Effect of seed rate x herbicides on ryegrass management in wheat (Minnipa, SA)

Abstract

A field trial was undertaken at Minnipa in 2020 to investigate combinations of wheat seed rate and herbicide treatments to control annual ryegrass. The average seedbank of annual ryegrass (ARG) at the site was 2012 ± 461 seeds/m^2. ARG plant density was significantly influenced by herbicide treatment (P=0.008). Boxer Gold and Sakura + Avadex controlled ARG plant density by 63% and 70% respectively. Consistent with the trends observed for ARG spike density, ARG seed production was also significantly influenced by herbicide treatments (P<0.001) and while not significant there was a trend towards suppression of ARG seed production when wheat seed rate was increased (P=0.096). When averaged across all the seed rate treatments, the untreated control produced 13,155 ARG seeds/m^2. The Boxer Gold treatment reduced ARG seed set by 69% to 4,018 ARG seeds/m^2, while the Sakura + Avadex treatment reduced it by 70% to 3,849 ARG seeds/m^2. Such high ARG seed set even when using pre-emergent herbicides highlights the importance of an integrated weed management strategy that incorporates diverse crop options such as hay and includes other cultural methods such as harvest weed seed collection and improved crop competitiveness. Consistent with the level of ARG control, herbicide treatments had a significant effect on wheat grain yield with Boxer Gold (1.869 t/ha) and Sakura + Avadex (1.871 t/ha) both increasing grain yield by 35% compared to the control (1.384 t/ha).

Introduction

There has been some research already on crop seed rate on weed suppression but many of these studies have not investigated the benefits of higher crop density in factorial combinations with 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 seed rate and herbicides on the management of annual ryegrass in wheat.

Methods

This field trial investigated combinations of the following management tactics.

1. **Seed rate (3)**: 1x (200 seeds/m^2), 0.75x (150 seeds/m^2), 0.5x (100 seeds/m^2)
2. **Herbicides (3)**:

(i) Nil (knockdown treatment only)
(ii) Boxer Gold 2.5 L/ha IBS
(iii) Sakura 118 g/ha + Avadex Xtra 2 L/ha IBS

Variety: Scepter

Trial design: factorial design

Replicates: 3

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

Trial Management

Table 1. Key management operations undertaken.

Operation	**Details**
Location	Minnipa, SA
Seedbank soil cores	April, 2019
Plot size	1.5 m x 10 m
Seeding date	6 May, 2020
Fertiliser	At sowing – DAP (18:20) @ 60 kg/ha
Variety	Scepter wheat
Seeding rate	100 seeds/m^2 150 seeds/m^2 200 seeds/m^2
Herbicides	6 May, 2020 (applied just before seeding) Sakura + Avadex Boxer Gold 2.5 L/ha IBS Control (knockdown treatment only)

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

In 2020, annual rainfall received at Minnipa was 12.6% above the long-term average and the growing season rainfall was 7.7% above the long-term average. The rainfall received in February, April and October 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 Minnipa in 2019 and the long-term average for the site.

	Rainfall (mm)	
Month	**2020**	**Long-term rainfall**
Jan	10.8	11.2
Feb	46.4	13.2
Mar	20.0	18.9
Apr	36.8	15.5
May	16.4	28.2
Jun	17.4	37.1
Jul	16.6	35.0
Aug	34.8	38.7
Sep	33.2	27.5
Oct	63.2	19.9
Nov	1.0	16.9
Dec	22.6	18.9
Annual total	319.2	282.3
GSR total	218.4	201.9

Results and Discussion

Annual ryegrass plant density and seedbank

The average seedbank of annual ryegrass (ARG) at the site was 2012 ± 461 seeds/m^2. ARG plant density was significantly influenced by herbicide treatment (P=0.008). Boxer Gold and Sakura + Avadex controlled ARG plant density by 63% and 70% respectively (Figure 2).

Annual ryegrass spike density and seed production

ARG spike density was significantly influenced by herbicide treatment (P<0.001). Though not significant (P=0.108), ARG spike declined in response to increasing wheat seed rate. As wheat seed rate increased from 100 seeds/m^2 to 150 and 200 seeds/m^2 ARG spike density reduced by 20 and 33%, but due to high spatial variability in the trial this was not significant (P>0.05). Herbicide treatments were effective in suppressing ARG spike density with Boxer Gold and Sakura + Avadex reducing ARG spike density by 69 and 72%, respectively.

Consistent with the trends observed for ARG spike density, ARG seed production was also significantly influenced by herbicide treatments (P<0.001) and while not significant there was a trend towards suppression of ARG seed production when wheat seed rate was increased (P=0.096, Table 3).

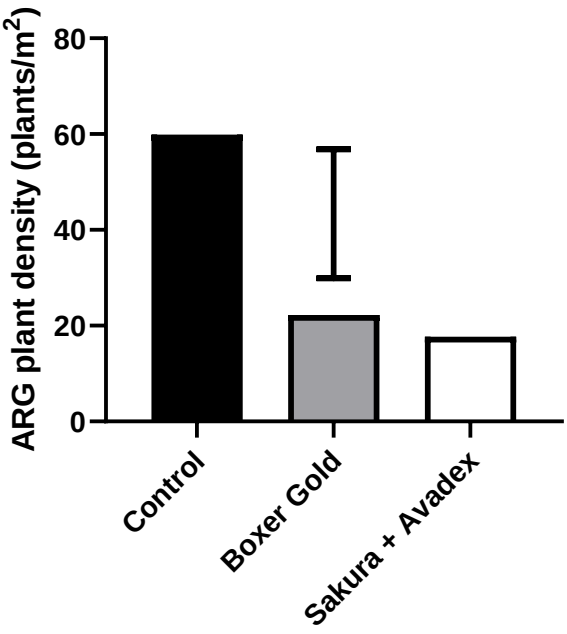

Figure 2. The effect of herbicide treatment on annual ryegrass density (P=0.008). The vertical bar represents the LSD (P=0.05).

Table 3. Trend of suppression of ARG seed production from increasing wheat seed density (P=0.096). Percentage increase from low in brackets.

Wheat seed rate (seeds/m^2)	**ARG seed production (ARG seeds/m^2)**
Low 100	9046
Medium 150	6584 *(27%)*
High 200	5392 *(40%)*

When averaged across all the seed rate treatments, the untreated control produced 13,155 ARG seeds/m^2. The Boxer Gold treatment reduced ARG seed set by 69% to 4,018 ARG seeds/m^2, while the Sakura + Avadex treatment reduced it by 70% to 3,849 ARG seeds/m^2 (Figure 3). This result closely follows the ARG spike density results and also shows that even with 2 high-end pre-emergent herbicide treatments ($30-$55), approximately 4000 ARG seeds/m^2 were produced. This amount of ARG seed is likely to substantially increase ARG problem at this site in the next season. These results highlight the importance of an integrated weed management strategy that incorporates diverse crop options such as hay and includes other cultural methods such as harvest weed seed collection and improved crop competitiveness.

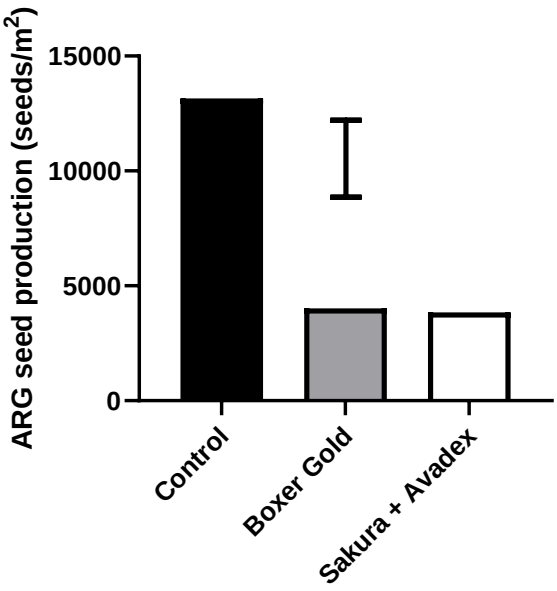

Figure 3. The effect of herbicide treatment on ARG seed production (P<0.001). The vertical bar represents the LSD (P=0.05).

Wheat grain yield and quality

Wheat grain yield at Minnipa was not significantly influenced by wheat seed rate (P=0.407). However, herbicide treatment (P=0.011) had a significant effect on grain yield. Averaged across all treatments, wheat produced a grain yield of 1.708 t/ha (site mean yield). Herbicide treatment had a significant effect on wheat grain yield with Boxer Gold (1.869 t/ha) and Sakura + Avadex (1.871 t/ha) both increasing grain yield by 35% compared to the control (1.384 t/ha) (Figure 4).

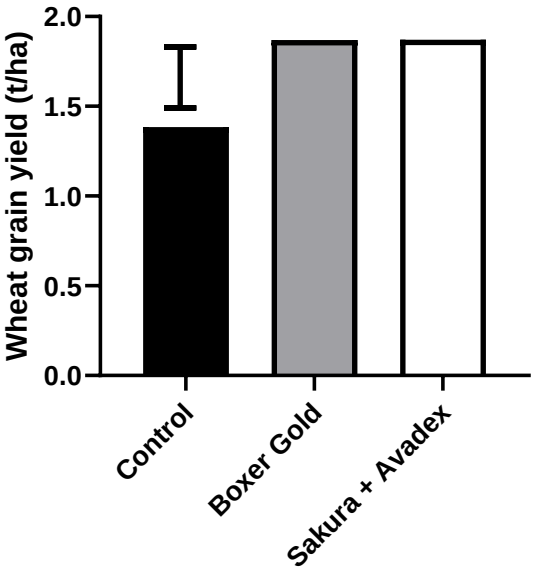

Figure 4. The effect of herbicide treatments (P<0.001) on wheat grain yield. The vertical bar represents the LSD (P=0.05).

Wheat grain screenings were significantly influenced by wheat seed rate ($P<0.001$) and herbicide treatment ($P<0.001$). In this trial, wheat screenings were significantly reduced from 7.86% in the low seed rate to 6.15% screenings in the high seed rate treatments. A similar trend was observed for grain size with the high seed rate (45.2 g/1000 grains) having 16% larger grains than the low seed rate (38.93 g/1000 grains). Herbicide treatment also had a significant influence on wheat screenings, with Sakura + Avadex (6.77%) and Boxer Gold (6.39%) significantly reducing wheat screenings compared to the untreated control (8.28%). It is quite likely that soil water used by ARG reduced crop canopy photosynthesis and supply of assimilates for grain fill in the untreated control compared to the herbicide treatments.