Effect of row spacing x seedbed utilisation x pre-emergence herbicides on ryegrass management in wheat (Minnipa, SA)

Abstract

The herbicide treatment had a significant effect on ARG density (P<0.001) in this field trial at Minnipa. Favourable rain events in June were highly suitable for the activity of both pre-emergent herbicides investigated in this trial. Averaged across the row spacing and SBU treatments, Boxer Gold and Sakura + Avadex reduced ARG plant density by 88% and 90%, respectively. The density of ARG spikes was significantly influenced by the herbicide treatment. Boxer Gold reduced ARG spike density by 74% compared to the untreated control, whereas Sakura + Avadex caused 85% reduction in ARG spike density. The density of ARG spikes in Sakura + Avadex were significantly lower than in the Boxer Gold treatment. ARG seed production was also significantly affected by the herbicide treatment (P<0.001) but not by wheat row spacing (P=0.272) or seed boot design (P=0.994). ARG produced 5740 seeds/m^2 in the untreated control, which was reduced by 74% by Boxer Gold and 86% by the mixture of Sakura + Avadex. Presence of ARG at 190 plants/m^2 in the untreated control, reduced wheat grain yield by 11% compared to Boxer Gold or 8% compared to Sakura + Avadex. However, it was still profitable to control ARG with effective herbicide treatments. Based on cash grain price of Australian Premium Wheat (APW) of $400/t in 2018, Boxer Gold would be expected to increase the gross margin by $68/ha as compared $12/ha increase for Sakura + Avadex.

Introduction

As a general principle, availability of large inter-row space tends to encourage weed invasion in field crops. At the start of the trend towards no-till, many growers adopted wider row spacing of crops as a way of achieving stubble retention. There is large variation in the row spacing used by growers for seeding wheat crops across the southern region. In wider row configurations the crop's ability to close the canopy and compete with weeds between rows reduces significantly. This delays inter-row weed suppression and the wider the rows the longer the delay. In a review of research gaps by Widderick et al. (2015), crop row spacing was identified as a priority area of research for the southern region. Seedbed utilisation (SBU) as a concept has been used by Australian agronomists to achieve safer use of fertilisers at crop sowing. Greater SBU reduces the concentration of fertiliser close to crop seed which improves safety. The same concept appears to have relevance for increasing the inter-row space occupied by crop plants, which has the potential to improve crop's competitive ability with weeds. Greater SBU by crops can be achieved by altering seed boots that provide greater lateral spread of crop seed. Some growers have been using 'Ribbon seeders' such as Concord to increase SBU and resource utilisation by their crops.

Methods

This field trial investigated combinations of the following management tactics (refer to Table 1 for details).

Row spacing x splitter boots (4): 25 cm (10") and 37.5 cm (13") – with and without splitter boots

Herbicides treatments (3):

(i) Control (pre-sowing glyphosate treatment only)
(ii) Boxer Gold 2.5 L/ha incorporated by sowing (IBS)
(iii) Sakura 118 g/ha plus Avadex 1.6 L/ha incorporated by sowing (IBS)

Variety: Scepter

Trial design: split plot design

Replicates: 3

Trial Management

Table 1. Key management operations undertaken.

Operation	**Details**
Location	Minnipa, SA
Seedbank soil cores	8 April, 2018
Plot size	1.5 m x 10 m
Seeding date	13 June, 2018
Fertiliser	At sowing – DAP (18:20) @ 60 kg/ha
Variety	Scepter wheat
Seeding rate	200 seeds/m^2
Herbicides	13 June, 2018 (applied just before seeding) Boxer Gold 2.5 L/ha IBS Sakura 118 g/ha + Avadex 1.6 L/ha IBS Control (pre-sowing glyphosate treatment only)

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.

In 2018, annual rainfall received at Minnipa was 14% below the long-term average and the disparity for the growing season rainfall from the long-term average was only 8%. The rainfall received in August was more than double the long-term average and rainfall in October and November was also greater than the long-term average. Additional information on rainfall pattern for 2018 can be found in the report for the time of sowing x wheat seed rate x herbicide trial undertaken in the same paddock.

Results and Discussion

Wheat plant density

Even though the same seed rate was used in the normal (25 cm) and wide row (37.5 cm) treatments, wheat plant density was slightly greater (4.5%) in the normal row spacing (P=0.04). Herbicide treatments and seeder boots (SBU) did not have any adverse effect on wheat plant density. The average wheat plant density in the trial was 140 plants/m^2, which is highly suitable for this agro-ecological environment.

Annual ryegrass plant density and seedbank

As expected, herbicide treatment had a significant effect on ARG density (P<0.001). Favourable rain events in June were highly suitable for the activity of both pre-emergent herbicides investigated in this trial (Figure 1). Averaged across the row spacing and SBU treatments, Boxer Gold and Sakura + Avadex reduced ARG plant density by 88% and 90%, respectively.

Assessment of soil cores for ARG seedbank showed that the average seedbank at the trial site was 1117 ± 71 seeds/m^2. This level of ARG seedbank would be regarded as a moderate infestation. There was no significant variation in ARG seedbank identified across the replicates, which indicates relatively weed uniform infestation. The recruitment index (RI) of ryegrass (the ratio between ARG seedbank and plant density) was also significantly affected by the herbicide treatments (P<0.001). The recruitment index of the untreated control was 0.22 (22% seedbank recruitment), which is

identical to the TOS 2 in the other trial at Minnipa. The successful recruitment ARG plants in Boxer Gold treatment was 0.026 (2.6%) and 0.022 (2.2%) for Sakura + Avadex.

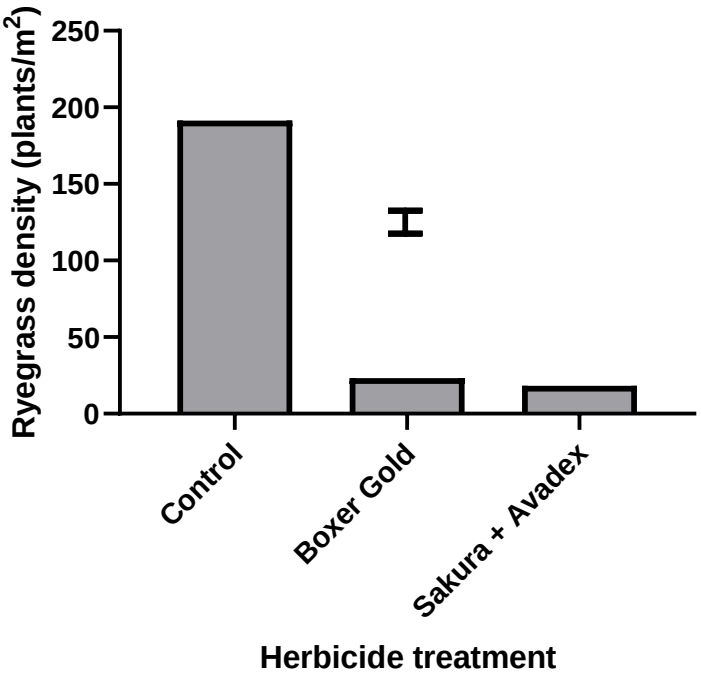

Figure 1. The effect of herbicide treatments on ryegrass plant density. The vertical bar represents the LSD (P=0.05).

Annual ryegrass spike density and seed production

The density of ARG spikes was significantly influenced by the herbicide treatment (Figure 2). However, crop row spacing and seed boot (SBU) did not affect ARG spike density. Both herbicide treatments caused a significant reduction ARG spike density (Figure 2). Boxer Gold reduced ARG spike density by 74% compared to the untreated control, whereas Sakura + Avadex caused 85% reduction in ARG spike density. The density of ARG spikes in Sakura + Avadex were significantly lower than in the Boxer Gold treatment.

Consistent with the spike density data, ARG seed production was also significantly affected by the herbicide treatment ($P<0.001$) but not by wheat row spacing ($P=0.272$) or seed boot design ($P=0.994$). ARG produced 5740 seeds/m^2 in the untreated control, which was reduced by 74% by Boxer Gold and 86% by the mixture of Sakura + Avadex (Figure 3). Superior performance of Sakura + Avadex is most likely related to its longer persistence or activity in the soil. These results also highlight the difficulty of eliminating ARG through the use of pre-emergence herbicides alone. Even within the most expensive and effective treatment of Sakura + Avadex (>$55/ha), ARG was able to produce 788 seeds/m^2. This moderate level of ARG seed production would be more than adequate to allow weed establishment in crops grown next year. Therefore, growers need to consider integration of harvest weed seed control or other management tactics to further reduce injection of ARG seeds into the seedbank.

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

Wheat grain yield

Wheat grain yield was significantly influenced by crop row spacing (P=0.011) and herbicide treatments (P=0.012) but not by the seed boot design or SBU (narrow Vs wide spread) or by the interaction between these management factors. In 25 cm rows wheat produced 2.22 t/ha grain yield, which was significantly greater than yield in 37.5 cm rows (2.11 t/ha). Even though the difference between the row spacing treatments was only 5%, it was significantly different.

Application of Boxer Gold or Sakura + Avadex provided a significant increase in wheat grain yield (Figure 3). These results also highlight the point that ARG is not highly competitive in wheat. Presence of ARG at 190 plants/m^2 in the untreated control, only reduced grain yield by 11% compared to Boxer Gold or 8% compared to Sakura + Avadex. However, it was still profitable to control ARG with effective herbicide treatments. Based on cash grain price of Australian Premium Wheat (APW) of $400/t in 2018, Boxer Gold would be expected to increase the gross margin by $68/ha as compared $12/ha increase for Sakura + Avadex.

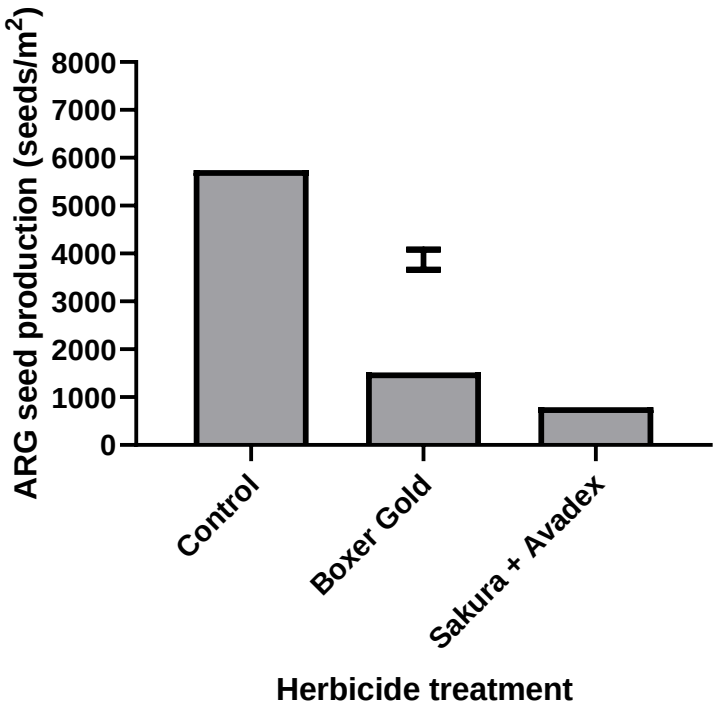

Figure 2. The effect of herbicide treatments on the ryegrass seed production. The vertical bar represents the LSD (P=0.05).

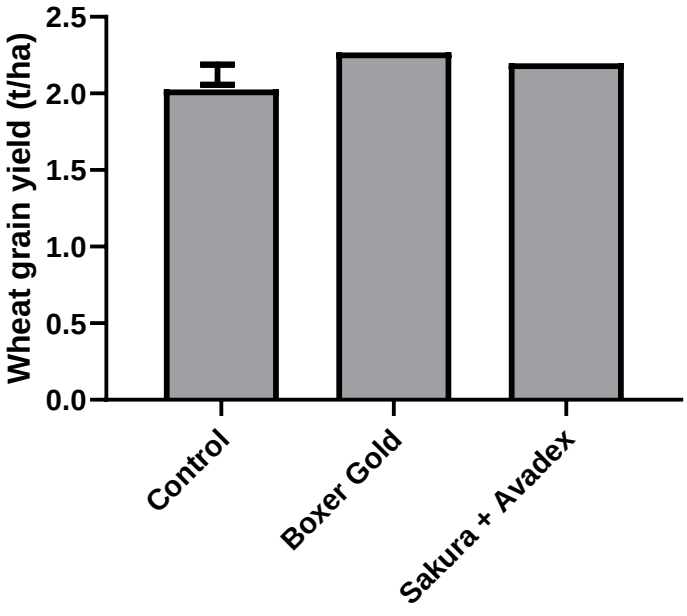

Figure 3. The effect of herbicide treatments on wheat grain yield. The vertical bar represents the LSD (P=0.05).