Integration of crop competition and herbicide strategies for the management of annual ryegrass in canola

Gurjeet Gill & Ben Fleet, University of Adelaide
Sarah Noack, Hart Field-Site Group

Key findings

- Atrazine pre-sowing followed by clethodim post-emergence reduced ryegrass plant density relative to the untreated control by 57%. The use of propyzamide pre-sowing, followed by atrazine and clethodim + Factor increased ryegrass control to 77%.
- Canola variety had a significant effect on ryegrass head density. When averaged across the sowing dates and herbicide strategies, ryegrass growing in HyTTec Trophy produced 52 heads/m^2 as compared to 78 heads/m^2 in ATR Bonito.
- Herbicide treatment application produced canola yields of around 0.8 t/ha, which was almost 50% greater than the yield obtained in the control. These results highlight the competitive ability of ryegrass against canola, especially in a dry 2018 season.

Why do the trial?

Farmers in the southern region have been gradually moving towards earlier sowing times for canola. In fact, many growers have been seeding canola into dry soil in mid-late April. Canola crops sown early tend to respond positively to the warm growing conditions and crop canopy closure can be rapid in such situations. Therefore, early sowing could be highly beneficial in achieving greater suppression of weeds such as ryegrass. Previous research has shown there can be differences in early vigour between hybrids and open pollinated TT varieties, which could play an important role in weed suppression. Therefore, it is important to investigate the combinations of sowing time x variety to identify best-bet cultural weed management tactics for canola.

The cost of hybrid canola seed is high (> $30 /kg) and many growers reduce their seeding rate to reduce production costs. Under weedy conditions, there may be a significant penalty for reducing plant density of hybrid varieties but this has not been tested experimentally. In Western Australia, French et al. (2016) showed that canola plant densities < 20 plants/m^2 were more vulnerable to ryegrass competition especially open-pollinated triazine tolerant varieties.

The aim of this trial is to investigate factorial combinations of sowing time, varieties and seed rate with herbicide strategies for ryegrass management.

How was it done?

Location	Washpool (near Spalding) *(rainfall refer to page 13)*		
Plot size	1.75 m x 10.0 m	**Fertiliser**	DAP (18:20) + Zn 2% @ 80 kg/ha
Seeding date	16th May, 2018 31st May, 2018		Urea (46:0) @ 100 kg/ha in-season
Varieties	Bonito (OP) HyTTec Trophy (hybrid) TT		
Seeding rates	25 plants/m^2 38 plants/m^2 50 plants/m^2		
Herbicides	HS1 - Atrazine 2.2 kg/ha IBS + clethodim 500 mL/ha at GS14 of ARG HS2 - Propyzamide 1 L/ha IBS + atrazine 1.1 kg/ha at GS12 of ARG + Clethodim 0.5 L/ha + Factor 80 g/ha at GS14 of ARG HS3 - Control (knockdown treatment only)		

Results and discussion

Canola plant density

Canola plant density was significantly influenced by seeding rate. Averaged across the two sowing dates, herbicide treatments and the two varieties, canola plant density increased from 32 plants/m^2 in the low seed rate to 44 plants/m^2 in the medium seed rate to 63 plants/m^2 in the high seed rate (Figure 1). Even though canola plant density in HyTTec Trophy was greater than Bonito by 10-20%, the differences between the two varieties were non-significant.

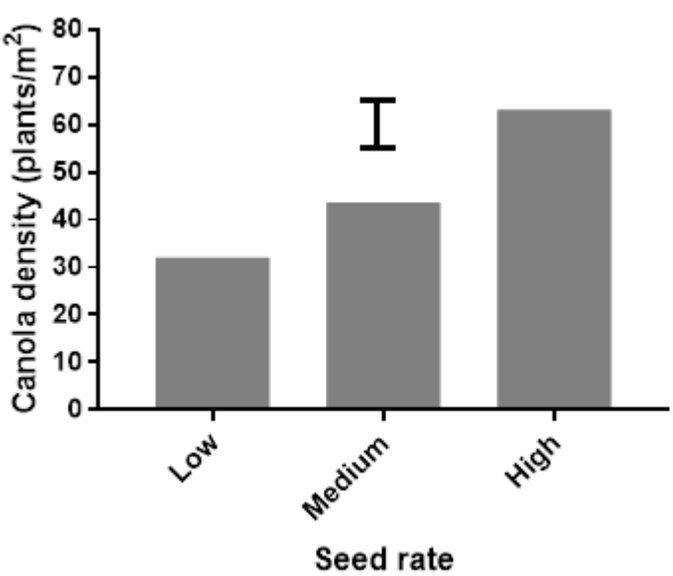

Figure 1. The effect of canola seed rate on its plant density. The vertical bar represents LSD (P=0.05).

Ryegrass plant and head density

The experimental site had a moderate infestation of annual ryegrass. In the control (nil herbicide) plots, ryegrass plant density was 88 plants/m^2 in sowing time one and 100 plants/m^2 in sowing time two. This result indicates that the two-week delay in sowing had no impact on annual ryegrass plant density. The herbicide strategy was the only factor to have a significant effect on ryegrass density. HS1 reduced ryegrass plant density relative to the control (nil herbicide) by 57% as compared to 77% reduction in HS2 (Figure 2 and Photo 1). However, the differences between these two herbicide strategies were non-significant.

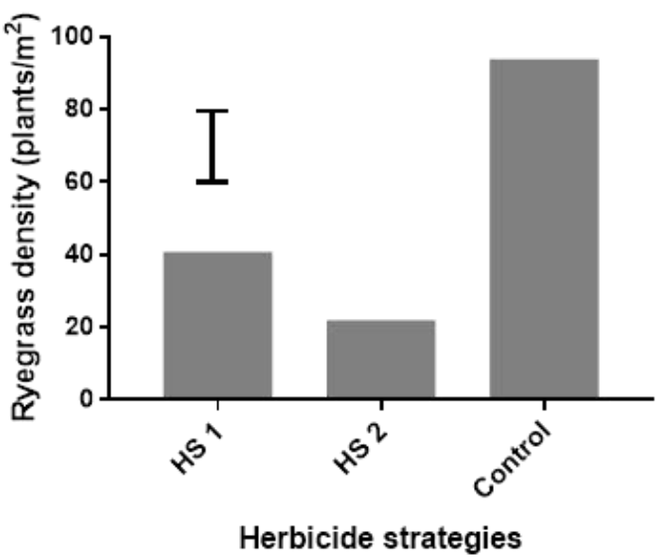

Figure 2. The effect of herbicide strategies on ryegrass plant density. The vertical bar represents LSD (P=0.05).

Data on ryegrass head density revealed greater differences between the management factors investigated. Canola variety had an effect on ryegrass head density. When averaged across the sowing dates and herbicide strategies, ryegrass growing in HyTTec Trophy produced 52 heads/m^2 as compared to 78 heads/m^2 in Bonito (33% reduction). HyTTec Trophy is a new hybrid triazine tolerant variety from Nuseed, which is known for high early vigour. In contrast, Bonito is an open pollinated canola variety from Nuseed. It is possible these differences in early vigour may have contributed to the significant differences in ryegrass head density between HyTTec Trophy and Bonito. However, in a similar trial at Hart in 2018, we were unable to detect differences in ryegrass control in these two canola varieties. The lack of differences at Hart, could be attributed to seasonal effects (reduced early vigour in general) and a lower ryegrass population.

Herbicide strategies also had a significant effect on ryegrass head density. Ryegrass grown without any selective herbicide treatment (control) produced 128 heads/m^2 as compared to 40 heads/m^2 in HS1 and 29 heads/m^2 in HS2. This works out to 69% reduction in HS1 relative to the control and 78% reduction in HS2.

There was a significant interaction between the time of sowing and the herbicide strategies. This interaction appears to be associated with greater ryegrass head density in time of sowing two, which may be an indication of reduced competitive ability of canola when sown later. However, herbicide activity against ryegrass was greater in time of sowing two which may be associated with wetter soil conditions leading to better herbicide uptake and activity (Figure 3). For example, HS2 only had 8 ryegrass heads/m^2 in the later time of sowing as compared to 50 heads/m^2 in time of sowing one.

Photo 1. Annual ryegrass in Bonito and HyTTec Trophy (medium seeding rate) under three herbicide strategies. Photos taken 11th Sept, 2018.

There was also an interaction between time of sowing, variety and herbicide, which was associated with superior weed competitive ability of HyTTec Trophy in time of sowing two. Ryegrass head density in Bonito increased from 100 heads/m^2 in time of sowing one to 193 heads/m^2 in time of sowing two. This highlights poorer competitive ability in later sown conditions. In contrast, ryegrass head density in HyTTec Trophy was similar in across both times of sowing (103 heads/m^2 and 114 heads/m^2).

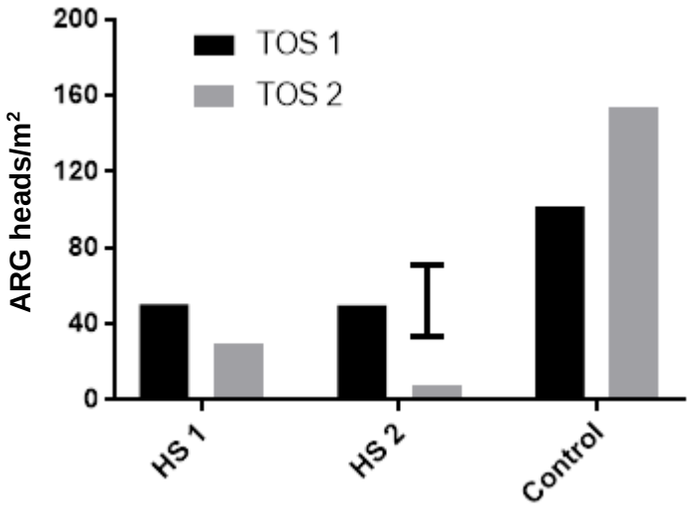

Figure 3. The interaction between sowing time and herbicide strategies (P<0.001) for ARG head density. The vertical bar represents LSD (P=0.05).

Annual ryegrass seed production

As was the case for ryegrass plant density, delayed sowing had no effect on ryegrass seed production. However, there were significant differences between the two canola varieties in ryegrass seed production. Averaged across the two sowing dates and herbicide treatments, ryegrass produced 3,775 seeds/m^2 in Bonito compared to 2,564 seeds/m^2 in HyTTec Trophy, a reduction of 32%. These results clearly highlight the potential for integrating vigorous hybrid varieties of canola for improving weed management.

Ryegrass seed production reflected the trends observed in head density data. There was a significant interaction between the time of sowing and herbicide strategies. Even though ryegrass seed set in the control was lower at the earlier time of sowing, when herbicide treatments were applied, ryegrass seed set was lower in time of sowing two (Figure 4). Greater herbicide activity in time of sowing two is likely to be due to better soil moisture at seeding time.

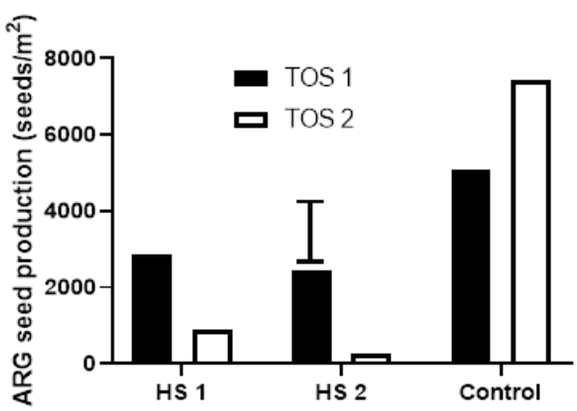

Figure 4. The effect of interaction between the time of sowing and herbicide treatments for ARG seed production. The vertical bar represents the LSD (P=0.05).

Canola grain yield

As expected, canola grain yield was reduced by the two-week delay in sowing dates. Averaged across the sowing dates, seed rates and herbicide treatments, HyTTec Trophy produced 40% greater grain yield than Bonito (0.50 t/ha Vs 0.83 t/ha). Canola seed rate also increased the grain yield; yield increased by 14% as plant density increased from 32 to 44 plants/m^2 and by 19% as density increased to 63 plants/m^2.

Herbicide strategies had the largest effect on canola yield. HS1 and 2 produced canola yield of around 0.8 t/ha, which was almost 50% greater than the yield obtained in the control (Table 1). These results highlight the competitive ability of ryegrass against canola, especially in a dry season such as 2018.

Table 1. The effect of three herbicide strategies on canola grain yield, averaged for both varieties.

Herbicide strategy	Canola grain yield (t/ha)
HS1 - Atrazine 2.2 kg/ha IBS + clethodim 500 mL/ha at GS14 of ryegrass	0.85
HS2 - Propyzamide 1 L/ha IBS + atrazine 1.1 kg/ha at GS12 of ryegrass + clethodim 0.5 L/ha + Factor 80 g/ha at GS14 of ryegrass	0.76
HS3 - Untreated control	0.39
LSD (P=0.05)	0.08

Gross margin analysis for the two varieties was undertaken based on grain yields averaged across the sowing dates, seed rates and herbicide treatments (Table 2). Based on the yield advantage of HyTTec Trophy over Bonito and taking into extra costs related to seed purchase and end point royalty, the gross margin for Trophy ($381) was $115/ha greater than for Bonito ($267). As oil content of canola grain was not determined, it is assumed that both varieties had a similar oil percentage.

Table 2. Estimation of gross margin for Bonito farmer retained seed and HyTTec Trophy. Canola yields for the two varieties are averages for the two sowing times, seed rates and herbicide treatments. Fertiliser and other management costs have been assumed to be identical for the two varieties.

Income	Bonito Farmer retained	HyTTec Trophy
Grain yield t/ha	0.50	0.83
Cash price $/t	550	550
Gross $/ha	276	457
Costs		
Seed cost per kg	2	19
Sowing rate kg/ha	3.7	3.5
Seed cost $	7	67
End point royalty $/t	5	10
EPR $/ha	2.5	8.3
Costs per ha	10	76
Gross margin $/ha	**267**	**381**

Acknowledgements

The authors thank the host grower and Clare SARDI team for assistance with trial management. We also acknowledge the investment from GRDC for the research into 'Cultural management for weed control and maintenance of crop yield' (9175134).