Effect of row spacing x seedbed utilisation x pre-emergence 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, plot design
Yield Limiting Factors
Anuual ryegrass and dry start to season

Key messages

- **Favourable rain events in June were highly suitable for the activity of both pre-emergent herbicides investigated in this trial.**
- **The density of ARG spikes and ARG seed production were significantly influenced by the herbicide treatment.**
- **It is profitable to control ARG with effective herbicide treatments. Based on the 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 to a $12/ha increase for Sakura + Avadex.**

Why do the trial?

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 to provide a 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.

How was it done?

Trial details are presented in Table 1. This field trial investigated combinations of the following management tactics: Row spacing x splitter boots (4): 25 cm (10") and 37.5 cm (13") – with and without splitter boots. These seeding treatments were overlayed with three different herbicide treatments: Control (knockdown treatment only), Boxer Gold 2.5 L/ha incorporated by sowing (IBS) and Sakura 118 g/ha plus Avadex 1.6 L/ha IBS.

Measurements taken in 2018 included: pre-sowing weed seedbank, crop density, weed density, annual ryegrass (ARG) spike density, ARG seed production and 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.

What happened?

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 ($P=0.04$).

Table 1 Key management operations undertaken

Operation	Details
Seedbank soil cores	8 April 2018
Plot size	1.5 m x 10 m x 4 replicates, split plot design
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 (knockdown treatment only)

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 uniform weed 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 RI of the untreated control was 0.22 (22% seedbank recruitment), which is identical to the TOS 2 in the other trial at Minnipa (EPFS Summary 2018 article "Effect of sowing time x seed rate x herbicides on ryegrass management in wheat"). The successful recruitment of ARG plants in the Boxer Gold treatment was 0.026 (2.6%) and 0.022 (2.2%) for Sakura + Avadex.

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. SBU was only increased by about 25% (8% to 10% SBU for 25 cm spacing) when the DBS splitter boots were used. This was not a big enough change in SBU to have a significant effect on ryegrass. Both herbicide treatments caused a 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 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).

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, the SBU (narrow vs wide spread) or by the interaction between these management factors (Figure 4). In 25 cm rows wheat produced 2.22 t/ha grain yield, which was greater than the 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.

What does this mean?

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.

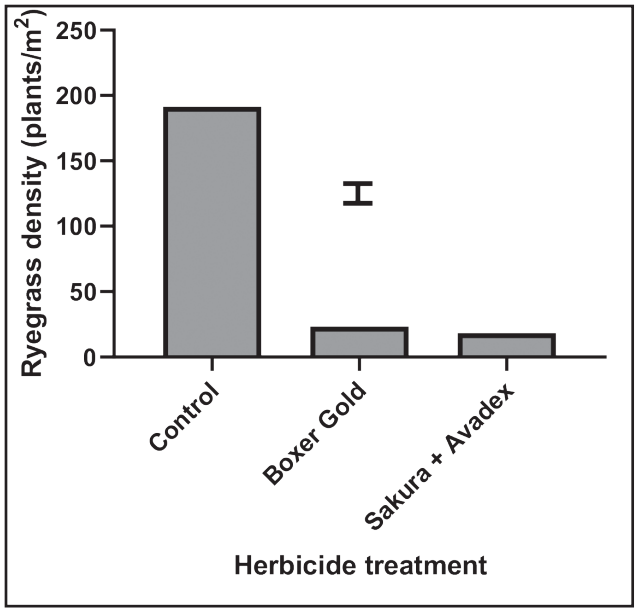

Figure 1 The effect of herbicide treatments on ryegrass plant density. The vertical bar represents the LSD (P=0.05).

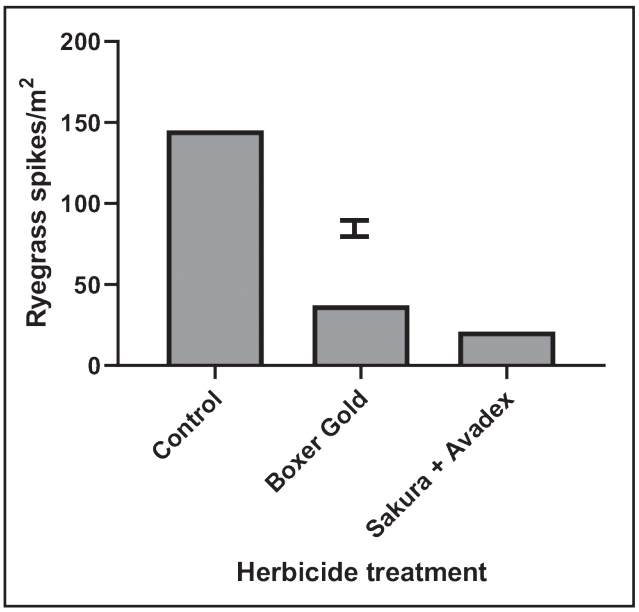

Figure 2 The effect of herbicide treatments on the density of ryegrass spikes. The vertical bar represents the LSD (P=0.05).

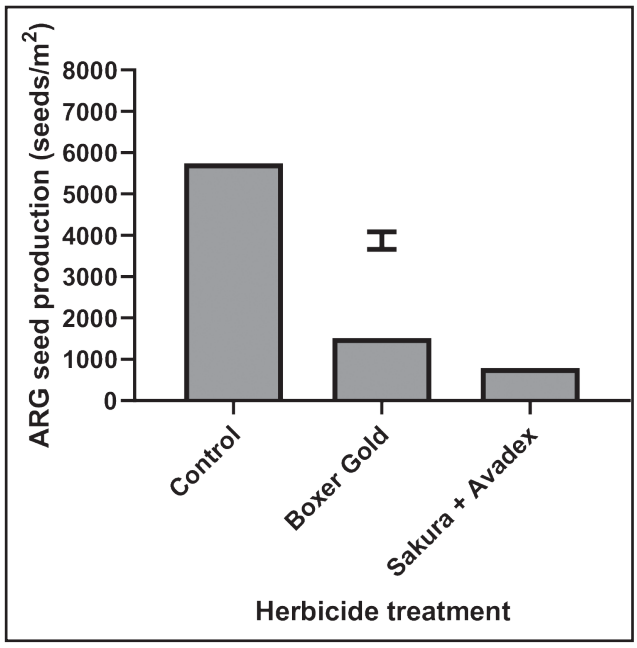

Figure 3 The effect of herbicide treatments on the ryegrass seed production. The vertical bar represents the LSD (P=0.05).

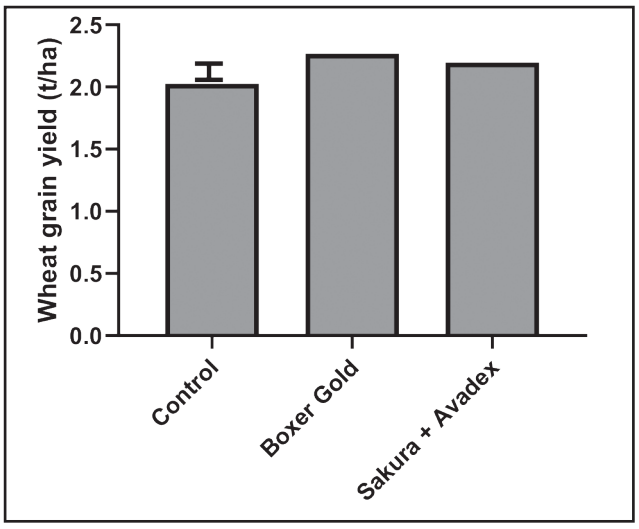

Figure 4 The effect of herbicide treatments on wheat grain yield. The vertical bar represents the LSD (P=0.05).

Application of Boxer Gold or Sakura + Avadex provided a significant increase in wheat grain yield (Figure 4). These results also highlight the point that ARG is not highly competitive in wheat. The 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 a 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.

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