Effect of combinations of sowing time, cultivar, seed rate and herbicides on ryegrass management in canola (Frances, SA)

Abstract

A field trial was undertaken in 2020 to investigate the effects of sowing time, canola variety, seed rate and herbicides on annual ryegrass management at a high rainfall site in South Australia (Frances). As expected, canola plant density was also significantly influenced by the seed rate ($P<0.001$). The lower seed rate had 26 plants/m^2 as compared 52 plants/m^2 in the higher seed rate. Therefore, crop seed rates selected were able to achieve the target crop density. Delayed sowing did not have any effect on in-crop ryegrass density ($P=0.355$). Application of pre- and post-emergent herbicide treatments resulted in a significant reduction in ARG plant density. However, there were no differences in ARG plant density between the herbicide treatments. These trends were also reflected in ARG spike density. The large amount of spikes produced by ARG in all the treatments indicates high tiller production by the plants that survived herbicide treatments as well as later emergence of ARG at this site. ARG spike production, which is the main determinant of its seed production, was significantly affected by canola variety ($P=0.007$). Hybrid variety Hyola 650TT was able to reduce ARG spike density by almost 50% compared to open-pollinated Wahoo. As seen with ARG spike density, canola variety had a significant effect on ARG seed set. Hybrid canola Hyola 650TT reduced ARG seed set by 73% as compared to the open-pollinated Wahoo ($P=0.017$). Herbicide treatments also had a significant effect ($P=0.014$) on ARG seed set. The treatment where Select + Factor + Atrazine were used post-emergent was the best performer with significantly lower ARG seed set than the other three treatments. Addition of Factor (butroxydim) has been shown to significantly improve control of clethodim resistant ARG populations. Canola variety selection also had a significant effect on grain yield ($P<0.001$). Hyola 650TT produced significantly higher grain yield than the open-pollinated Wahoo. These results clearly highlight the benefits of good early vigour of the hybrid variety for grain yield and weed suppression in this high rainfall environment.

Introduction

Sowing time of canola can have a large impact on crop yield. Many farmers have adopted early sowing in canola including dry seeding because of its positive impact on early crop vigour and grain yield. The impact of early seeding on annual ryegrass management is not well understood. Another uncertainty is related to the negative effects of dry soil conditions in early seeding on the performance of pre-emergent herbicides. The review of Widderick et al. (2015) also recommended research on sowing time in many crops.

This field trial was undertaken Frances in SA, a high rainfall environment, to investigate factorial combinations of sowing time, cultivar, seed rate and herbicides on the management of annual ryegrass in triazine tolerant canola.

Methods

This field trial was established in a split-split plot design and investigated combinations of the following management tactics.

1. **Main plot - sowing time (2)**: early May and late May
2. **Sub-plot – variety x seed rate (4)**:

a. **Variety**: Hyola 650TT (triazine tolerant hybrid) and Wahoo (triazine tolerant open pollinated)
b. **Seed rate**: 25 and 50 seeds/m^2

3. **Herbicides (4)**:

(i) Untreated Control (knockdown treatment only)
(ii) Atrazine @ 2.2 kg/ha IBS fb Select @ 500 mL/ha POST
(iii) Rustler (propyzamide) @ 1 L/ha + Atrazine @ 2.2 kg/ha IBS
(iv) Rustler (propyzamide) @ 1 L/ha + Atrazine @ 1.1 kg/ha IBS fb Select @ 375 mL/ha POST + Factor 80 g/ha + Atrazine @ 1.1 kg/ha POST

Replicates: 3

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

Trial Management

Table 1. Key management operations undertaken.

Operation	**Details**
Location	Frances, SA
Seedbank soil cores	April, 2020
Plot size	1.5 m x 8 m
Seeding date	TOS 1: 4 May, 2020 TOS 2: 25 May, 2020
Fertiliser	At sowing – 140 kg/ha 18:13:0:10 3% Zn + 400ml Flutriafol
Variety	Hyola 650TT and Wahoo triazine tolerant canola
Seeding rate	25 and 50 seeds/m^2
Herbicides	Pre-Emergent herbicides applied immediately before seeding IBS; Post Emergent (POST) herbicides 23 June (TOS 1) and 14 July (TOS 2). POST applied when canola was at 4 leaf stage.

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

In 2020, the site received above-average rainfall in autumn but the rainfall was below-average for the winter months. However, the season finished well with above average rainfall in September and October. Both annual and growing season rainfall at the site in 2020 were slightly greater than the long-term average (Table 2).

Table 2. Rainfall received at Frances in 2020 and the long-term average for the site.

	Rainfall (mm)	
Month	**2020**	**Long-term average**
Jan	24.2	22.0
Feb	51.2	21.5
Mar	5.6	23.9
Apr	61.0	36.0
May	62.6	52.7
Jun	49.0	59.7
Jul	40.4	65.5
Aug	56.6	65.9
Sep	65.8	57.6
Oct	65.4	49.5
Nov	21.2	34.7
Dec	20.8	29.5
Annual total	400.8	386.9
GSR total	523.8	518.5

Results and Discussion

Canola plant density

Canola plant density was significantly affected by the sowing time with average density of 41 plants/m^2 in TOS 2 and 37 plants/m^2 in TOS 1 (P=0.01). The week leading up to the seeding in TOS 2 received 25 mm rainfall, which led to excellent seed-bed conditions for canola establishment. As expected, canola plant density was also significantly influenced by the seed rate (P<0.001). The lower seed rate had 26 plants/m^2 as compared 52 plants/m^2 in the higher seed rate. Therefore, crop seed rates selected were able to achieve the target crop density.

Annual ryegrass plant and spike density

The trial site had a fairly low density of annual ryegrass (Table 3). Delayed sowing did not have any effect on in-crop ryegrass density (P=0.355). Application of pre- and post-emergent herbicide treatments resulted in a significant reduction in ARG plant density. However, there were no differences in ARG plant density between the herbicide treatments. These trends were also reflected in ARG spike density (Table 3). The large of spikes produced by ARG in all the treatments indicates high tiller production by the plants that survived herbicide treatments as well as later emergence of ARG at this site. It appears ARG is likely to set a large amount of seed in such a high rainfall environment even when targeted with several herbicides.

ARG spike production, which is the main determinant of its seed production, was significantly affected by canola variety (P=0.007). Hybrid variety Hyola 650TT was able to

reduce ARG spike density by almost 50% compared to open-pollinated Wahoo. Excellent expression of hybrid vigour in Hyola 650TT was highly effective in suppressing ARG growth in this trial (Figure 1).

Table 3. Effect of herbicide treatments on annual ryegrass (ARG) plant density (P=0.003), spike density (P=0.007) and seed production (P=0.014) in canola. Treatment means followed by a different letter are significantly different at P=0.05.

Treatment	**ARG plants/m^2**	**ARG spikes/m^2**	**ARG seeds/m^2**
Untreated Control (knockdown treatment only)	11.5 b	484 b	37771 b
Atrazine @ 2.2 kg/ha IBS fb Select @ 500 mL/ha POST	2.9 a	169 a	22890 b
Rustler (propyzamide) @ 1 L/ha + Atrazine @ 2.2 kg/ha IBS	2.6 a	158 a	29938 b
Rustler (propyzamide) @ 1 L/ha + Atrazine @ 1.1 kg/ha IBS fb Select @ 375 mL/ha POST + Factor 80 g/ha + Atrazine @ 1.1 kg/ha POST	3.2 a	172 a	3567 a

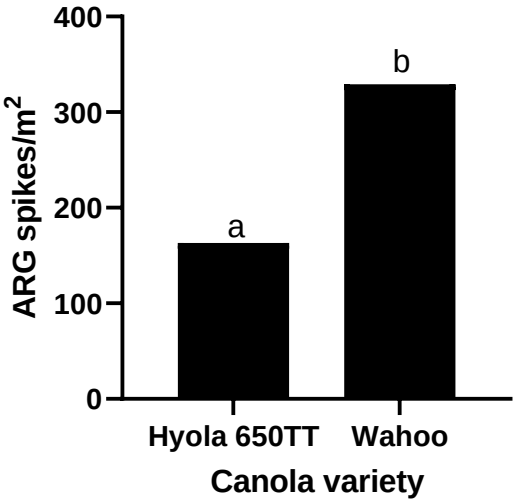

Figure 1. Effect of canola variety on annual ryegrass (ARG) spike density (P=0.007). Different letters above each variety indicate significant differences (P=0.05).

Annual ryegrass seed production

As seen with ARG spike density, canola variety had a significant effect on ARG seed set (Figure 2). Hybrid canola Hyola 650TT reduced ARG seed set by 73% as compared to the open-pollinated Wahoo (P=0.017). Herbicide treatments also had a significant effect (P=0.014) on ARG seed set (Table 3). The treatment where Select + Factor + Atrazine were used post-emergent was the best performer with significantly lower ARG seed set than the other three treatments. Addition of Factor (butroxydim) has been shown to significantly improve control of clethodim resistant ARG populations. This appears to be the most likely reason for the large suppression of ARG plants and seed set in this trial.

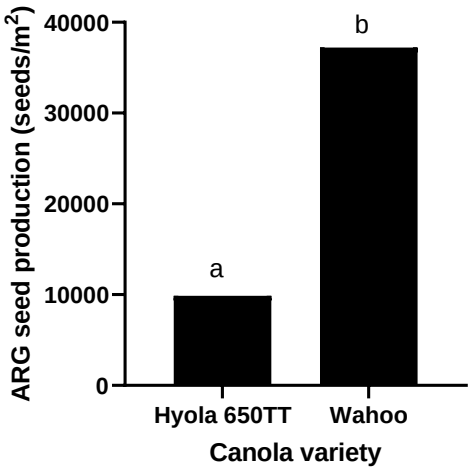

Figure 2. Effect of canola variety on annual ryegrass (ARG) seed production (P=0.017). Different letters above each variety indicate significant differences (P=0.05).

Canola grain yield

Even though there was 10% yield penalty for delayed sowing (2.22 t/ha in TOS 1 Vs 2.02 t/ha in TOS 2), these differences were not significant (P=0.463). It appears short delay in canola seeding does not impose serious yield penalty in this high rainfall environment. Increase in canola seed rate resulted in a significant yield increase in both varieties (P=0.001; 2.01 t/ha at 25 plants/m^2 Vs 2.23 t/ha at 50 plants/m^2). Canola variety selection also had a significant effect on grain yield (P<0.001). Hyola 650TT produced significantly higher grain yield than the open-pollinated Wahoo (Figure 3). These results clearly highlight the benefits of good early vigour of the hybrid variety for grain yield and weed suppression (Figure 2) in this high rainfall environment. Interestingly, the herbicide treatments did not have a significant effect on grain yield at Frances (P=0.245). This tolerance of canola to ARG appears to be related to low weed density at this site (<15 plants/m^2).

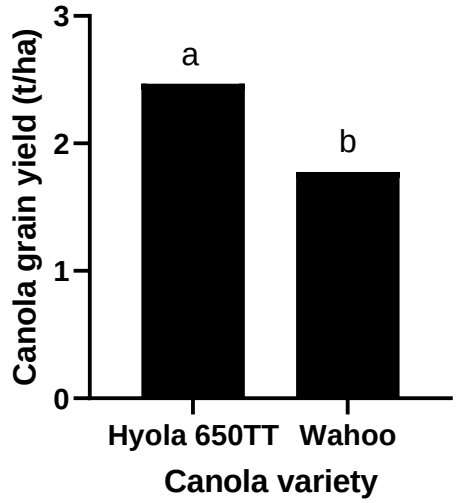

Figure 3. Effect of canola variety on canola grain yield (P<0.001). Different letters above each variety indicate significant differences (P=0.05).