

## Investigating alternative herbicide options for the control of resistant populations of annual ryegrass (*Lolium rigidum*)

**Trial Code:** GOWE04917-4  
**Year:** Autumn, 2017  
**Location:** Alectown  
**Trial Partners:** Roger Armstrong and Mat Shephard

### Keywords

GOWE049, Annual ryegrass, resistance, knockdown, adjuvants, RoundUp CT®, glyphosate, paraquat, wetters, Narromine

### Take home messages

- Paraquat or products with a paraquat component can provide good levels of control of annual ryegrass – though important to ensure adequate coverage
- Knowing the resistance status of ryegrass populations allows for use of most appropriate management options

Annual ryegrass (ARG) is exhibiting increasing levels of resistance to various herbicides across the Orana Region. Developing resistance to glyphosate is of the highest concern, as it is a key for ARG knockdown control in fallows. Effectiveness of glyphosate needs to be protected as much as possible to prolong its useful life.

This trial focuses on testing various knockdown options, including glyphosate tank mixes, for control of glyphosate resistant ryegrass.

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### Aim

Test efficacy of a range of knockdown herbicide options on control of ARG in populations with suspected resistance to glyphosate.

### Methods

This trial used a small plot randomised complete block split design with three replicates. It was established in growers' paddock with visible ARG population.

Herbicide treatments (Table 2), were applied using an ATV mounted boom.

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Results were analysed by ANOVA and results compared by using LSD method with a 95% confidence interval. Any references to differences between treatments should be assumed to be statistically different unless otherwise stated. The Analysis of Variance (ANOVA) and Least Significant Difference (LSD) tests are used to measure the difference between the averages. A statistically significant difference is one in which we can be confident that the differences observed are real and not a result of chance. The statistical difference is measured at the 5% level of probability, represented as 'P<0.05'. If there is no significant difference the P values are greater than 0.05.

**Table 1.** Trial site details

<b>Trial Establishment Date</b>	Autumn, 2017
<b>Soil Type</b>	Gravelly colluvium
<b>Previous Crop</b>	Wheat
<b>ARG resistance status</b>	Detailed in appendix- suspected resistance to RoundUp CT®

**Table 2.** Narromine site treatment list (a full list registered products and active ingredients is in the annex).

Product 1	Rate (mL or g)	Product 2	Rate (mL or g)	Adjuvant	rate %
Alliance®	4000	-	-	-	-
Clethodim	250	-	-	Uptake™	0.50%
Clethodim	500	-	-	Uptake™	0.50%
RoundUp CT®	750	Boxer Gold®	2500	-	-
RoundUp CT®	750	clethodim	250	Uptake™	0.50%
RoundUp CT®	750	Sledge®	150	-	-
RoundUp CT®	750	Sharpen®	34	-	-
RoundUp CT®	750	Verdict™	150	Uptake™	0.50%
RoundUp CT®	750	-	-	-	-
paraquat	2000	Balance®	100	-	-
paraquat	2000	Boxer Gold®	2500	-	-
paraquat	2000	diuron	280	-	-
A21304D	2400	-	-	Adigor™	0.50%
paraquat	1600	-	-	Wetter TX	0.25%
paraquat	2000	-	-	-	-
paraquat	2400	-	-	-	-
UTC	-	-	-	-	-
Verdict™	150	-	-	Uptake™	0.50%
Verdict™	300	-	-	Uptake™	0.50%

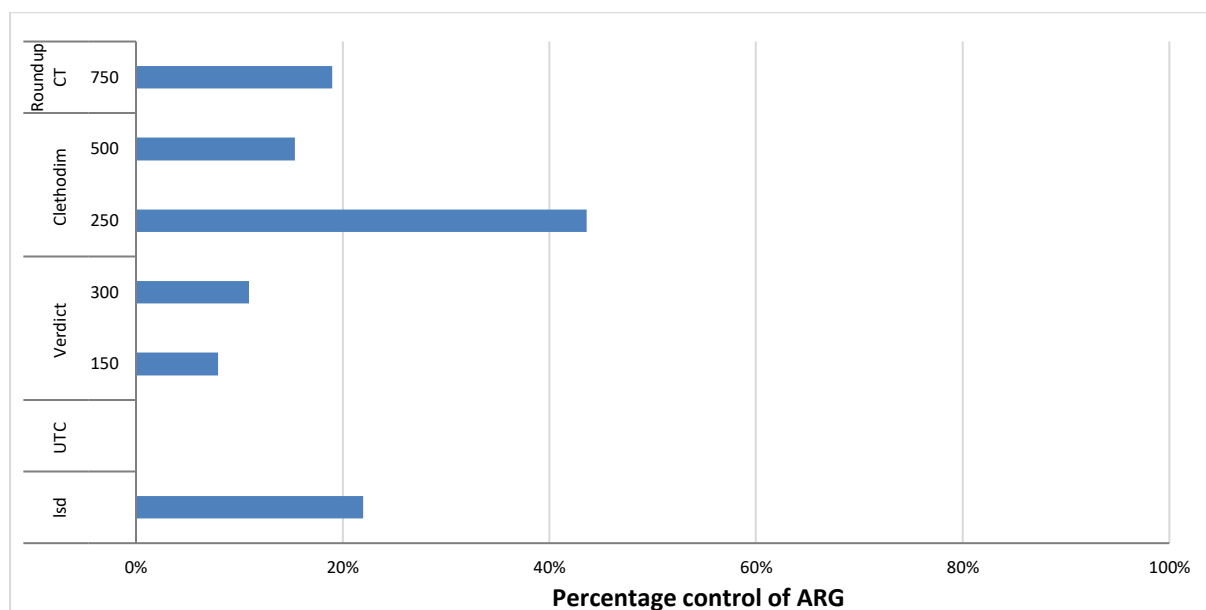
**Table 3.** Application records

<b>Date Applied</b>	12/04/2017	<b>Temp (°C)</b>	<b>Wind (km/hr)</b>	<b>Wind Dir.</b>	<b>Humidity (%)</b>
<b>Start time</b>	12:15	26	5-12	E	38.6
<b>Finish Time</b>	13:10	<b>Δt</b>	9.1	<b>% Cloud</b>	75%
<b>Water rate (L/ha)</b>	100	<b>Nozzle</b>	DG015	<b>Pressure</b>	3
<b>Equipment</b>	ATV	<b>Speed (km/h)</b>	8		

## Results

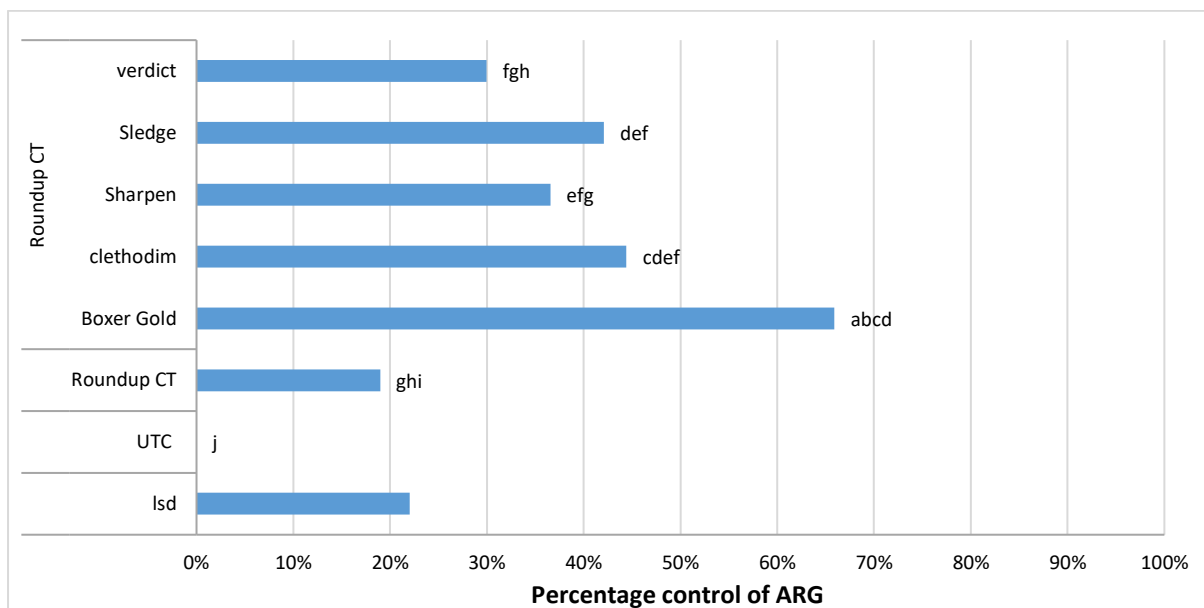
ARG population in this trial was between 50 and 115 plants/m<sup>2</sup>, as assessed in the untreated control (UTC).

Group A herbicides: Neither of the Group A herbicides provided any meaningful control of annual ryegrass (**Figure 1**). There was an anomaly whereby the lower rate of clethodim gave a better level of control than the high rate, and it also performed better than RoundUp CT® @ 750 mL/ha.



**Figure 1.** Percentage ARG control (compared to the UTC) for a single application of selected Group A herbicides and RoundUp CT®. Assessed 55 days after initial application (DAA1).

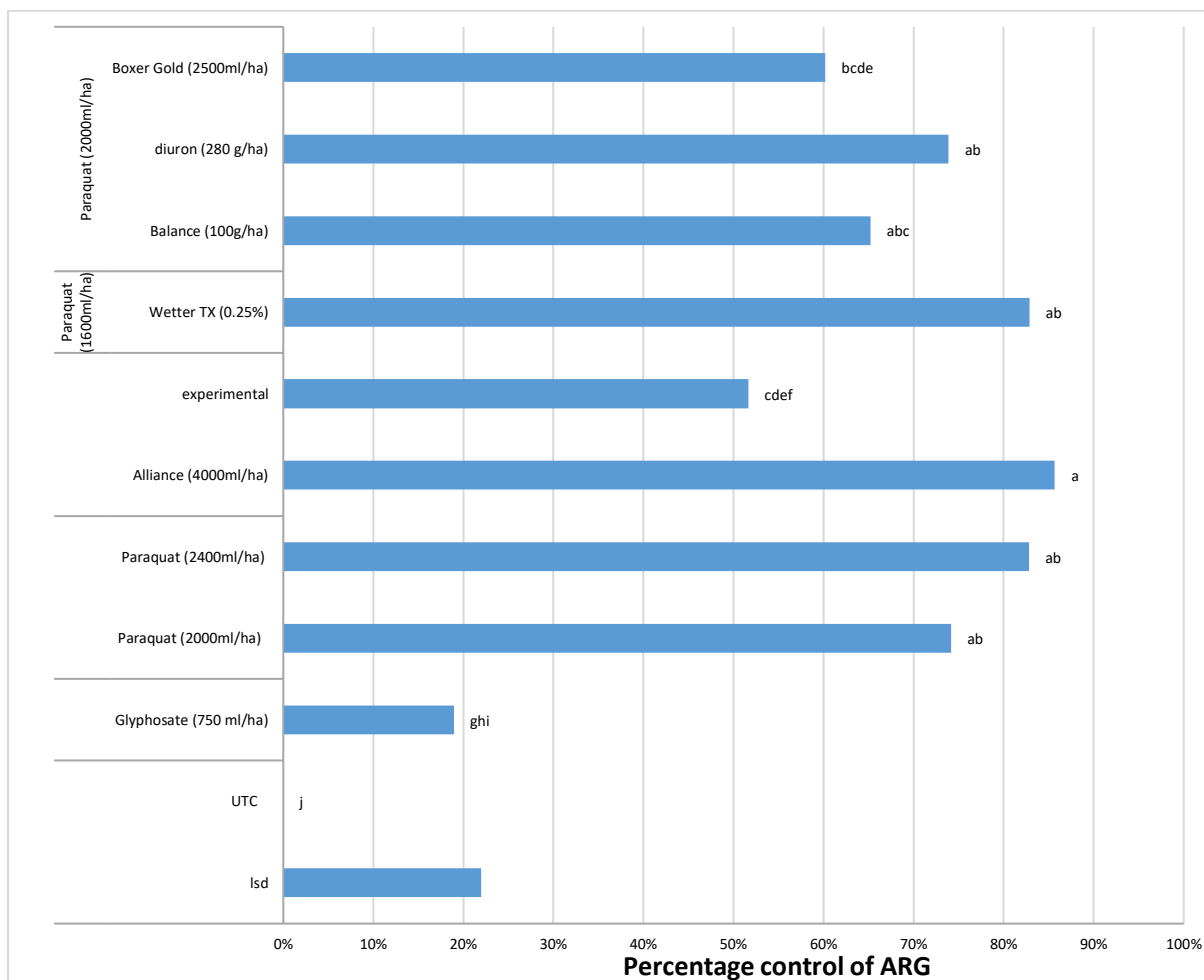
RoundUp CT® tank mixes: RoundUp CT® (750 mL/ha) as a standalone application achieved relatively low levels of control (about 19%). Addition of selected tank mixes tended to improve efficacy, however, only tank mixes with Sharpen®, Sledge® and Boxer Gold® were significantly better than RoundUp CT® by itself (Figure 2).



**Figure 2.** Percentage ARG control (compared to the UTC) for selected herbicides tank mixed with RoundUp CT®. Assessed 55DAA1.

Paraquat at 2000 mL/ha controlled approximately 74% of the ARG population. Using paraquat at higher and lower rates (with surfactants) or with selected tank mix partners did not significantly improve control.

Alliance® (amitrole{250g/L} + paraquat{125g/L}) @ 4000 mL/ha provided 86% control, and the experimental product (with a paraquat component) achieved 52%. Level of control provided by paraquat @2000 mL/ha was significantly better than RoundUp CT® @ 750 mL/ha (**Figure 3**).



**Figure 3.** Percentage ARG control (compared to the UTC) for paraquat, selected herbicides tank mixed with paraquat and Alliance®. Assessed 55DAA1.

## Discussion

**Note:** The performance of Balance® may have been compromised by not adding an adjuvant as per label requirements. Similarly, RoundUp CT® was applied without an adjuvant (label suggests that control may be improved by addition of Wetter TX). These must be appreciated when interpreting these results.

Prior to the trial's establishment, significant rainfall events in March (approximately 90 mm) ensured an ample germination. Subsequently there was approximately 11mm rain in April. At the time of initial application, plants were 3-6 leaf and not visibly stressed, though conditions were hot and dry.

Trial site was selected because it had suspected (RoundUp CT®) resistance, however, subsequent testing did not support this suspicion. ARG resistance to group A herbicides Clethodim and Verdict™ was confirmed.

Group A herbicides failed to provide any meaningful levels of control. Resistance testing revealed that the ARG population should have been susceptible to the higher rate of clethodim, however the field results did not reflect this.

RoundUp CT® @ 750 mL/ha provided only low levels of control as a standalone product. This rate is arguably below label recommendations for this situation. Additionally label details suggest that ARG

control may be improved by addition of Wetter TX (not used in this trial). Both higher rate and Wetter TX may have contributed to improved performance. Addition of selected tank mix partners to RoundUp CT® tended to improve control, with clethodim, Sledge® and Boxer Gold® all achieving significant improvements. However, none provided commercially acceptable levels of control.

Paraquat @ 2000 mL/ha provided some of the highest levels of control. Adding a tank mix or adjuvant did not provide any additional benefit. Similarly, Alliance® and the experimental (both with a paraquat component) provided similar levels of control to “stand alone” paraquat. It may be possible that a lower rate can be used in conjunction with a surfactant.

## Conclusion

Know the glyphosate resistance status of ARG populations to determine rate requirements for better control.

Paraquat may be seen as an alternative to RoundUp CT® for ARG control. Addition of various products to either glyphosate or paraquat provided incremental (but not significant) levels of control, and can allow for targeting of secondary weeds.

## Acknowledgements

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## Appendix –

Figure 4- Excerpt from herbicide resistance tests performed on ARG population

**Table 1:** Results as determined by resistance testing 3 weeks after treatment. Data recorded as % survival (% of plants surviving) as compared to untreated plants. 100% refers to all plants surviving and 0% refers to death. Data is the mean of 2 replicate pots per herbicide rate. Included in the test was a susceptible (S) biotype and resistant biotypes. Data for the S and R biotypes is not shown.

Herbicide	Herbicide Group	Paddock Sample Alectown	
		Survival	Rating
Select 250ml/ha + 1% Hasten	Group A - Dims	30	RR
Select 500ml/ha + 1% Hasten	Group A - Dims	0	S
Verdict 300ml/ha + 1% Hasten	Group A - Fops	75	RRR
Paraquat 2/ha + 0.2% BS1000	Group L	0	S
Glyphosate 450@ 0.75L/ha	Group M	0	S
Glyphosate 450@ 1.5L/ha	Group M	0	S
Glyphosate 450@ 3L/ha	Group M	0	S

Resistance-rating:      RRR- indicates plants tested have strong resistance      RR - indicates medium-level resistance      R-indicates low-level but detectable resistance      S- indicates no detection of resistance

Ryegrass control 30 days after the application of various RoundUp CT® treatments.

Product 1	Rate 1 (g or ml/ha)	Product 2	Rate 2 (g or ml/ha)	Control	Groups
UTC				0%	d
Verdict™	150			17%	c
	300			15%	c
Clethodim	250			15%	c
	500			24%	c
RoundUp CT®	750			89%	ab
		clethodim	250	92%	ab
		Verdict™	150	93%	ab
		Sledge®	150	86%	b
		Sharpen®	34	90%	ab
Paraquat		Boxer Gold®	2500	94%	ab
	1600	Wetter TX	0.25%	91%	ab
	2000			92%	ab
		Boxer Gold®	2500	100%	a
		Balance®	100	99%	a
A21304D		diuron	280	99%	a
	2400			97%	ab
	1600			95%	ab
Alliance®	4000			99%	a
				12%	

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List of products used and active ingredients

Registered Name	Group	Active
<b>A21304D</b>		(experimental)
<b>Alliance</b>	L Q	250 g/l amitrole, 125 g/l paraquat
<b>Balance® 750WG</b>	H	750 g/kg isoxaflutole
<b>Boxer Gold®</b>	J K	800 g/l Prosulfocarb, 120 g/l S-Metolachlor
<b>Diurex</b>	C	900g/kg diuron
<b>Paraquat 250</b>	L	250 g/l paraquat
<b>Platinum</b>	A	240 g/L Clethodim
<b>Roundup CT</b>	M	455 g/l glyphosate
<b>Sharpen® WG</b>	G	700 g/kg saflufenacil
<b>Sledge®</b>	G	25 g/L Pyraflufen-ethyl
<b>Verdict 520</b>	A	520 g/l Haloxypop