

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

Trial Code: GOWE04917-1
Year: Autumn, 2017
Location: Narromine
Trial Partners: Billy Browning and Campbell Muldoon

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 (ARG) – though important to ensure adequate coverage
- A range of alternative herbicides tested showed little value in improving the control of ARG
- Knowing the resistance status of ryegrass populations allows for improved choice of weed control options.

Annual ryegrass (ARG) is showing increasing levels of resistance to various herbicides across the Orana Region. Developing resistance to glyphosate is the greatest concern, as it is a key ARG knockdown control option in the fallow period. Effectiveness 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 the control of glyphosate resistant ryegrass.

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Aim

Test the efficacy of a range of knockdown herbicide options (products) 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. The trial was established in growers' paddock with visible ARG population.

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

GOA Trial Site Report

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.

Table 1. Trial site details

Trial Establishment Date	Autumn, 2017
Soil Type	Red sandy clay loam
Previous Crop	Wheat
ARG resistance status	Detailed in appendix- low level to group M, high levels to Fops and Dims

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

Product 1	Rate (mL or g/ha)	Product 2	Rate (mL or g/ha)	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	-	-	-	-	-
UTC	-	-	-	-	-
Verdict™	150	-	-	Uptake™	0.50%
Verdict™	300	-	-	Uptake™	0.50%

Table 3. Application records

Date Applied	7/04/2017	Temp (°C)	Wind (km/hr)	Wind Dir.	Humidity (%)
Start time	12:15 pm	28.3	3-6	E	44%
Finish Time	1:40 pm	Δt	8.1	% Cloud	5%
Water rate (L/ha)	100	Nozzle	DG015	Pressure	3 Bar
Equipment	ATV	Speed (km/h)	8		

Results

ARG population was high in this trial; over 100 plants/m² in the untreated control (UTC).

Group A herbicides: Neither of the Group A herbicides provided any useful control of annual ryegrass at this site (**Figure 1**).

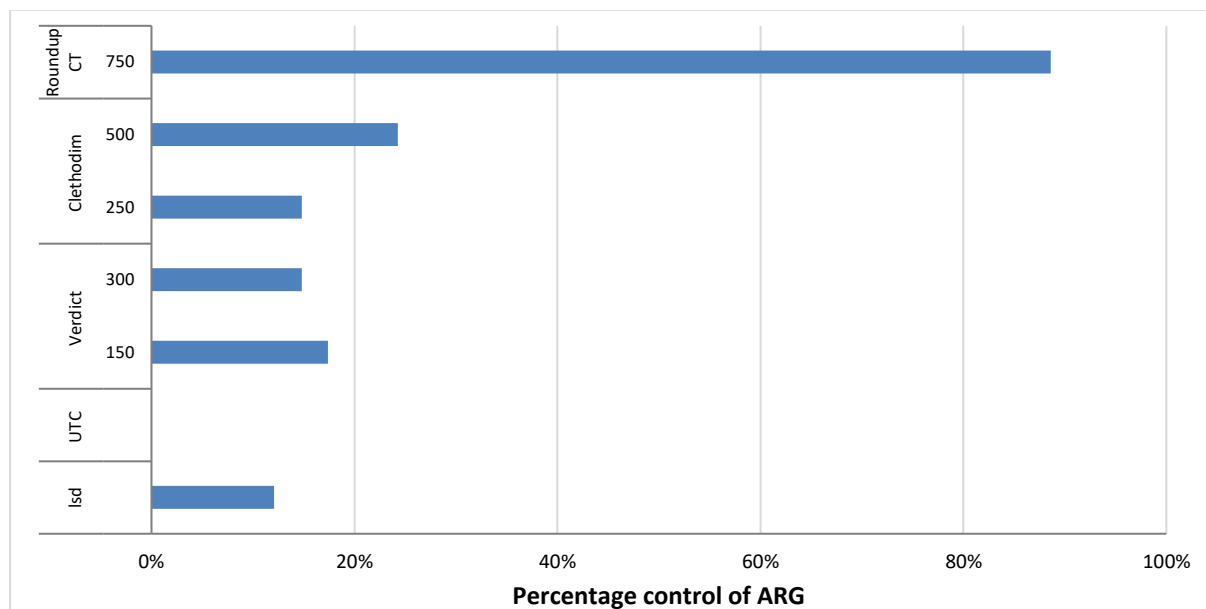


Figure 1. Percentage ARG control (compared to the UTC) for a single application of selected Group A herbicides and RoundUp CT®, 30 days after initial application (30AA1).

RoundUp CT® tank mixes: RoundUp CT® (750 mL/ha) achieved close to 89% control, which was not (statistically) improved by the addition of clethodim, Verdict™, Sledge®, Sharpen® or Boxer Gold®.

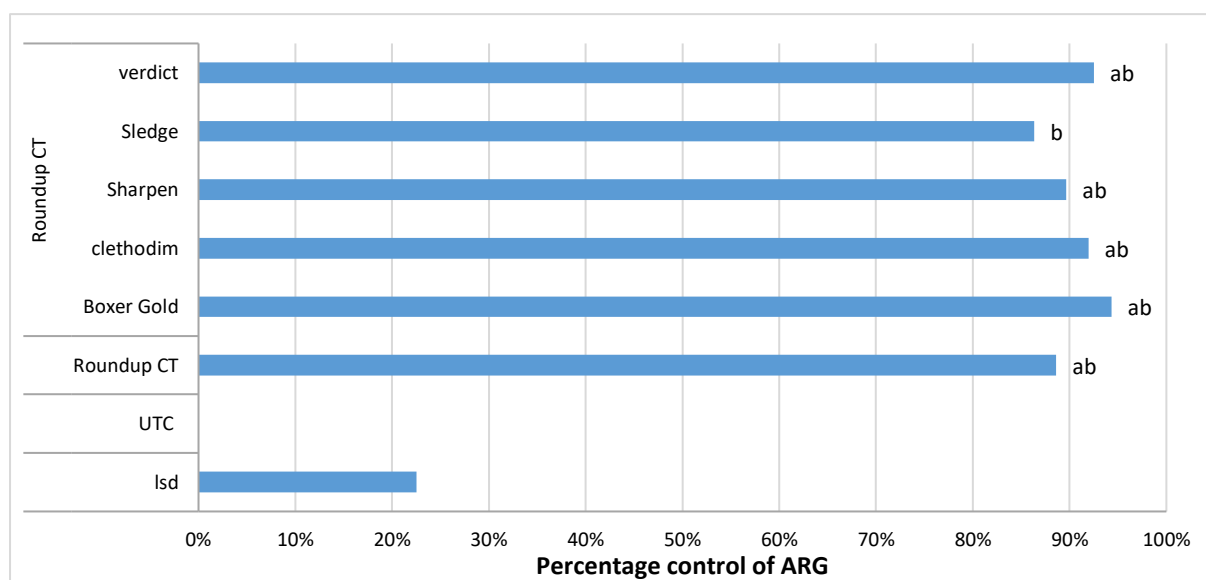


Figure 2. Percentage ARG control (compared to the UTC) for selected herbicides tank mixed with RoundUp CT® (750 ml/ha), 30DAA1.

Paraquat at 2000 mL/ha controlled approximately 92% of the ARG population. At higher and lower rates (with a surfactant) or with selected tank mix partners control was not significantly different. Level of control provided by RoundUp CT® @ 750 mL/ha was not significantly different to any of the paraquat options (**Figure 3**).

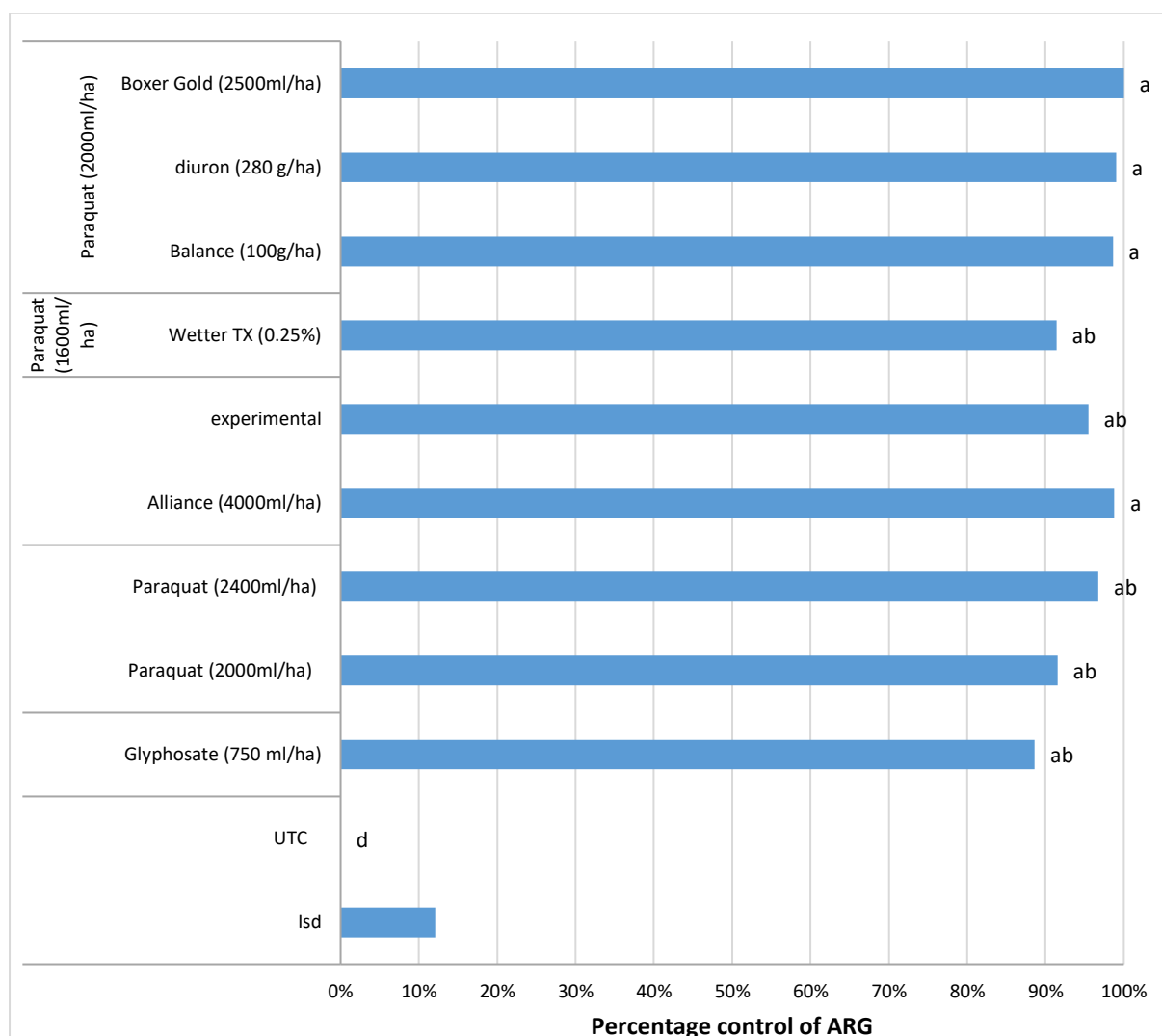


Figure 3. Percentage ARG control (compared to the UTC) for paraquat, selected herbicides tank mixed with paraquat and Alliance®. Assessed 30DAA1.

Alliance® @ 4000 mL/ha provided 99% control, and the experimental product (with a paraquat component) achieved 95%.

Discussion

Note: In this trial 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 the addition of Wetter TX when used in this situation). Interpreting of these results need to appreciate these trial limitations.

Prior to the trial’s establishment, significant rain fell in March (approximately 90 mm) ensuring an ideal weed germination. Subsequently there was approximately 11mm rain in April. At the time of the initial herbicide application, plants were 3-6 leaf and not visibly stressed, though conditions were hot and dry.

This trial site was selected as it had suspected ARG glyphosate resistance. Commercial resistance testing revealed low levels of resistance to RoundUp CT® at the lower label rate. Levels of field control achieved (89%) with 750 mL/ha RoundUp CT® closely reflected resistance tests.

ARG resistance to group A herbicides clethodim and Verdict™ was confirmed, and they failed to provide any meaningful levels of control. Resistance testing revealed that ARG should have been susceptible to at least the higher clethodim rate, however, there was no difference in level of control between the low and high rates.

Both RoundUp CT® @ 750 mL/ha and paraquat @ 2000 mL/ha provided high levels of control. Adding a tank mix or adjuvant to either of these products provided only small incremental increases (though not significantly different) in the levels of control. It is likely that a higher rate of RoundUp CT® would also provide better control.

Paraquat, Alliance® and the experimental (all have a paraquat component) provided high levels of control. It may be possible that a lower rate can be used in conjunction with a surfactant. Addition of Boxer Gold®, Balance® or diuron provided very high levels of control (>98%) but again not different to paraquat alone.

Conclusion

Knowing the glyphosate resistance status of ARG populations would help determine rate requirements for best control.

Paraquat may be seen as an alternative to RoundUp CT® for ARG control.

However, the addition of other various products to either glyphosate or paraquat did not improve the control achieved. These trials suggest there is little value in their inclusion to improve control of ARG. The use pattern is also off label and there would be additional complication with herbicide residues for subsequent crop growth as well.

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 Narromine	
		Survival	Rating
Select 250ml/ha + 1% Hasten	Group A - Dims	85	RR
Select 500ml/ha + 1% Hasten	Group A - Dims	10	RR
Verdict 300ml/ha + 1% Hasten	Group A - Fops	90	RR
Paraquat 2L/ha + 0.2% BS1000	Group L	0	S
Glyphosate 450@ 0.75L/ha	Group M	10	R
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

Table 4. Ryegrass control 30 days after the application of various RoundUp CT® treatments.

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

Table 5. List of products used and active ingredients

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