Effect of sowing time x seed rate x herbicides on ryegrass management in wheat (Lake Bolac, VIC)

Abstract

General application of Sakura + Avadex over the whole trial site provided good control of ARG. As a result, follow-up application of Boxer Gold @ 1.5 L/ha or 2 L/ha at GS 11 (1-leaf stage) did not significantly reduce ARG plant density. Post-emergence application of Boxer Gold at 1.5 or 2 L/ha after pre-emergence Sakura + Avadex extended the period of weed control, which reduced spike density of ARG (P=0.02). However, the additional suppression of ARG was only around 20%. Increase in wheat seed rate also had a significant effect of ARG spike density (P<0.001). At both sowing times, increase in wheat plant density from 100 to 200 plants/m^2 reduced ARG spike density by 44%. Delayed sowing at this site reduced the competitive ability of wheat against ARG. Averaged across the seed rates and herbicide treatments, ARG produced 234 spikes/m^2 in TOS 2 as compared to 75 spikes/m^2 in TOS 1 (68% reduction in TOS 1). Additional post-emergence application of Boxer Gold significantly increased wheat grain yield (P=0.008) compared to the baseline treatment of Sakura + Avadex. Wheat yield increased by 9% or 0.4 t/ha with the additional post-emergence treatment of Boxer Gold as compared to Sakura + Avadex treatment alone. Wheat grain yield was also significantly affected by wheat seed rate (P<0.001). Wheat grain yield increased from 4.6 t/ha at the density of 100 plants/m^2 to the maximum of 5.48 t/ha at the seed rate of 200 plants/m^2. This yield gain of 0.9 t/ha clearly indicates that early sowing, wheat density of 200 plants/m^2 and effective use of herbicides can have a large influence on the profitability of wheat in the HRZ.

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) 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. In high rainfall areas such as Lake Bolac, adoption of higher crop seeding rates can be relatively easy to achieve.

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

Methods

This field trial investigated combinations of the following management tactics (refer to Table 1 for details). All plots received pre-sowing application of glyphosate.

1. **Sowing time (2)**: early May and early June
2. **Seed rate (4)**: 250 seeds/m^2, 200 seeds/m^2, 150 seeds/m^2, and 100 seeds/m^2
3. **Herbicides (3)**:

(i) Sakura 118 g/ha + Avadex 3 L/ha IBS

(ii) Sakura 118 g/ha + Avadex 3 L/ha IBS - Boxer Gold 1.5 L/ha GS 11

(iii) Sakura 118 g/ha + Avadex 3 L/ha IBS – Boxer Gold 2.0 L/ha GS 11

According to the original trial protocol, herbicide treatments to be used were:
Nil (knockdown treatment only)
Boxer Gold 2.5 L/ha IBS
Sakura 118 g/ha plus Avadex (500 g/L) 2 L/ha IBS

Even though there were errors in the implementation of the protocol, still the treatments implemented are highly relevant for the high rainfall zone.

Trial design: split plot design

Replicates: 3

Trial Management

Table 1. Key management operations undertaken.

Operation	**Details**
Location	Lake Bolac, VIC
Seedbank soil cores	12 April, 2018
Plot size	1.6 x 12 m
Seeding date	TOS 1: 21 May, 2018 TOS 2: 6 June, 2018
Fertiliser	At sowing – DAP (18:20) @ 60 kg/ha
Variety	Beaufort wheat
Seeding rate	100 seeds/m^2 150 seeds/m^2 200 seeds/m^2 250 seeds/m^2
Herbicides	21 May and 6 June, 2018 (applied just before seeding) Sakura 118 g/ha + Avadex 3 L/ha IBS Sakura 118 g/ha + Avadex 3 L/ha IBS - Boxer Gold 1.5 L/ha GS 11 Sakura 118 g/ha + Avadex 3 L/ha IBS – Boxer Gold 2.0 L/ha GS 11

Measurements: 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.

	Rainfall (mm)	
Month	**2018**	**Long-term average**
Jan	9.6	32.8
Feb	9.6	32.0
Mar	19.0	31.5
Apr	12.4	43.1
May	63.6	47.2
Jun	44.6	45.7
Jul	48.4	51.3
Aug	64.4	59.3
Sep	16.9	54.4
Oct	20.8	51.0
Nov	39.4	47.7
Dec	53.4	40.4
Annual total	402.2	536.4
GSR total	310.6	399.7

Lake Bolac experienced a very dry start to the year in 2018, with rainfall well below the long-term average from January to April (Table 2). Rainfall from May to August was just above or close to the average. However, the spring months (Sep-Oct) were dry and received less than half the long-term average.

Results and Discussion

Wheat plant density

Wheat plant density was significantly affected by crop seed rate (P<0.001) but not by sowing time or herbicide treatments. As soil moisture conditions at the two times of sowing were favourable, wheat emergence was excellent. In fact, wheat plant density achieved was higher than the target by 6-20%.

Annual ryegrass seedbank

The experimental site at Lake Bolac had an average ARG seedbank of 1452 ± 226 seeds/m^2. However, there was considerable variation across the replicates or blocks at the site. There was a systematic gradient in ARG seedbank from block 1 to 3 (east to west). This larger than usual variation in ARG seedbank did have some effect on the coefficient of variation for data collected at the site.

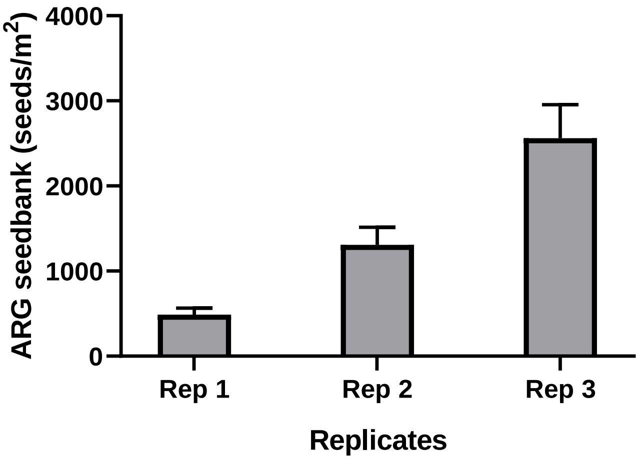

Figure 1. Pre-sowing seedbank of annual ryegrass across the trial site at Lake Bolac in 2018.

Annual ryegrass plant and spike density

General application of Sakura + Avadex over the whole trial site provided good control of ARG. As a result, follow-up application of Boxer Gold @ 1.5 L/ha or 2 L/ha at GS 11 (1-leaf stage) did not enhance ARG control. Even though ARG plant density decreased from 67 plants/m^2 without Boxer Gold to 54 plants/m^2 when Boxer Gold was sprayed, this difference was non-significant (P>0.05).

ARG spike or head density was significantly affected by the wheat seed rate (P<0.001), herbicide treatment (P=0.022) and the interaction between time of sowing and seed rate (P<0.001).

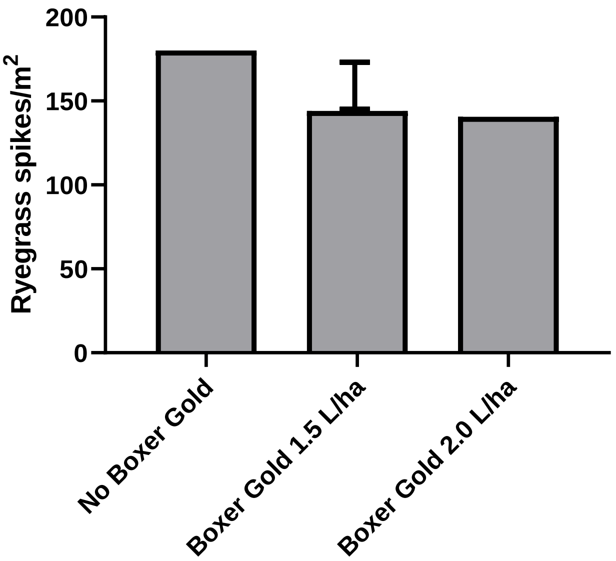

Figure 2. The effect of herbicide treatments averaged across times of sowing and seed rates on annual ryegrass spike density. All plots were sprayed with basal rate of Sakura 118 g/ha + Avadex 3 L/ha IBS. The vertical bar represents the LSD (P=0.05).

It is highly likely that additional application of Boxer Gold at 1.5 or 2 L/ha extended the period of weed control, which reduced spike density of ARG (P=0.02). However, the additional suppression of ARG was only around 20% (Figure 2). Therefore, the benefits of this additional cost need to considered carefully.

Increase in wheat seed rate also had a significant effect of ARG spike density ($P<0.001$; Figure 3). This result clearly indicates that at both sowing times, increase in wheat plant density from 100 to 200 plants/m^2 reduced ARG spike density by 44%. The benefits of increased wheat seed rate on its competitive ability with ARG are consistent with previous research from other cropping environments in Australia (Lemerle et al. 2004).

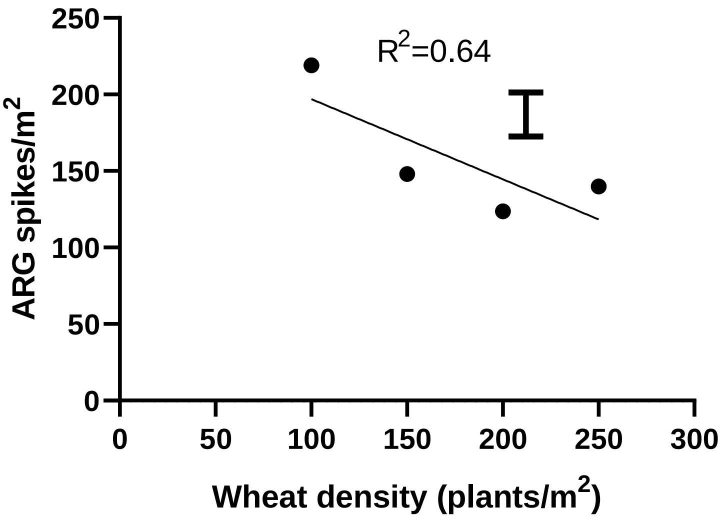

Figure 3. The relationship between wheat target plant density and ryegrass spike density. The vertical bar represents the LSD (P=0.05).

Delayed sowing at this site reduced the competitive ability of wheat against ARG. Averaged across the seed rates and herbicide treatments, ARG produced 234 spikes/m^2 in TOS 2 as compared to 75 spikes/m^2 in TOS 1 (68% reduction in TOS 1). ARG is well known for its tolerance to cold and wet conditions, which appears to have favoured ARG plants to tiller and produced more spikes (heads) in the later sown crop (Figure 4).

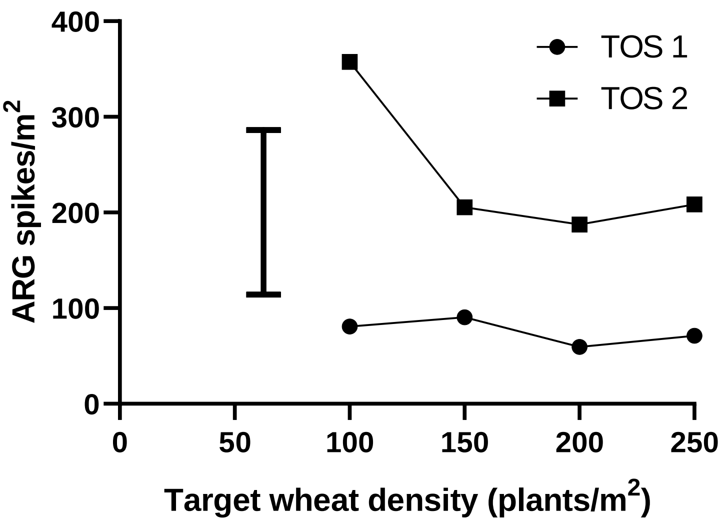

Figure 4. The response of annual ryegrass spike density to wheat seed rate at the two times of sowing. The vertical bar represents LSD (P=0.05) for the interaction between time of sowing and wheat seed rate.

Wheat grain yield

Additional post-emergence application of Boxer Gold significantly increased wheat grain yield (P=0.008) compared to the baseline treatment of Sakura + Avadex (Figure 5). As ARG density that survived the basal herbicide treatment of Sakura + Avadex was <100 plants/m^2, it only had a modest effect on wheat grain yield. Therefore, wheat yield increased by 9% or 0.4 t/ha with the additional post-emergence treatment of Boxer Gold. Previous research in the high rainfall zone has shown that wheat crops can be more resilient to ARG competition, possibly due to greater water availability.

Wheat grain yield was also significantly affected by wheat seed rate (P<0.001). Wheat grain yield increased from 4.6 t/ha at the density of 100 plants/m^2 to the maximum of 5.48 t/ha at the seed rate of 200 plants/m^2 (Figure 6). This yield gain of 0.9 t/ha clearly indicates that early sowing, wheat density of 200 plants/m^2 and effective use of herbicides can have a large influence on the profitability of wheat in the HRZ.

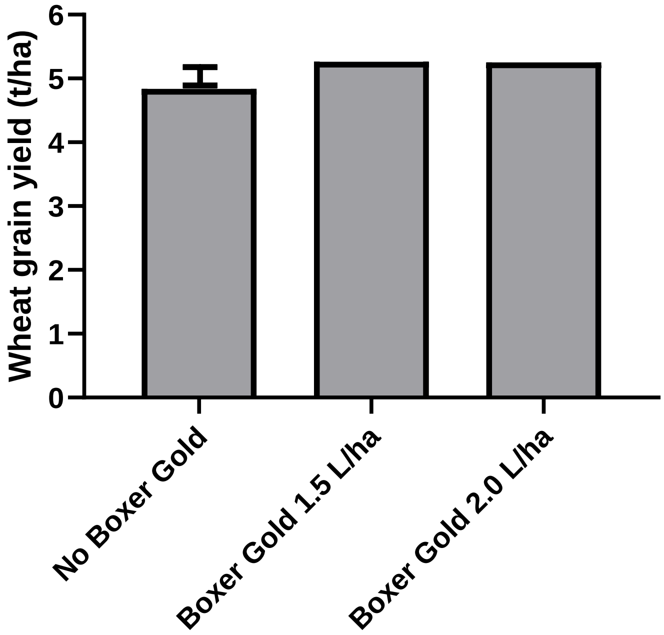

Figure 5. The effect of herbicide treatments, averaged across times of sowing and wheat seed rates, on wheat grain yield (P=0.008). All plots were sprayed with basal rate of Sakura 118 g/ha + Avadex 3 L/ha IBS. The vertical bar represents the LSD (P=0.05).

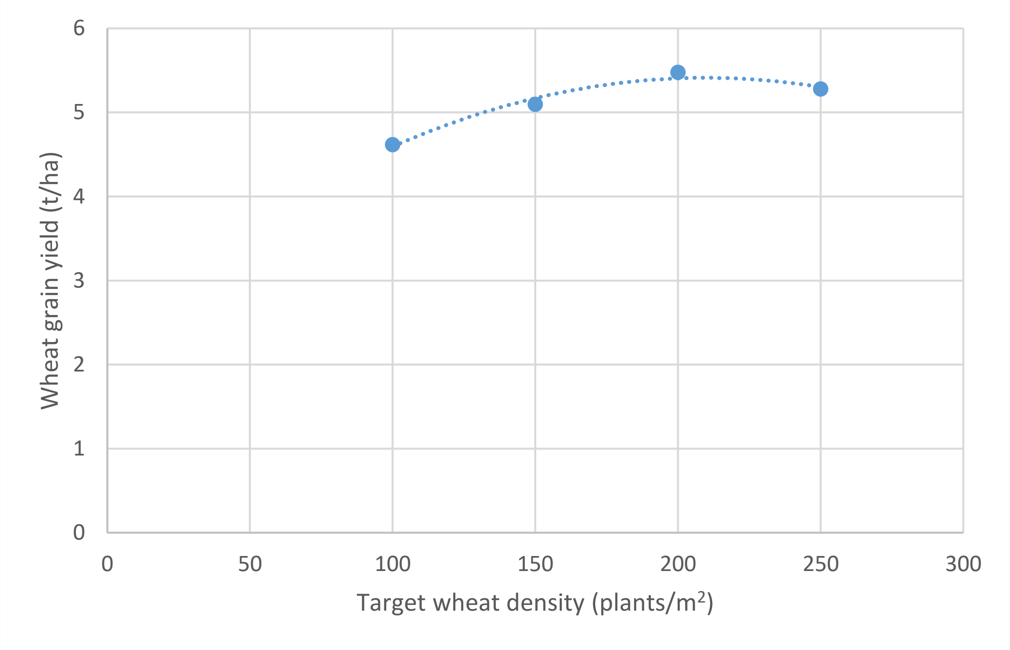

Figure 6. The relationship between target wheat plant density and wheat grain yield (R^2=0.97).

Literature cited

Lemerle, D., Cousens, R. D., Gill, G. S., Peltzer, S. J., Moerkerk, M., Murphy, C. E., Collins, D. J., Cullis, B. (2004). Reliability of higher seeding rates of wheat for increased competitiveness with weeds in lowrainfall environments. *Journal of Agricultural Science*, 142: 395-409.