Effect of sowing time x cultivar x seed rate and herbicides on brome grass management in canola (Mallala, SA)

Abstract

The trial site at Mallala was infested with a large seedbank of group A resistant brome grass, which made weed control in canola very difficult. Furthermore, the trial site experienced drought like conditions for most of the growing season which reduced the efficacy of atrazine. Even though the two-week delay in sowing reduced brome grass density from 927 plants/m^2 in TOS 1 to 704 plants/m^2 in TOS 2 (25%), this difference was not statistically significant. However, the herbicide treatments (P=0.005) and the interaction between sowing date and herbicides (P=0.006) had a significant effect on brome grass plant density. Herbicide performance at the site was negatively affected by dry conditions and group A resistance in brome grass. As a result, even the best treatment combinations had more than 300 panicles/m^2, which could lead to a large seed set in brome grass. When averaged across the sowing time, seed rate and herbicides, HyTTec Trophy produced 38% higher grain yield than Bonito. This difference in variety performance is consistent with superior crop establishment in HyTTec Trophy than Bonito. As a result of herbicide resistance in brome grass, yield increase in the Verdict treatment compared to the control (atrazine POST) was non-significant. However, use of clethodim increased yield by 61% compared to the control, which was statistically significant.

Introduction

Farmers in the southern region have been gradually moving towards earlier sowing time of canola. In fact many growers now seed 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 very rapid in such situations. Therefore, early sowing could be highly beneficial in achieving greater suppression of weeds such as ryegrass. Widderick et al. (2015) have also identified sowing time as the highest priority for further research on cultural weed management in canola.

There are large differences in early vigour between hybrids and open pollinated TT cultivars. In field trials undertaken by the UA (2015 and 2016; UCS00020), hybrid canola cultivars were shown to provide 50% greater weed suppression than the open-pollinated ATR Stingray. Therefore, it is worth investigating factorial combinations of sowing time x cultivar to improve weed management in canola.

Cost of hybrid canola seed can be as high as $30/kg. Therefore, growers are often tempted to reduce the seed rate of canola crops to reduce their production costs but they hope that extra early vigour of hybrids will adequately compensate for reduced plant density. Under weedy conditions, there may be a significant yield penalty for reducing plant density even in hybrid varieties. In a recent study 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.

Methods

Trial site: Mallala, SA

This field trial investigated the effectiveness of non-chemical tactics (sowing time, varieties and seed rate) with herbicides for brome grass control in canola (refer to Table 1 for details). Management factors investigated were:

1. **Sowing time (2)**: late April and mid-late May [Main plot]
2. **Cultivar (2) x crop density (3)** [Sub-plot]
    i. Cultivars: Bonito and HyTTec Trophy
    ii. Seed rate: 0.5x, 0.75x and 1x (where x = target plant density of 50 plants/m^2); use 60 seeds/m^2 for 1x

3. **Herbicides (3) [Sub-sub plot]**
   (i) Control (pre-sowing glyphosate treatment followed by atrazine at 1.1 kg/ha at GS12)
   (ii) Atrazine (e.g. Gesaprim 900 WG) 2.2 kg/ha IBS fb Select 150 mL/ha at GS14 of brome grass
   (iii) Atrazine (e.g. Gesaprim 900WG) at 2.2 kg/ha IBS fb Verdict (haloxyfop 520) at 75 mL/ha at GS14 of brome

   Trial design: split-split plot design

Measurements: pre-sowing weed seedbank, crop density, weed density, brome grass panicle density, brome seed production per panicle, brome grass seed production, canola grain yield.

Trial Management

Table 1. Key management operations undertaken.

Operation	**Details**
Sowing date (sowing was delayed due to lack of rain in 2018)	TOS 1: 14 May, 2018 TOS 2: 1 June, 2018
Fertiliser at sowing	Diammonium phosphate @ 100 kg/ha
In-crop fertiliser application	TOS 1: Urea @ 100 kg/ha at 4-6 leaf stage – 19 July TOS 1: Urea @ 100 kg/ha just before stem elongation – 6 August TOS 2: Urea at 100 kg/ha at 4-6 leaf stage – 2 August TOS 2: Urea at 100 kg/ha just before stem elongation – 17 August
General broadleaf weed control	Archer® (clopyralid) at 300 mL/ha for common vetch control
Pre-emergent herbicide treatments	Within 12 hours of crop sowing
Post-emergent treatments	TOS 1: 25 July - Atrazine post + Hasten, Select 150ml + Hasten, Verdict 75mL +uptake TOS 2: 13 August - Atrazine post + Hasten, Select 150mL + Hasten, Verdict 75mL +uptake

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

Mallala experienced a very dry growing season in 2018. As compared to the long-term average rainfall for the growing season (April-October) of 297 mm, Mallala in 2018 only received 188 mm. Rainfall received in every month of the growing season, except August, was well below the long-term average (Figure 1).

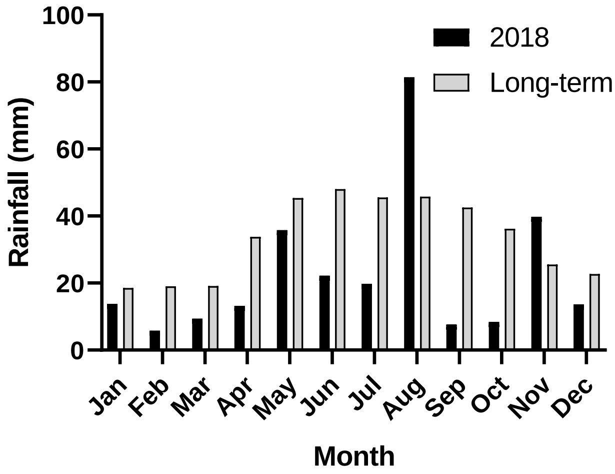

Figure 1. Rainfall received Mallala during the 2018 growing season.

Results and Discussion

Brome grass seedbank and plant density

Assessment of soil cores taken from the trial site revealed large seed bank of brome grass (9509 ± 521 seeds/m^2). There was a gradient in brome grass seedbank across the trial site. Replicate 1 had a seedbank of 6692 ± 310 seeds/m^2, replicate 2 with 11197 ± 635 seeds/m^2 and replicate 3 with 10,639 seeds/m^2. Therefore, replicate 1 had a lower seedbank than replicate 2 and 3 but the whole site had an extremely high seedbank of brome grass. Herbicide screening and dose response trials later in the season revealed a very high level of resistance to the group A herbicides, especially FOPS. This high level of resistance to the group A herbicides explains the presence of such high levels of brome grass in the trial paddock.

Even though the two-week delay in sowing reduced brome grass density from 927 plants/m^2 in TOS 1 to 704 plants/m^2 in TOS 2 (25%), this difference was statistically non-significant. However, the herbicide treatments (P=0.005) and the interaction between sowing date and herbicides (P=0.006) had a significant effect on brome grass plant density.

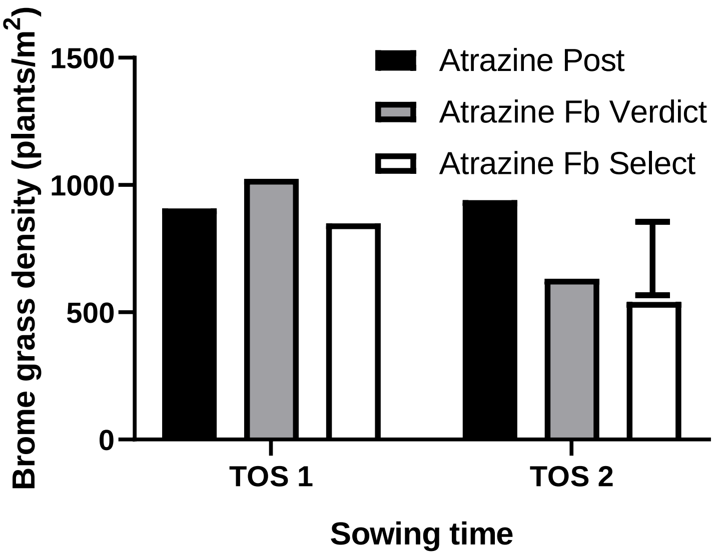

Figure 2. The effect of interaction between the time of sowing canola and herbicide tactics. The vertical bar represents LSD (P=0.05).

Due to dry conditions after TOS 1, pre-sowing atrazine incorporated by sowing (IBS) provided very little control of brome grass (Figure 2). Consequently, brome grass density in all 3 herbicide strategies was higher in TOS 1 than in TOS 2. High levels of resistance to haloxyfop (Verdict) identified in this population of brome grass is likely to be responsible for the moderate efficacy of this herbicide at the trial site. The level of recruitment of brome grass from the seedbank in the control ranged from 11% in TOS 1 and 10% in TOS 2. This relatively low level of seedling recruitment from the seedbank is likely to be related to extremely dry conditions in 2018 and is an indication of a high level of seedling mortality. It is also possible that the persistence of brome grass seedbank in a dry year could be greater than 15-20% expected in a season with higher rainfall.

Brome grass panicle density

Brome grass panicle production was significantly affected by sowing time (P=0.015) and the interaction between sowing time and herbicide treatments (P=0.001). As mentioned earlier, poor efficacy of atrazine applied pre-sowing and greater vigour of early germinating brome appears to be responsible for greater panicle density in atrazine followed by haloxyfop (Verdict) or clethodim (Select). The best treatment combinations had more than 300 panicles/m^2, which could lead to a large seed set in brome grass.

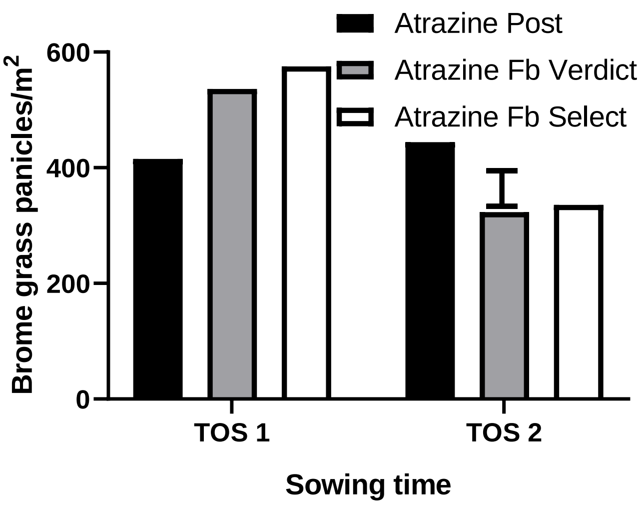

Figure 3. The effect of herbicide treatments applied at the two times of sowing on brome grass panicle density. The vertical bar represents the LSD (P=0.05).

Brome grass seed production

As a result of unexpected group A resistance in this population, none of the herbicide treatments provided effective weed control and weed seed production was very high. Brome grass seed was significantly affected by the time of sowing (P=0.009), variety (0.041), herbicide treatments (P<0.001) and the interaction between time of sowing and herbicide (P<0.001). When averaged across the varieties, seed rates and herbicide treatments, brome grass produced 19,234 seeds/m^2 in TOS 1 and 21,327 seeds/m^2 in TOS 2. HyTTec Trophy reduced brome grass seed production compared to Bonito by 11%. The significant interaction between the time of sowing and herbicide treatments appears to be largely related to the lower seed set in atrazine post-emergence plots. Brome grass in these plots grew so large that they ran out of plant available water in spring. As a result, weed seed set in atrazine post in TOS 1 was about half of the treatments where brome grass density had been reduced by the use of pre-sowing and post-emergence treatments (Figure 4). Such large production of brome grass seeds in this trial in all herbicide treatments would have significant rotational implications. Growers would be advised to introduce break crop options where the Clearfield® technology could be used (e.g. wheat followed by lentils). To bring such a large seedbank down to manageable levels would require effective control options for at least 2 years. Taking the paddock out of cropping and into a pasture phase with use of propyzamide and spray-topping could also be considered.

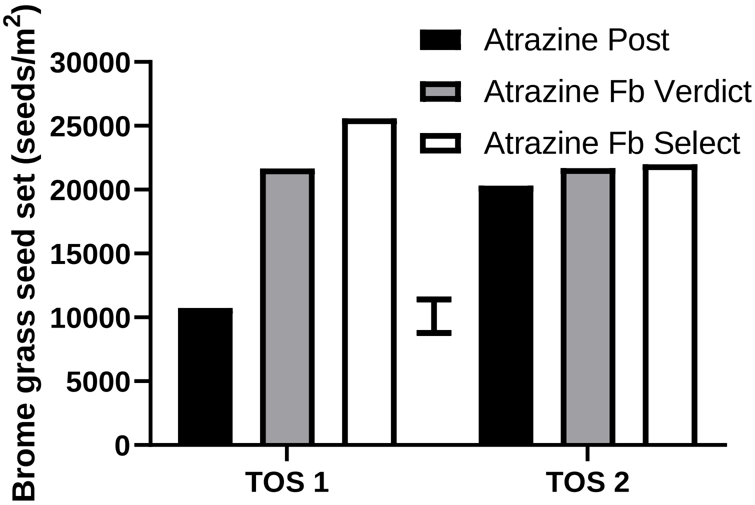

Figure 4. The effect of herbicide treatments applied at the two times of sowing on brome grass seed production. The vertical bar represents the LSD (P=0.05).

Canola plant density

Canola plant density was significantly influenced by the sowing time (P=0.05), seed rate (P=0.001), and variety (P=0.001). Even though May was dry in 2018 (79% of long-term average rainfall), June was even drier (46% of the long-term average rainfall). As a result, canola density in TOS 1 (48 plants/m^2) was significantly greater than in TOS 2 (29 plants/m^2). There were also significant differences between Bonito and HyTTec Trophy in canola plant density across the sowing dates, seed rates and herbicide treatments (P=0.001). Even though Bonito had a slightly higher 1000 seed weight than HyTTec Trophy (4.76 g Vs 4.55 g), Trophy produced significantly greater canola plant density. Average Bonito plant density was 34 plants/m^2 as compared to 42 plants/m^2 in HyTTec Trophy (Figure 4). This difference between the two canola varieties in crop establishment could be related to the hybrid vigour of HyTTec Trophy (Figure 5).

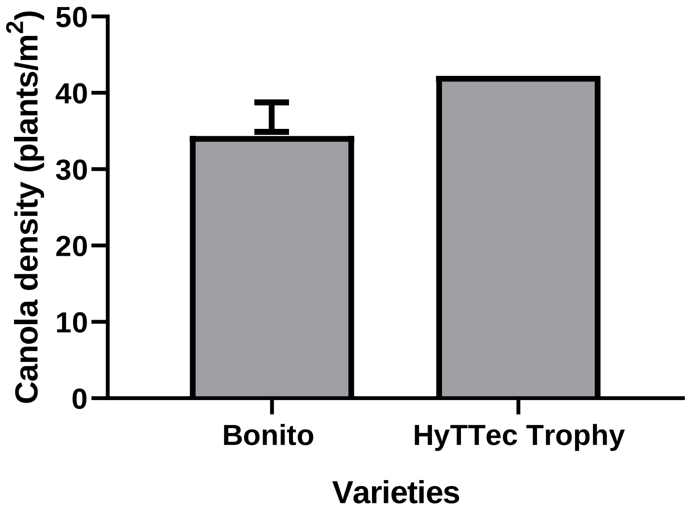

Figure 5. Canola plant density in Bonito and HyTTec Trophy. The vertical bar represents the LSD (P=0.05).

Canola plant density increased with seed rate from low (27 plants/m^2), medium (39 plants/m^2) and high (49 plants/m^2), which were very close to the target plant densities of 25, 38 and 50 plants/m^2.

Canola grain yield

As the average site yield was only 237 kg/ha due to drought like conditions in 2018, the results on grain yield from this trial need to be interpreted with caution.

Canola grain yield significantly influenced by the main effects of variety (P=0.001), seed rate (P=0.009) and the herbicide treatment (P<0.001). When averaged across sowing time, seed rate and herbicides, HyTTec Trophy produced 38% higher grain yield than Bonito (Figure 6). This discrepancy between the varieties is consistent with superior crop establishment in HyTTec Trophy than Bonito.

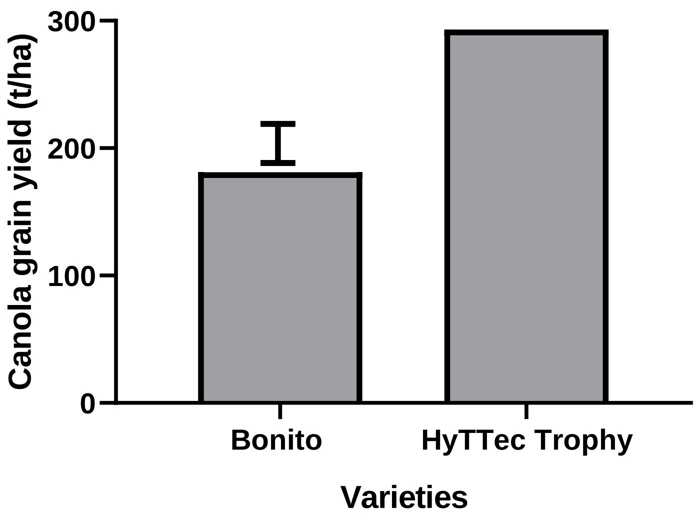

Figure 6. Effect of canola variety on its grain yield; the vertical bar represents LSD (P=0.05).

Even under the dry conditions experienced in 2018, canola grain yield increased significantly with improvement in weed control (Figure 7). As this brome grass population had a high level of resistance to the group A FOP herbicides, yield improvement in the Verdict treatment compared to the control (atrazine POST) was non-significant. However, use of clethodim increased yield by 61% compared to the control, which was statistically significant. As stated earlier, herbicide activity and canola yield expression would have seriously influenced by the extremely low rainfall received at the Mallala site in 2018. Even though the results follow the expected trends and make good biological sense, they should be interpreted with caution.

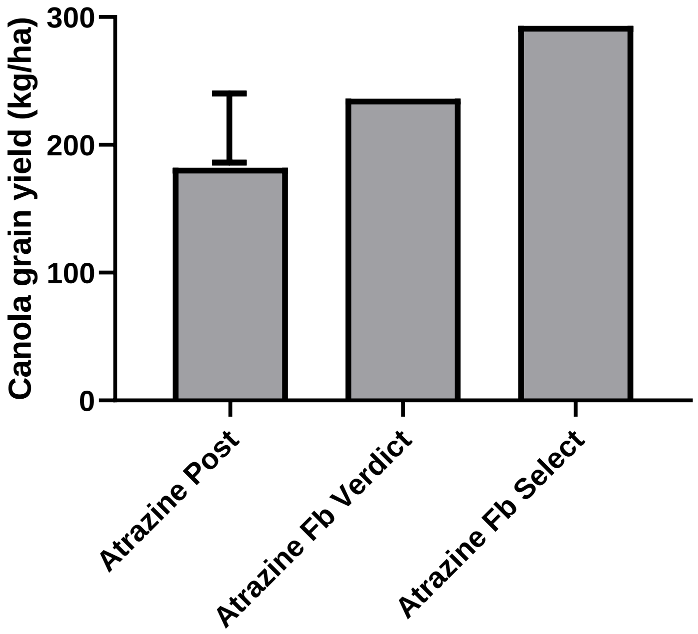

Figure 7. The effect of herbicide treatments on canola grain yield; the vertical bar represents the LSD (P=0.05).