# 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=0.012). The Ribbon seeder system had the highest wheat density (171 plants/m<sup>2</sup>) as compared to the knife-point system (156 plants/m<sup>2</sup>) and the Zero row spacing (151 plants/m<sup>2</sup>). The establishment of wheat plants in the inter-row space in the Zero row spacing treatment was strongly influenced by the pre-emergent herbicide treatment (P=0.002). Trifluralin, Avadex or Boxer Gold were higher risk pre-emergent herbicides for wheat establishment, whereas Sakura appears much safer where wheat seed is placed on the soil surface in the Zero row spacing system. Annual ryegrass (ARG) plant density was not significantly affected by the planting arrangement (P=0.513) or pre-emergent herbicide treatments (P=0.13). ARG spike density was not significantly influenced by wheat planting arrangement (P=0.185). Herbicide treatment did have a significant influence on ARG spike density (P=0.023) and ARG seed production (P=0.003). The best performing herbicide treatment of Sakura + Avadex still produced 16824 ARG seeds/m<sup>2</sup>. While this is 51% lower than the Treflan + Avadex, it will replenish the soil seedbank to a highly problematic level for the future. Wheat grain yield was significantly affected by the planting arrangement (P=0.034) and the herbicide treatments (P=0.004). Even though the differences in wheat yield were small <10% for planting arrangement and <14% for herbicide treatments, they were statistically significant.

## 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 2/3<sup>rd</sup> of the crop seed is sown at normal depth through tines but rest of the seed (1/3<sup>rd</sup>) 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

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. Trifluralin 2 L/ha (480 g/L trilfuralin) + Avadex Xtra 2 L/ha (500 g/L triallate) IBS
- 2. Boxer Gold (800 g/L prosulfocarb + 120 g/L s-metolachlor) 2.5 L/ha IBS
- 3. Sakura (850 g/kg pyroxasulfone) 118 g/ha IBS
- 4. Sakura (850 g/kg pyroxasulfone) 118 g/ha + Avadex Xtra (500 g/L triallate) 2L/ha

### Variety: Scepter wheat

Trial design: randomised complete block design (4 replicates)

## **Trial Management**

Table 1. Key management operations undertaken.

Operation	Details
Sowing date	15 May 2019
Row spacing	25 cm
Target crop density	200 plants/m <sup>2</sup>
Fertiliser at sowing	Diammonium phosphate (DAP) @ 120 kg/ha
In-crop fertiliser application	Urea @ 100 kg/ha at GS23 & GS30
Pre-emergent herbicide	Within 12 hours before crop sowing
treatments	

All data collected during the growing season was analysed using the Analysis of Variance function in GenStat version 19.0.

## **Results and Discussion**

#### Wheat plant density

Wheat plant density was significantly affected by the planting arrangement (P=0.012; Figure 1). The Ribbon seeder system had the highest wheat density (171 plants/m<sup>2</sup>) as compared to the knife-point system (156 plants/m<sup>2</sup>) and the Zero row spacing (151 plants/m<sup>2</sup>). The reduction in wheat plant density between the knife point system and Zero row spacing was largely due to crop damage from pre-emergent herbicide treatments (Figure 2).



Figure 1. The effect of planting arrangement on wheat plant density (P=0.012). 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 reduced by the pre-emergent herbicide treatment (P=0.002). The highest wheat establishment

efficiency in the inter-row space was present in the Sakura treatment (76% of the total spread seed) and the lowest in Treflan + Avadex (20% of the total spread seed). Boxer Gold and the Sakura + Avadex treatments had an inter-row establishment efficiency of 42% and 35% respectively. These results clearly suggest Trifluralin, Avadex or Boxer Gold are higher risk pre-emergent herbicides for the Zero row spacing. Whereas Sakura appears much safer where wheat seed is placed on the soil surface.





#### Annual ryegrass plant and spike density

Annual ryegrass (ARG) plant density was not significantly affected by the planting arrangement treatments (P=0.513). Surprisingly, pre-emergent herbicide treatments did not have a significant effect on ARG plant density (P=0.13). There is some history of trifluralin resistance at the site and testing of seed for Boxer Gold is being conducted following these results. However, given that all pre-emergent herbicides in this study performed poorly, it is likely that low soil moisture conditions at seeding reduced herbicide efficacy. Figure 3 shows rainfall for the 34 days following the first significant rainfall event at the site on 10 May, five days prior to sowing wheat. While there was some soil moisture at the time of sowing, the seedbed conditions were drying over the next four weeks. A drying soil profile can be challenging for the efficacy of pre-emergent herbicides. By the time adequate soil moisture is present to solubilise herbicides in such seasons, ARG plants are at 2-3 leaf stage and more tolerant to herbicides and some of the herbicide applied has partially degraded.



Figure 3. The distribution of rainfall in the days following the first significant rainfall event on 10 May. Sowing date of wheat shown by the arrow (15 May 2019).

ARG spike density was not significantly influenced by wheat planting arrangement (P=0.185). However, herbicide treatment did have a significant influence on ARG spike density (P=0.023). Despite pre-emergent herbicide treatments not having a significant impact on ARG plant density, they suppressed weed growth and reduced ARG spike density. The worst performing herbicide treatment was Treflan + Avadex (527 spikes/m<sup>2</sup>) and the best treatment of Sakura + Avadex had a 44% lower ARG spike density of 297 spikes/m<sup>2</sup> (Figure 4).



Figure 4. The effect of pre-emergent herbicides on ARG spike density (P=0.023). The vertical bar represents the LSD (P=0.05).

#### Annual ryegrass seed production

Consistent with the trend for spike density, ARG seed production was also not significantly influenced by wheat planting arrangement (P=0.181). However, herbicide treatment did have a significant influence on ARG seed production (P=0.003). Despite pre-emergent herbicide treatments not having an effect on controlling ARG plants they did have a significant impact on suppressing ARG seed production (Figure 5). The best performing herbicide treatment of Sakura + Avadex still produced 16824 ARG seeds/m<sup>2</sup>. While this is 51% lower than the Treflan + Avadex is will replenish the soil seedbank at a highly problematic level in the future.



Figure 5. The effect of pre-emergent herbicides on ARG seed production (P=0.003). The vertical bar represents the LSD (P=0.05).

#### Wheat grain yield

Wheat grain yield was significantly affected by the planting arrangement (P=0.034) and the herbicide treatments (P=0.004). Even though the differences between the planting arrangements in grain yield were <10%, these differences were statistically significant (P=0.034; Figure 6). Herbicide treatments were also significantly different in terms of grain yield with Sakura + Avadex producing the highest yield (3.24 t/ha), which was 14% higher yielding than the Treflan + Avadex (Figure 7). These results show that ryegrass was quite competitive against wheat under the dry conditions experienced in 2019. It is interesting to note that even though the herbicide treatments failed to significantly reduce ryegrass plant density, they still suppressed ARG spike density, seed set and increased wheat grain yield.



Figure 6. The effect of planting arrangement on wheat grain yield (P=0.034). The vertical bar represents LSD (P=0.05).



Figure 7. The effect of herbicide treatments averaged across the three planting arrangements on wheat grain yield. The vertical bar represents the LSD (P=0.05).