

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

Trial Code: GOWE04917-3
Year: Autumn, 2017
Location: Parkes
Trial Partners: Allan McGill and Peter Yelland

Keywords

GOWE049, Annual ryegrass, resistance, knockdown, adjuvants, Roundup CT®, glyphosate, paraquat, wetters, Parkes

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 best use of appropriate management options

Annual ryegrass (ARG) is exhibiting increasing levels of resistance to various herbicides across the Orana Region. The developing resistance to glyphosate is of high concern, as it is a key for ARG knockdown control in the fallow period. Glyphosate effectiveness 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

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

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

Results were analysed by ANOVA and treatments compared by using LSD method with a 95% confidence interval. Any references to differences between treatments should be assumed to be

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statistically different unless otherwise stated. The Analysis of Variance (ANOVA) and Least Significant Difference (LSD) tests are used to measure difference between 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- Nil resistance to Group M, resistant to Group A- Fops and Dims

Table 2. Treatment list (products, chemical groups and active ingredients are listed 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%
Verdict™	150	-	-	Uptake™	0.50%
Verdict™	300	-	-	Uptake™	0.50%
Roundup CT®	750	-	-	-	-
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%
Paraquat	2000	-	-	-	-
Paraquat	2400	-	-	-	-
Paraquat	1600	-	-	Wetter TX	0.25%
Paraquat	1600	-	-	Consume	0.50%
Paraquat	2000	Balance®	100	-	-
Paraquat	2000	Boxer Gold®	2500	-	-
Paraquat	2000	diuron	280	-	-
UTC	-	-	-	-	-

Table 3. Application records

Date Applied	12/04/2017	Temp (°C)	Wind (km/hr)	Wind Dir.	Humidity (%)
Start time	8.00 am	14.8	1-2k	S	74.3%
Finish Time	8.55 am	Δt	3	% Cloud	0%
Water rate L/ha	100	Nozzle	DG015	Pressure	3 Bar
Equipment	ATV	Speed (km/h)	8		

Results

There was a high population of ARG, over 400 plants/m², as assessed in the untreated control (UTC).

Group A herbicides: Verdict™ provided no control of ARG regardless of rate used. Clethodim tended to be rate responsive with 14% control at the lower rate compared to 43% at the higher rate (**Figure 1**).

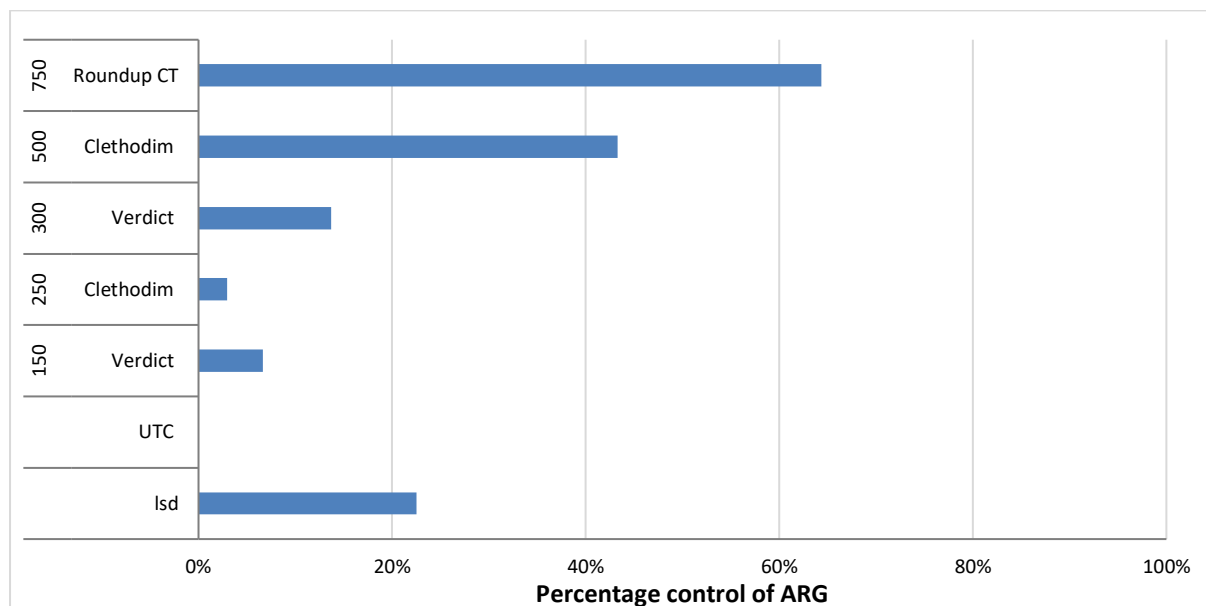


Figure 1. Percentage ARG control (compared to untreated) for a single application of selected Group A herbicides and Roundup CT®, 30DAA1.

Roundup CT® tank mixes: Roundup CT® (750 mL/ha) achieved close to 64% ARG control as a stand-alone. Control was improved by tank mixing with Boxer Gold® to over 90%, however was not (statistically) improved by addition of clethodim, Verdict™, Sledge® or Sharpen® (**Figure 2**).

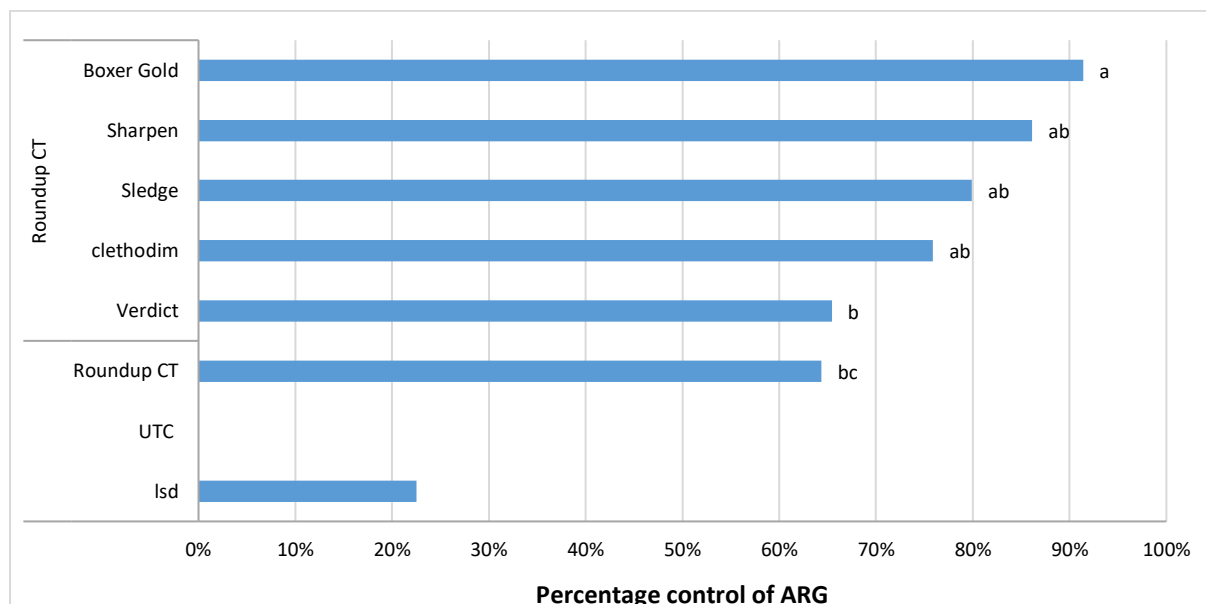


Figure 2. Percentage ARG control (compared to the UTC) for selected herbicides tank mixed with Roundup CT®, 30DAA1.

Paraquat at 2000 mL/ha controlled approximately 83% of ARG, control was improved at 2400 mL/ha but not significantly different. Paraquat at 1600 mL/ha with a surfactants or with a range of alternate tank mix partners did not significantly improve control. A number of paraquat options (and tank mix

options) performed better than Roundup CT® @ 750 mL/ha, see Figure 3. Alliance® (amitrole 250g/L + paraquat 125g/L), at 4000 mL/ha provided 84% control,

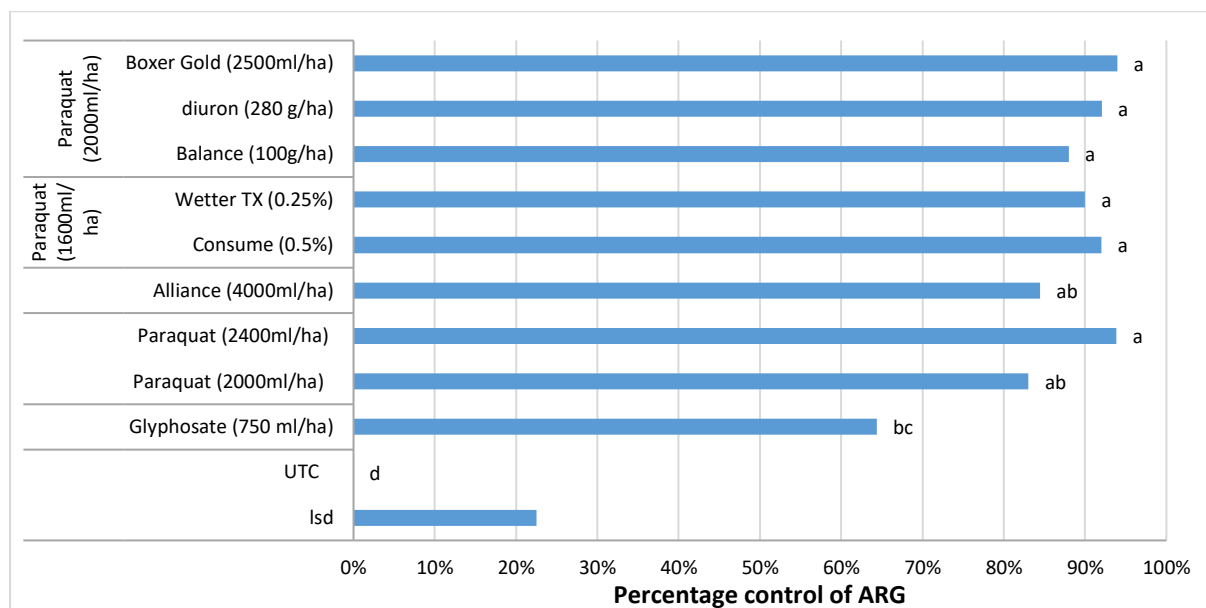


Figure 3. Percentage ARG control (compared to the UTC) for paraquat, selected herbicides tank mixed with paraquat and Alliance®. Assessed 30DAA1.

Paraquat at 2400 mL/ha (94%). Was the only single product to provide better than 90% control. A number of treatments provided better than 90% control; Roundup CT® with Boxer Gold®, Paraquat (@1600mL/ha) with Wetter TX (90%) or Consume (92%), Paraquat (@2000mL/ha) with diuron (92%), or Boxer Gold® (94%) but statistically none were better than paraquat alone.

Discussion

Note: In this trial 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 control may be improved by addition of Wetter TX). These needs to be noted when interpreting results.

The trial site was selected as both grower and advisor suspected ARG population had significant resistance to Roundup CT®, and the high population present would tend to suggest that the population was proving difficult to control. However, commercial testing detected no resistance (detailed in the appendix). If the suspicion of resistance was due to poor levels of control from commercial spray applications it is possible that this could be related to application set up, water quality for spraying, plant maturity or stress factors. Resistance to the group A herbicides Clethodim and Verdict™ was confirmed.

Prior to trial establishment local BOM sites indicated significant rainfall events in March (approximately 170mm) ensured an ample ARG germination. A further ~35mm fell in April and 45mm in May. At the time of initial application, plants were from 3-6 leaf and not visibly stressed. However, conditions at the time were hot and dry.

Mixing Group A herbicides with Roundup CT® did not provide significantly enhanced control of ARG, (when compared to Roundup CT® alone) however, tank mixing with Boxer Gold® did and achieved commercially acceptable control.

Paraquat (and Alliance®) provided high levels of control. It may be possible that a lower rate can be used in conjunction with a surfactant. Addition of a number of other herbicides did not improve control.

Conclusion

Knowing the glyphosate resistance status of ryegrass populations to better target herbicide choice.

In this trial paraquat was a good alternative to glyphosate 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 –

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

Product 1	Rate 1	Product 2	Rate 2	Control	Groups
Untreated Control				0%	d
Verdict™	150			7%	d
Verdict™	300			14%	d
Clethodim	250			3%	d
Clethodim	500			43%	c
Roundup CT®	750			64%	bc
Roundup CT®		Boxer Gold®	250	91%	a
Roundup CT®		clethodim	150	76%	ab
Roundup CT®		Sharpen®	150	86%	ab
Roundup CT®		Sledge®	34	80%	ab
Roundup CT®		Verdict™	2500	65%	b
Paraquat	1600	Wetter TX	0.25%	92%	a
Paraquat		Consume	0.5%	90%	a
Paraquat	2000			83%	ab
Paraquat		Boxer Gold®	2500	94%	a
Paraquat		Balance®	100	88%	a
Paraquat		diuron	280	92%	a
Paraquat	2400			94%	a
Alliance®	4000			84%	ab
Lsd				23%	

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 Goa Trial Site	
		Survival	Rating
Select 350ml/ha + 1% Hasten	Group A - Dims	95	RR
Select 500ml/ha + 1% Hasten	Group A - Dims	10	R
Verdict 100ml/ha + 1% Hasten	Group A - Fops	100	RRR
Paraquat 1L/ha + 0.2% BS1000	Group L	0	S
Glyphosate 540@ 1.0L/ha	Group M	0	S
Glyphosate 540@ 1.5L/ha	Group M	0	S
Glyphosate 540@ 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
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Figure 4- Excerpt from herbicide resistance tests performed on ARG population- Parkes 2017

Table 5. List of products used and active ingredients

Registered Name	Group	Active
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