FACTSHEET

Managing Resistant Ryegrass in Canola with Crop Competition and Pre-emergent Herbicides

Clethodim has been a major herbicide used to control annual ryegrass (*Lolium rigidum*) in canola and pulse crops in southern Australia. However, resistance to clethodim in ryegrass is increasing. Some growers have responded by using increased rates of this herbicide, but weed control often remains disappointing and the risk of crop damage in canola is high.

Crop competition practices such as decreasing row spacing, increasing seeding rates, and growing more competitive canola cultivars can all contribute to reducing the number and impact of weeds. Field trails in South Australia have demonstrated that competition afforded by hybrid canola in combination with pre-emergent herbicides, can greatly reduce ryegrass seed set. It is clear that crop competition could provide an effective simple-to-use tool for integrated management of herbicide resistant weeds.

Highlights

Greater weed control was achieved through crop competition offered by an hybrid triazine tolerant (TT) canola (Hyola559TT) compared to an open-pollinated TT (ATR-Stingray), especially when combined with an effective pre-emergent herbicide strategy.

- Ryegrass seed production was reduced by > 50% by hybrid canola (greater weed suppression);
- The hybrid cultivar better maintained grain yield in the presence of weeds, and was therefore more tolerant of weed competition than the conventional OP variety;
- Herbicide strategies that included applications of post-emergent atrazine were most effective;
- Crop competition is an easy and effective tool for integrated management of grass weeds in canola.

Hybrid vs Open-pollinated (OP): *(See GRDC's Canola Factsheet[1] for more information)*

- Hybrid canola is created by cross-pollinating specific male and female in-bred parents, with the aim of improving certain traits such as early vigour, yield, oil content, disease resistance and uniformity.
- Open-pollinated canola comes from seeds that are pollinated randomly by wind, insects or birds. The main issue with OP canola is that they are largely self-pollinated and hence inbred. This leads to the accumulation of deleterious recessive alleles that result in slower growth.

Research Approach

A field trial was established at Roseworthy, SA, in 2016 to investigate the effect of crop competition and different pre-emergent herbicides on annual ryegrass control in canola.

The trial was established in a split-plot design to compare a triazine tolerant (TT) open-pollinated (OP) cultivar (ATR-Stingray) with a TT-Hybrid (Hyola559TT), under six pre-emergent herbicide strategies.

Canola seed rate was adjusted to obtain a density of 35 plants/m^2.

Herbicide mixtures including applications of post-emergent atrazine, when ryegrass was at the 3-leaf stage, were also included.

Canola establishment was not affected by herbicide treatments.

Field trial site to investigate options for control of herbicide-resistant ryegrass.

Similar trials ran at Roseworthy in 2015 and 2017. Three TT cultivars, ATR Stingray, Hyola559TT and Hyola750TT, were examined in 2015 and the outcomes are in line with 2016 trial findings. In 2017, two cultivars were examined; ATR Bonito (OP) and Hyola559TT.

Ryegrass density is dictated by the herbicide strategy

All herbicide treatments reduced ryegrass populations in crop, by 60-80%, despite high ryegrass pressure.

Post-emergent atrazine application boosts ryegrass control considerably

The most effective herbicide treatments provided 78% control of ryegrass relative to the Nil, and both included post-emergence application of atrazine [treatments 4 & 6]. A 27% improvement in ryegrass control was achieved by following pre-emergent propyzamide/simazine application with post-emergent atrazine [treatments 6 vs 5]. This result highlights the benefit of extended weed control provided by post-applied residual herbicides, which becomes crucial in the absence of effective grass-selective herbicides, such as for clethodim, resistant, ryegrass populations. However, rainfall is required to get atrazine to work effectively.

Influence of canola cultivar and herbicide strategy on ryegrass density (12 weeks after sowing), ryegrass heads, and grain yield at Roseworthy in 2016. (PRE: Pre-emergent; POST: Post-emergent)

Herbicide Treatment (active ingredient/hectare)	**Spray Timing**	**Ryegrass plants/m^2**		**Ryegrass heads/m^2**		**Grain yield t/ha**	
		ATR-Stingray	Hyola 559TT	ATR-Stingray	Hyola 559TT	ATR-Stingray	Hyola 559TT
1. Nil	-	773	671	1186	748	0.17	0.96
2. Propyzamide 500g	PRE	437	417	1062	733	0.24	1.07
3. Propyzamide 500g + Triallate 1kg	PRE + PRE	325	299	1135	694	0.45	0.94
4. Simazine 1kg + Atrazine 1kg	PRE + POST	179	140	498	212	0.97	1.7
5. Propyzamide 500g + Simazine 1kg	PRE + PRE	386	321	753	510	0.54	1.12
6. Propyzamide 500g + Simazine 1kg + Atrazine 1kg	PRE + PRE + POST	127	182	610	367	0.99	1.41

Ryegrass seed-heads affected by canola cultivar & herbicide treatment

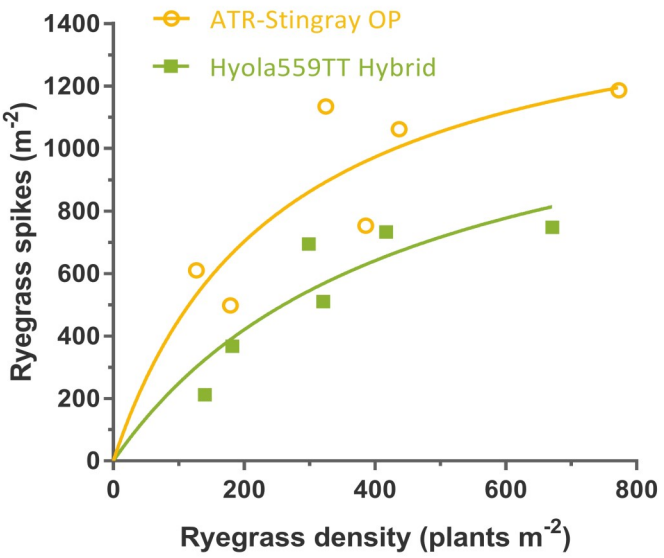
There were significant effects of both canola cultivar and herbicide treatment on the number of ryegrass spikes (seed-heads) produced, which in turn will affect its seed production. *See table on page 2.*

Hybrid canola was far more competitive against ryegrass than OP canola:

There were significantly more spikes of ryegrass growing in canola cultivar ATR-Stingray (OP) compared to Hyola559TT (874 vs 544 spikes m^{-2}), despite the presence of the same number of ryegrass plants. (Canola cultivar did not affect ryegrass density.)

The relationship between ryegrass plant and spike density equated to 2-fold higher seed-set per ryegrass plant for ATR-Stingray.

2016 results were similar to the 2015 trial, where significantly fewer seed-heads were produced by annual ryegrass growing in the two hybrid canola cultivars. Annual ryegrass seed production was approximately half in the hybrid crops compared to the open-pollinated canola, where herbicides were incorporated.



Seed-set was almost double for ryegrass competing with ATR-Stingray (OP) compared to Hyola559TT (hybrid) in 2016. This graph shows the relationship between ryegrass plant and spike densities across all herbicide strategies.

Post-emergent atrazine application reduced ryegrass spikes by 50%:

The herbicide strategies that best controlled ryegrass [treatments 4 & 6] also resulted in approximately 50% fewer spikes per plant compared to the Nil treatment. These treatments of either pre-emergent simazine [4] or pre-emergent propyzamide plus simazine [6], followed by post-emergent atrazine, were far more effective than standalone applications of pre-emergent herbicides [treatments 2, 3 & 5].

Ryegrass seed set was very similar to the untreated Nil in the absence of atrazine (e.g. PRE propyzamide [treatment 2] and PRE propyzamide plus triallate [treatment 3]). The high ryegrass seed-set that occurred under these treatments would likely result in a considerable blow-out in the seed bank.

Cultivar & herbicide treatment both affected canola yields significantly

ATR-Stingray yields declined far more sharply at low to moderate densities of ryegrass compared to Hyola559TT, reaching maximum yield loss at densities above 500 plants/m^2. Despite no difference in ryegrass density between the 2 cultivars, the grain yield of Hyola559TT averaged across all herbicide treatments was more than double that of ATR-Stingray (1.2 vs 0.56 t/ha).

Canola yields increased with greater ryegrass control, and were the highest in treatments 4 and 6 at around 1 t/ha for ATR-Stingray and 1.7 t/ha for Hyola559TT. Although the trial received well above average winter and spring rainfall, canola yields were generally low because of the high weed pressure. *See table on page 3.*

Vigour & early growth of hybrid canola increases its competitiveness

Canola traits such as rapid early growth, large leaves to shade weeds effectively, and large root systems to compete for water and nutrients, aid the competitiveness of canola against weeds like ryegrass. These traits are typically more strongly aligned to the growth displayed by hybrid cultivars.

The significantly larger amount of canopy cover from Hyola559TT resulted in greater suppression of weed growth, which in turn contributed to increased crop biomass, when compared to ATR-Stingray .

Crop ground cover was significantly higher for hybrid Hyola559TT relative to ATR-Stingray (OP), from crop emergence through to flowering.

It is possible to close the gap between OP cultivars and hybrids by choosing more competitive OP cultivars, sowing them at appropriate seeding rates and grading for seed size. For example, in our 2017 trial the OP cultivar ATR-Bonito, which has better early vigour than ATR Stingray, had the same ryegrass seed production as Hyola559TT, except in the absence of herbicides. This is in stark contrast to ATR Stingray (OP) versus Hyola559TT (2015 and 2016). Despite this, Hyola559TT better maintained grain yield in the presence of weeds (1.8 fold higher than OP, in untreated plots), meaning it was more tolerant of weed competition than was ATR-Bonito.

Summary

A combination of effective pre-emergent herbicides with more competitive cultivars of canola can significantly reduce ryegrass seed production, and may play a critical role in its longer-term management.

- Ryegrass seed production was reduced by more than 50% for the hybrid cultivar Hyola559TT, compared to open-pollinated ATR-Stingray, when effective herbicides were integrated.
- Hyola559TT better maintained grain yield in the presence of weeds, which clearly demonstrated its superior tolerance to ryegrass competition over ATR-Stingray and ATR Bonito.

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Resources: [1]GRDC Canola Factsheet: https://grdc.com.au/resources-and-publications/all-publications/bookshop/2010/10/canola-growing-hybrid-canola-fact-sheet