

Management of annual ryegrass in genetically modified (GM) canola for the medium rainfall zone

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Key findings

- Pre-emergent herbicides performed well at Hart, and in some cases reduced annual ryegrass populations by up to 80%.
- Trial results at Hart and Spalding show that equal control of annual ryegrass (ARG) was observed for various application timings and rates, particularly treatments with two in-crop spray regimes.
- The incorporation of clethodim to glyphosate tank mixes at the early in-crop timing (2 – 4 leaf), provided similar but effective control of ARG weeds on susceptible weed populations at Hart and Spalding.
- In susceptible ARG populations, lower rates of on-label glyphosate perform similarly to higher label rates.

Why do the trial?

In 2021, the genetically modified (GM) moratorium in South Australia lifted, providing mainland growers the opportunity to grow GM canola for the first time.

Canola technologies that growers have had access to include triazine tolerant and Clearfield® (imidazolinone tolerant) options, however, the development of metabolic resistance to these chemistries, including Group 1 (previously Group A) herbicides in weeds like annual ryegrass (ARG) has become of concern. Current resistance levels of annual ryegrass in South Australia (tested within the past 5 years) show that approximately 49% of paddocks have confirmed resistance to imidazolinone herbicides and > 10% to clethodim (Boutsalis et al. 2021).

New GM technology options including Roundup Ready® (RR) TruFlex® (XX) and LibertyLink®, in addition to other mixed tolerance options provide additional weed management tools on-farm, assisting growers to manage in-crop weeds through the use of glyphosate and glufosinate.

This project aims to demonstrate a best-use-approach for in-crop management of ARG in GM canola, particularly through the use of on-label glyphosate options. The trials also compare new technologies to current TT and CL management practices as a benchmark.

How was it done?

Hart			
Plot size	2.0 m x 10.0 m	Water rate	100 L/ha
Seeding date	May 7, 2021		
Location	Hart, SA		
Harvest date	November 9, 2021		
Spalding			
Plot size	2.0 m x 10.0 m	Water rate	100 L/ha
Seeding date	April 24, 2021		
Location	Spalding, SA		
Harvest date	NA		



Two SAGIT funded trials were conducted across the Mid-North region in 2021 at Hart and Spalding. The trials were set up as a randomised complete block design and were managed with the application of pesticides to ensure an insect and disease-free canopy. In-crop herbicide regimes focused on a two-spray approach, targeting the medium rainfall environments (Table 1 and 2). All in-crop applications of glyphosate targeted young ARG plants prior to tillering (Figure 1).

Hart

The main trial conducted at the Hart field site trialed 17 herbicide treatments comparing various rates and timings of glyphosate in Roundup Ready® and TruFlex® variety options (Table 2). Clearfield® and TT treatments were also included to compare new GM technologies to current options growers have access to. Technologies with LibertyLink® traits were also included.

Annual ryegrass seed with a known susceptibility to trialed herbicides was broadcast to trial plots and lightly incorporated prior to the application of herbicide treatments on May 7, 2021. Canola plots were then sown using a standard knife-point press wheel system on 22.5 cm (9") spacings. All plots were assessed for crop establishment (%), ARG weed counts (plants/m²), ARG head counts (heads/m²) and grain yield (t/ha).

Spalding

The second trial was located at Spalding due to dry seasonal conditions affecting early ARG populations and crop establishment at Hart. This trial was located in a paddock sown to TruFlex® canola, targeting eight in-crop spray regimes, comparing rates and application timings of two glyphosate products registered for in-crop use; Roundup Ready® PL and Crucial™, at label rates (Table 1). All plots were assessed for ARG weed counts (plants/m²) after each application timing. At this site, the pre-emergent herbicide used was trifluralin at 1.5 L/ha.

Table 1. Glyphosate treatments trialed at Spalding in 2021.

	Crop stage 6-8 L (1)		Crop stage 8-10 L (2)		1 st Flower (3)	
	Treatment	Rate	Treatment	Rate	Treatment	Rate
1	Roundup Ready® PL	1.67 L	-	-	-	-
2	Roundup Ready® PL	1.15 L	Roundup Ready® PL	1.15 L	-	-
3	Roundup Ready® PL	1.67 L	Roundup Ready® PL	1.67 L	-	-
4	-		Roundup Ready® PL	1.67 L	Roundup Ready® PL	1.67 L
5	Roundup Ready® PL	1.67 L	-	-	Roundup Ready® PL	1.67 L
6	Roundup Ready® PL + Clethodim 240 + Hasten™	1.15 L + 500 mL + 1%	Roundup Ready® PL	1.15 L	-	-
7	Crucial™	1.5L	Crucial™	1.5L	-	-
8	Crucial™	1L	Crucial™	1L	Crucial™	1L

Table 2. Herbicide treatments trialed at Hart in 2021.

	Technology	Pre-emergent (1)		PSPE (2)		Crop stage 2-4 L (3)		Crop stage 6-8 L (4)		1st Flower (5)	
		Treatment	Rate	Treatment	Rate	Treatment	Rate	Treatment	Rate	Treatment	Rate
1	CL	Propyzamide	1L	-	-	-	-	-	-	-	-
2	CL	Overwatch®	1.25 L	-	-	-	-	-	-	-	-
3	CL	Propyzamide	1L	-	-	Clethodim 240 + Intervix® + Hasten™	500 ml + 600 ml + 1%	-	-	-	-
4	CL	Overwatch®	1.25 L	-	-	Clethodim 240 + Intervix® + Hasten™	500 ml + 600 ml + 1%	-	-	-	-
5	TT	Propyzamide + Simazine	1L + 1kg	-	-	Clethodim 240 + Atrazine + Hasten™	500 ml + 1kg + 1%	-	-	-	-
6	TT	Overwatch®	1.25 L	-	-	Clethodim 240 + Atrazine + Hasten™	500 ml + 1kg + 1%	-	-	-	-
7	RR	Propyzamide	1L	-	-	Roundup Ready® PL	1.67 L	-	-	-	-
8	LibertyLink® + TT	Propyzamide	1L	Atrazine	1kg	Liberty® + Clethodim 240 + Uptake®	2L + 500 ml + 0.5%	Liberty® + Uptake®	2L + 0.5%	-	-
9	LibertyLink® + XX	Propyzamide	1L	-	-	Liberty® + Roundup Ready® PL + Uptake®	2 L + 1.67 L + 0.5%	Liberty® + Uptake®	2L + 0.5%	Roundup Ready® PL	1.67L
10	XX	Propyzamide	1L	-	-	Roundup Ready® PL	1.67 L	-	-	-	-
11	XX	Propyzamide	1L	-	-	Roundup Ready® PL	1.15 L	Roundup Ready® PL	1.15 L	-	-
12	XX	Propyzamide	1L	-	-	Roundup Ready® PL	1.67 L	Roundup Ready® PL	1.67 L	-	-
13	XX	Propyzamide	1L	-	-	Roundup Ready® PL	1.67 L	-	-	Roundup Ready® PL	1.67 L
14	XX	Propyzamide	1L	-	-	Roundup Ready® PL + Clethodim + Hasten™	1.15 L + 500 mL + 1%	Roundup Ready® PL	1.15 L	-	-
15	XX	Overwatch®	1.25 L	-	-	Roundup Ready® PL + Clethodim + Hasten™	1.15 L + 500 mL + 1%	Roundup Ready® PL	1.15 L	-	-
16	XC	Propyzamide	1L	-	-	Roundup Ready® PL + Intervix® + Hasten™	1.67 L + 600 mL + 1%	Roundup Ready® PL	1.67L	-	-
17	XT	Terbyne® Xtreme®	1kg	-	-	Roundup Ready® PL + atrazine + Hasten™	1.15 L + 1kg + 1%	Roundup Ready® PL	1.67L	-	-

Results and discussion

Seasonal conditions

Early growing season conditions at Hart were dry, with significant opening rain events occurring by May 25, approximately three weeks post-seeding. Poor seasonal conditions led to the late and staggered emergence of both canola and ARG. Dry April and May conditions were also followed by average June rainfall (43 mm) and a wetter than average July, of 63 mm. August was moderately dry, preventing conducive conditions to germinate late ryegrass populations.

Growing season rainfall trends experienced at Spalding were similar to Hart in 2021.

Pre-emergent herbicides

At Hart in 2021, pre-emergent herbicides performed well, and in some cases reduced annual ryegrass populations by up to 80% across the site (data not shown).

Propyzamide trialed at 1 L/ha provided increased weed control compared to Overwatch® at 1.25 L/ha at initial weed assessments; however, this result was likely due to the increased persistence of propyzamide in soils after a significant opening rain event in May (23 mm) following dry conditions and controlling ARG for a longer period of time.

By the second assessment timing, following the application of in-crop herbicides at crop stage 6 – 8 leaf, no differences in weed control were observed between treatments with propyzamide or Overwatch® applied.

In-crop weed management

Spalding trial results showed equal control of ARG for all treatments, particularly those incorporating two in-crop sprays. This result means that the same level of control was gained by applying two applications of glyphosate early in-season from crop stages 2–10 leaf, or applying one early, followed by a second application at flowering (Figure 2). These results were also observed at Hart and is a result of dry seasonal conditions, preventing the germination of later ARG populations emerging.

It was also evident that lower rates of on-label glyphosate, in this case Roundup Ready® PL at 1.15 L/ha performed similarly to higher label rates of 1.67 L/ha. This gives growers confidence that lower rates may be applied to susceptible ARG populations to achieve good in-crop weed control and reduce input costs (Table 3).

Preliminary data also suggests that TT, CL and LibertyLink® options trialed at Hart in 2021 provide similar levels of ARG control to glyphosate options, however, further trials will be required across multiple seasons to explore this further.

The incorporation of tank mixes at early in-crop timings, in this case clethodim (Group 1) at Hart and Spalding, provided similar but effective control of ARG. This result is likely due to susceptible ARG populations, however, incorporating additional modes of action into a spray program can reduce the potential development of metabolic resistance to herbicides while continuing to provide effective weed control.

Previous research conducted by Plant Science Consulting has shown that some populations of ryegrass have resistance to clethodim, glyphosate or both herbicides (Boutsalis et al. 2021). Pot studies conducted in 2020 show that tank mixes of 1.15L/Roundup Ready® PL and 500 ml/ha Clethodim 240 had effective control across most populations tested, with control of ARG averaging 95%, compared to 73% for standalone glyphosate and 79% for standalone clethodim (Boutsalis et al. 2021).



Figure 1. L-R: Plot treated with an in-crop application of glyphosate at 6 – leaf, compared to a plot prior to the planned application at 8-leaf, at Spalding.

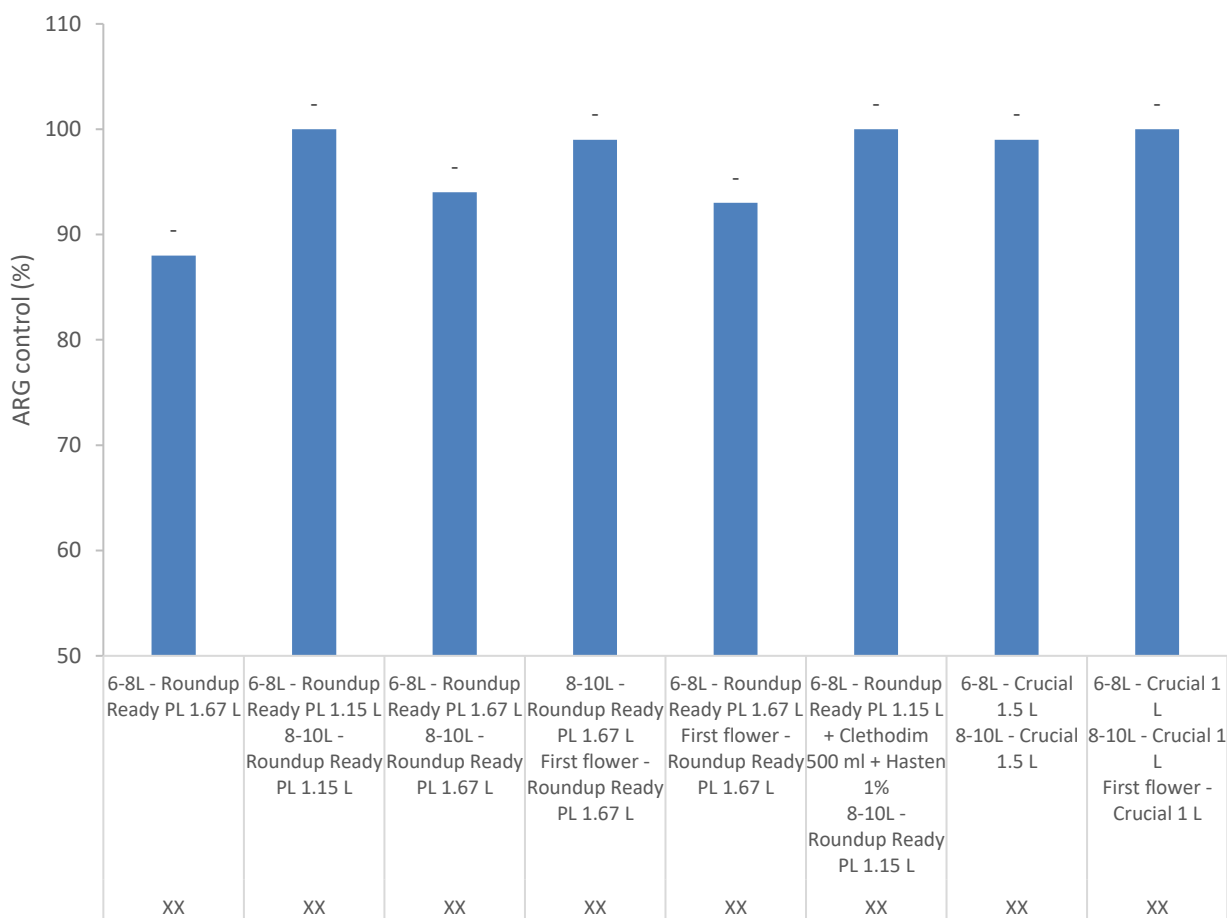


Figure 2. Annual ryegrass control (%) in TruFlex® canola at Spalding, 14 days post the application of in-crop glyphosate applied at first flower.

Table 3. Gross margins for various Roundup Ready®, TruFlex®, CL and TT canola technologies for targeted in-crop weed management strategies. This data is based on one season and should be used a guide only. An average canola yield for the medium rainfall zone has been used at 1.4 t/ha (TT = 1.3 t/ha).

Technology	Weed management strategy	Rates/ hectare	Gross margin \$/ha
Clearfield®	IBS: Propyzamide	1L	\$ 287.82
	Post-emergent – Clethodim 240 + Intervix + adjuvant	500 ml + 600 ml + 1%	
Clearfield®	IBS: Propyzamide	1 L	\$ 277.02
	Post-emergent: Clethodim 240 + Intervix + adjuvant Pre- harvest: glyphosate	500 ml + 600 ml + 1% 2 L	
Triazine Tolerant	IBS: Propyzamide + Simazine Post emergent: Clethodim 240 + Atrazine + adjuvant	1 L 500 ml + 1 kg + 1%	\$ 238.55
Roundup Ready®	IBS: Propyzamide	1 L	\$ 215.79
	Post-emergent: Roundup Ready PL (1 application)	1.67 L	
TruFlex®	IBS: Propyzamide Post-emergent: Roundup Ready PL (2 applications)	1 L 1.15 L + 1.15 L	\$ 212.39
	IBS: Propyzamide Post-emergent: Roundup Ready PL (2 applications)	1 L 1.67 L + 1.67 L	\$ 206.77
	IBS: Propyzamide Post-emergent: Roundup Ready PL + Clethodim Post-emergent: Roundup Ready PL	1 L 1.15 L + 500 ml 1.15 L	\$ 203.28
	IBS: Propyzamide Post-emergent: Roundup Ready PL + Clethodim Post-emergent: Roundup Ready PL	1 L 1.67 L + 500 ml 1.67 L	\$ 197.66
	IBS: Propyzamide Post-emergent: Roundup Ready PL + Clethodim Post-emergent: Roundup Ready PL Post-emergent: Roundup Ready PL	1 L 1.15 L + 500 ml 1.15 L 1.15 L	\$ 197.07
	IBS: Propyzamide Post-emergent: Roundup Ready PL Post-emergent: Roundup Ready PL Post-emergent: Roundup Ready PL	1 L 1.15 L 1.15 L 1.15 L	\$ 206.18

Values sourced from: Farm Gross Margin and Enterprise Planning Guide, 2021.



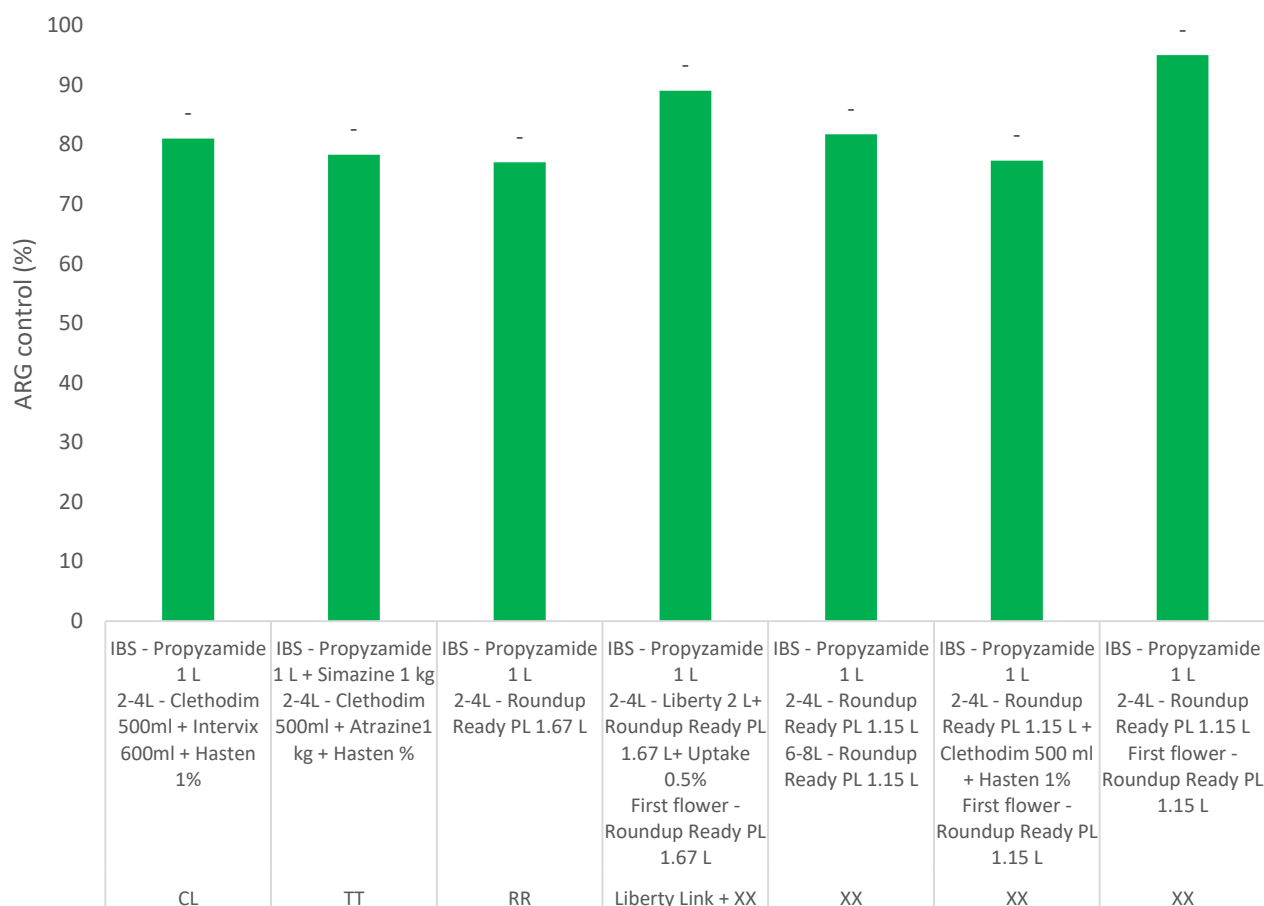


Figure 3. Annual ryegrass control (%) after the application of in-crop glyphosate was applied at first flower.

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References

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2021 Farm Gross Margin and Enterprise Planning Guide (2021).