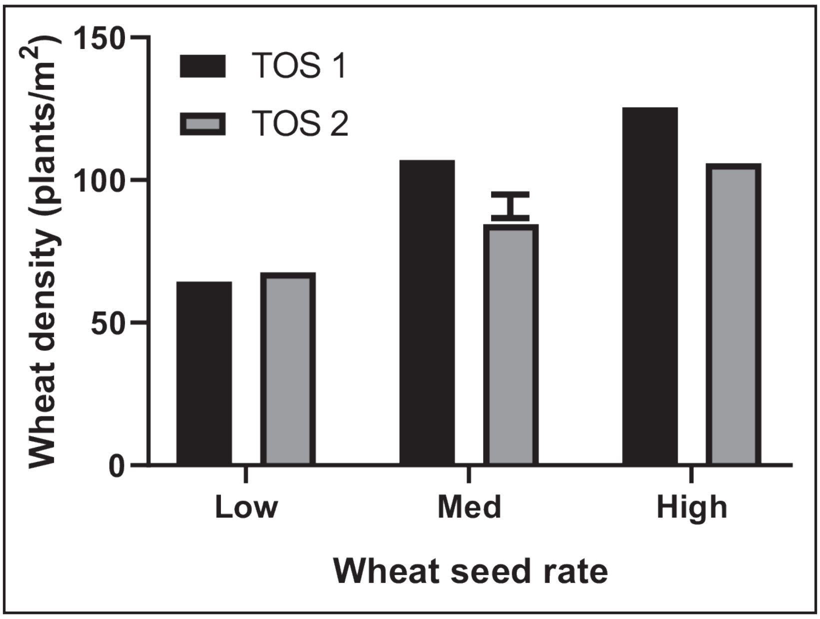

Figure 1 The effect of seed rate on wheat plant density in time of sowing 1 (TOS 1) and time of sowing 2 (TOS 2). The vertical bar represents the LSD (P=0.05).

Annual ryegrass plant density and seedbank

The average seedbank of annual ryegrass (ARG) at the site was 716 ± 38 seeds/m^2. ARG plant density was significantly influenced by the time of sowing ($P<0.001$), herbicide treatment ($P<0.001$) and the interaction between the time of sowing and herbicide ($P<0.001$).

There was a large impact of the six week delay in seeding on ARG plant density (Figure 2). This was particularly evident in the untreated control in which ARG density decreased from 262 plants/m^2 in TOS 1 to 139 plants/m^2 in TOS 2. This large response of ARG density to delayed sowing is most likely related to many small rainfall events in June, which would have caused weed emergence. The reduction in ARG plant density due to delayed seeding was also apparent in the herbicide treatments (Figure 2) with both herbicide treatments providing greater efficacy in TOS 2.

The recruitment index (RI) of ryegrass (the ratio between ARG seedbank and plant density) was also significantly affected by the interaction between the time of sowing and herbicide treatments ($P<0.001$). In the untreated control, RI for ARG was 0.46 (i.e. 46% recruitment) which declined to 0.22 (22% recruitment) in TOS 2. This large difference in ARG establishment in two sowing dates again points to high pre-sowing weed establishment, which was effectively controlled by the knockdown treatment of glyphosate.

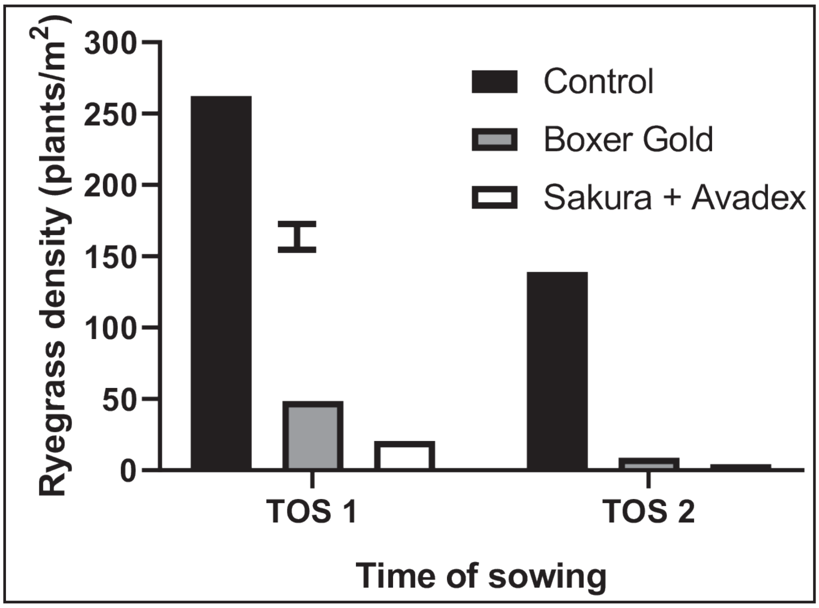

Figure 2 The interaction between the time of sowing and herbicide treatments (P<0.001). The vertical bar represents the LSD (P=0.05).

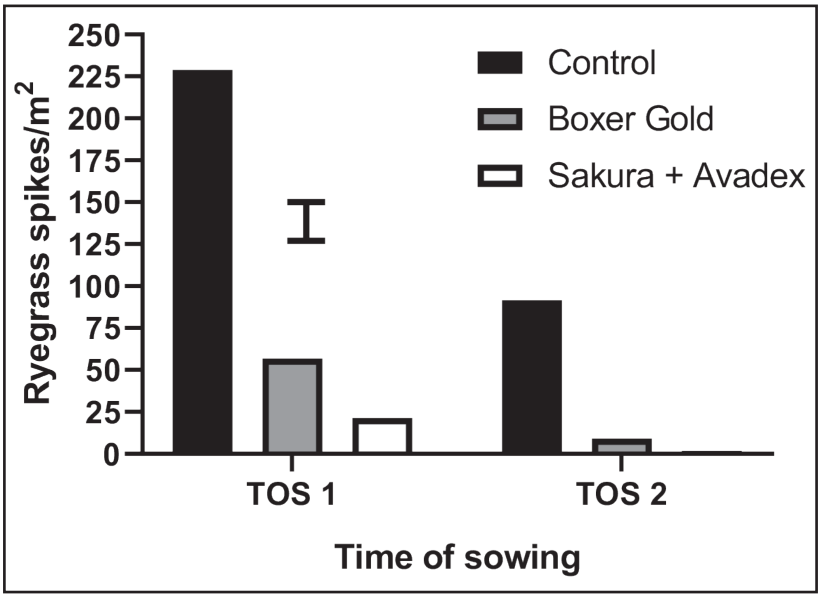

Figure 3 The effect of interaction between the time of sowing and herbicide treatments (P<0.001) on ARG spike density. The vertical bar represents the LSD (P=0.05).

Annual ryegrass spike density and seed production

ARG spike density was significantly influenced by the time of sowing (P=0.012), herbicide treatment (P<0.001) as well as the interaction between the TOS and herbicide treatment (P<0.001). However, there was no effect of wheat seed rate on ARG spike density (P=0.212). When averaged across the seed rates and herbicide treatments, the six week delay in seeding at Minnipa reduced ARG spike density from 102 spikes/m^2 to 34 spikes/m^2 (67% reduction).

Herbicide treatments were also more effective in TOS 2, with the Sakura + Avadex treatment resulting in the production of only two ARG spikes/m^2 (Figure 3). These results clearly highlight the ability of Boxer Gold and Sakura to effectively manage moderate levels of ARG seedbank under adequate soil moisture conditions.

Consistent with the trends observed for ARG spike density, ARG seed production was also significantly influenced by the time of sowing (P=0.047), herbicide treatments (P=0.001) and the interaction between the TOS and the herbicide treatments (P=0.023). Pre-emergence herbicides performed much better in TOS 2 where the density of ARG plants had been reduced by the delay in seeding (Figure 4). In the treatment of Sakura + Avadex, ARG only produced 53 seeds/m^2 in TOS 2, compared to 830 seeds/m^2 in TOS 1.

Wheat grain yield

Wheat grain yield at Minnipa was significantly influenced by the time of sowing (P=0.002), seed rate (P<0.001), herbicide treatment (P<0.001) and the interaction between the time of sowing and herbicide treatments (P<0.001). Averaged across the seed rates and herbicide treatments, wheat produced grain yield of 1.67 t/ha in TOS 1, compared to 1.06 t/ha in TOS 2 (Figure 5). Even though the amount of rainfall received in May and June was well below the long-term average, the six week delay in sowing reduced wheat yield by 36%. Wheat yield increased as seed rate increased from low (1.25 t/ha), to medium (1.41 t/ha) and high (1.44 t/ha). Even though this increase was only 13%, it was statistically significant.

Weeds

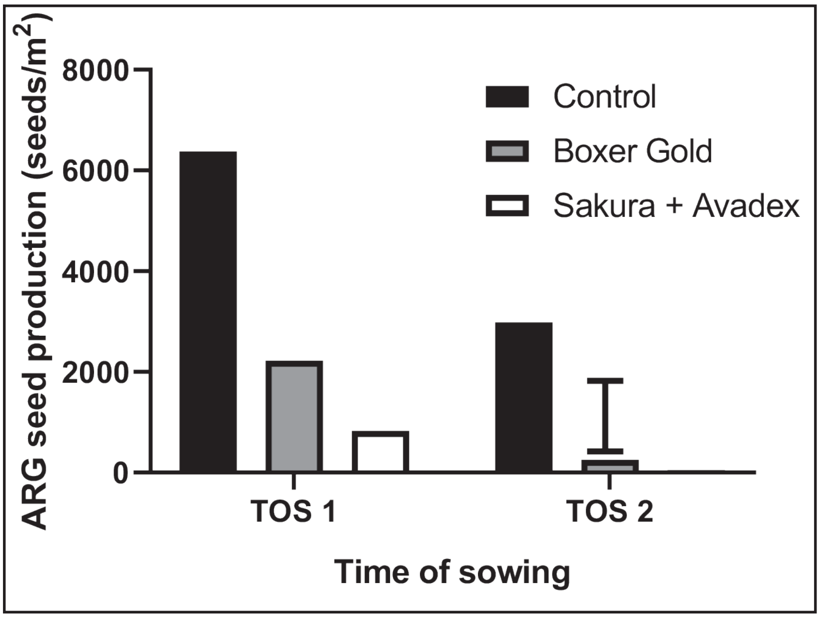

Figure 4 The effect of interaction between the time of sowing and herbicide treatments ($P<0.001$) on ARG seed production. The vertical bar represents the LSD ($P=0.05$).

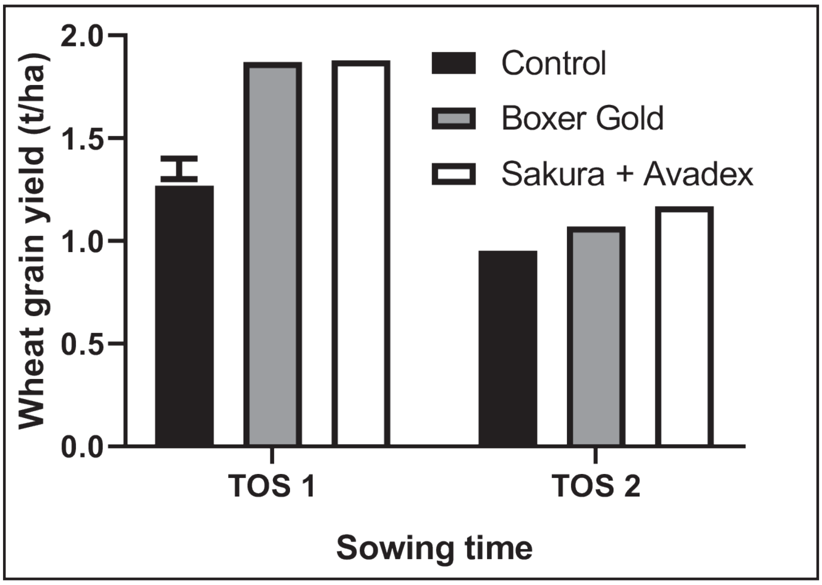

Figure 5 The effect of interaction between the time of sowing and herbicide treatments ($P<0.001$) on wheat grain yield. The vertical bar represents the LSD ($P=0.05$).

What does this mean?

As stated earlier, there were large benefits of delayed sowing on weed control by herbicides in terms of ARG plant density, spike density and seed production. However, these benefits came at a significant cost in wheat grain yield. All herbicide treatments showed a significant reduction in yield due to the six week delay in sowing. Sakura + Avadex provided superior control of ARG than Boxer Gold, but there were no differences in wheat yield between these treatments.

Even though the untreated control plots had a greater ARG plant density in TOS 1 (262 plants/m^2) than TOS 2 (139 plants/m^2), still wheat produced 0.32 t/ha more grain yield in TOS 1 than TOS 2.

These results clearly highlight the superior competitive ability of wheat against ARG at earlier sowing. It could also be argued that yield loss of wheat due to delayed sowing was greater than the yield loss due to ARG competition. Therefore, it would not be advisable to delay sowing wheat to manage ARG unless weed seedbanks are excessively large. It would be preferable to target the optimum sowing date for wheat in the region and use the most effective herbicide options available to control ARG.

Based on grain yields achieved and APW prices for last year, TOS 1 treated with Boxer Gold provided $291/ha greater gross margin than TOS 2 treated with the same herbicide.

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