Effect of planting arrangements of wheat and pre-emergence herbicides on annual ryegrass management (Roseworthy, SA)

Abstract

Wheat plant density was significantly affected by the planting arrangement (P=0.027) and the herbicide treatment (P<0.001). The Ribbon seeder system had the highest wheat density (196 plants/m^2) as compared to the knife-point system (180 plants/m^2) and the Zero row spacing (177 plants/m^2). Wheat plant density in the inter-row space in the Zero row spacing treatment was reduced by Treflan + Avadex and Boxer Gold. Annual ryegrass plant density was only affected by the herbicide treatments (P<0.001). Pre-emergent herbicide activity was much lower than expected (24-29% efficacy) and is likely to be due to extremely dry soil conditions at the site (decile 1 growing season). Similarly, the reduction in ryegrass spike density by the herbicides relative to the untreated control was low and ranged from 6 to 24%. There was no significant reduction in ryegrass seed production by the herbicide treatment, which was surprising because Sakura and Boxer Gold did reduce ryegrass spike density. However, ryegrass responded to reduced spike density in these treatments by increasing seed production per spike. For example, ARG in Sakura plots produced 41 seeds per spike as compared to 35 seeds per spike in the untreated control. Ryegrass was able to produce 18-20,000 seeds/m^2 in different herbicide treatments, which highlights the poor efficacy of pre-emergent herbicide in dry conditions. Herbicide treatments had a significant effect on wheat grain yield with Sakura producing the highest yield (2.31 t/ha), closely followed by Boxer Gold (2.13 t/ha). Sakura and Boxer Gold treatments increased wheat grain yield by 29% and 19% compared to the untreated control, respectively. These results show that ryegrass was quite competitive against wheat under the dry conditions experienced in 2018. The treatment of Sakura ($40/ha) increased wheat yield by 0.5 t/ha compared to the untreated control, which would have improved the gross margin by $150/ha.

Introduction

Row spacing at which crops are sown in Australia was originally increased to manage crop stubble but it leaves open spaces for weeds to invade and thrive. Some farmers are now considering narrowing their row spacing to achieve greater weed suppression. This has been feasible for the growers who are using single disc seeders but is a difficult proposition for no-till tine seeders. More recently, one of the innovative growers from Swan Hill in Victoria investigated a seeding system in which 2/3rd of the crop seed is sown at normal depth through tines but rest of the seed (1/3rd) is distributed on the soil surface in order to increase seedbed utilisation and make the crop more competitive with weeds. This system has been labelled 'zero-row spacing'. However, placing crop seeds on the soil surface is likely to achieve lower establishment rate than drilled seed especially during a dry start to the season. Furthermore, crop seeds on soil surface are more likely to be damaged by pre-emergent herbicides.

Methods

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

Trial site: Roseworthy

Planting arrangement/seeding systems (3)

1. Knife-point no-till (farmer practice),
2. Zero-row spacing (1/3rd crop seed spread on soil surface, rest will be drilled) and
3. Ribbon seeder no-till (splitter boots to increase SBU)

Herbicides (4)

1. Control (pre-sowing glyphosate treatment only)
2. Trifluralin 2 L/ha (480 g/L) + Avadex 2 L/ha (500 g/L) IBS
3. Boxer Gold 2.5 L/ha IBS
4. Sakura 118 g/ha IBS

Variety: Scepter wheat

Trial design: randomised complete block design (4 replicates)

Trial Management

Table 1. Key management operations undertaken.

Operation	**Details**
Seedbank sampling	24 April 2018
Sowing date	5 June 2018
Row spacing	25 cm
Target crop density	200 plants/m^2
Fertiliser at sowing	Diammonium phosphate (DAP) @ 100 kg/ha
In-crop fertiliser application	Urea @ 100 kg/ha at GS30
Pre-emergent herbicide treatments	Within 12 hours before crop sowing

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

Results and Discussion

Wheat plant density

Wheat plant density was significantly affected by the planting arrangement (P=0.027) and the herbicide treatment (P<0.001). The Ribbon seeder system had the highest wheat density (196 plants/m^2) as compared to the knife-point system (180 plants/m^2) and the Zero row spacing (177 plants/m^2). The reduction in wheat plant density was largely due to crop damage from the Treflan + Avadex treatment (Figure 1). Even though there was no interaction between the planting arrangement and herbicides, there was clearly a greater reduction in wheat density due to Treflan + Avadex in the Zero row spacing treatment.

Figure 1. The effect of pre-emergent herbicide treatments on wheat plant density. The vertical bar represents LSD (P=0.05).

The establishment of wheat plants in the inter-row space in the Zero row spacing treatment was also strongly influenced by the pre-emergent herbicide treatment. The highest wheat establishment in the inter-row space was present in the Control treatment (23% of the total density) and the lowest in Boxer Gold and Treflan + Avadex (9-10% of the total density). These results clearly suggest greater risk from pre-emergence herbicides in treatments where wheat seed is placed on the soil surface.

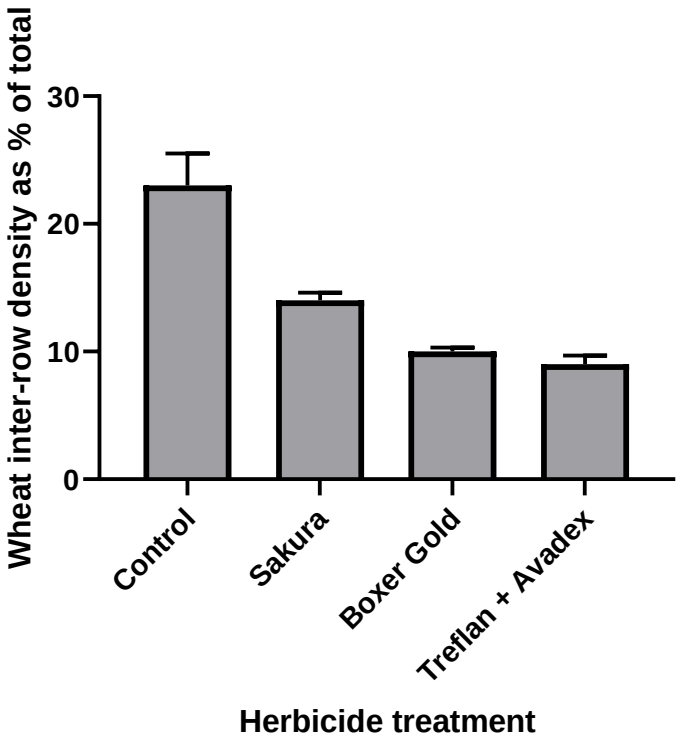

Figure 2. The effect of pre-emergent herbicides on wheat inter-row density expressed as a %age of the total wheat density.

Annual ryegrass plant and spike density

Annual ryegrass plant density was only affected by the herbicide treatments (P<0.001). Pre-emergent herbicide activity was much lower than expected (24-29% efficacy) and is likely to be the consequence of extremely dry soil conditions (decile 1 growing season). Similarly, the reduction in ryegrass spike density by herbicides relative to the untreated control was also low and ranged from 6 to 24% (Table 2). Ryegrass mortality was estimated from the spikes produced from the plant density present 4 weeks after sowing. There was large mortality of ryegrass (74 to 81%) irrespective of the herbicide treatment. This failure of many ryegrass plants to survive and produce spikes in the spring again highlights the severity of water stress during the 2018 growing season.

Table 2. The effect of herbicide treatments on annual ryegrass plant and spike density. Figures in brackets represent reduction in plant or spike density relative to the control treatment.

Herbicide treatment	Annual ryegrass			
	Plants/m^2	Spikes/m^2	Mortality (%)	Seed production (seeds/m^2)
Control	3177	613	80.7	21508
Sakura	2315 (27.1%)	467 (23.8%)	79.8	19214
Treflan +Avadex	2240 (29.5%)	578 (5.6%)	74.2	24922
Boxer Gold	2406 (24.3%)	474 (22.6%)	80.3	18082
LSD (P=0.05)	428.9	57.1	-	

Annual ryegrass seed production

The planting arrangement or the seeding system did not have a significant effect on ARG seed production (P=0.439). There was no significant reduction in ryegrass seed production by the herbicide treatment. This result is somewhat surprising because Sakura and Boxer Gold did reduce ryegrass spike density (Table 2). However, ryegrass responded to reduced spike density in these treatments by increasing seed production per spike. For example, ARG in Sakura plots produced 41 seeds per spike as compared to 35 seeds per spike in the untreated control.

Wheat grain yield

Wheat grain yield was significantly affected by the planting arrangement (P=0.009) and the herbicide treatments (P<0.001). Even though the differences between the planting arrangements in terms of grain yield were <10%, these differences were statistically significant (P=0.009). Herbicide treatments were also significantly different in terms of grain yield with Sakura producing the highest yield (2.31 t/ha), closely followed by Boxer Gold (2.13 t/ha). Sakura and Boxer Gold treatments increased wheat grain yield by 29% and 19% compared to the untreated control (Figure 3). These results show that ryegrass was quite competitive against wheat under the dry conditions experienced in 2018. The treatment of Sakura ($40/ha) increased wheat yield by 0.5 t/ha compared to the untreated control, which would improve the gross margin by $150/ha. Even though Sakura produced 10% greater yield than Boxer Gold, these differences were statistically non-significant. It is interesting to note that even though the herbicide treatments failed to significantly reduce ryegrass seed production, they still increased wheat grain yield and gross margin.

Figure 3. The effect of herbicide treatments averaged across the three planting arrangements. The vertical bar represents the LSD (P=0.05).