GOA Trial Site Report

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

Trial Code: GOWE04918-2

Season/Year: Autumn, 2018

Location: 'Mimosa', Alectown

Trial Partners: Craig Ward and Peter Yelland

Keywords

GOWE049, Annual ryegrass, resistance, knockdown, adjuvants, glyphosate, paraquat, wetters, Alectown

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 better use of the appropriate management options

Annual ryegrass (ARG) is expressing increasing levels of resistance to various herbicides across the Orana Region. Developing resistance to glyphosate is highly concerning, as it is a key tool for ARG knockdown control in fallows and pre-winter crop sowing. 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 the control of glyphosate resistant ARG.

Drought condition badly impacted on the efficiency of all herbicide treatments in this trial.

DISCLAIMER

Following is a report on a scientific experiment. It may contain some herbicide treatments that are not registered for the situation, manner or rate at which they are used in this trial. This document or anything else resulting from, construed or taken from this or by GOA or its representatives should not be taken as a suggestion, recommendation or endorsement for unregistered herbicide use.

Aim

Test the efficacy of a range of knockdown herbicide products on the control of ARG with suspected resistance to glyphosate.

Methods

This trial used a small plot randomised complete block split design with three replicates, established in growers' paddock with visible ARG population suspected of glyphosate resistance.

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

Results were analysed by ANOVA and compared by using an LSD method with a 95% confidence interval. Any references to differences between treatments should be assumed to be statistically different unless otherwise stated. Analysis of Variance (ANOVA) and Least Significant Difference (LSD) tests are used to measure the difference between the averages.

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Table 1. Trial site details

Trial Establishment Date	Winter, 2018
Soil Type	Red Clay Loam
Previous Crop	Canola
ARG resistance status	Low level of glyphosate resistance at low rates and moderate (65%) resistance to Vedict- full results in the appendix

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®	2800	-	-	-	-
Alliance®	1500	-	-	-	-
Boxer Gold®	2500	-	-	-	-
Clethodim	250	-	-	Uptake™	0.50%
	500	-	-	Uptake™	0.50%
Paraquat	1000	Balance®	100	-	-
	1000	Boxer Gold®	2500	-	-
	1000	diuron	280	-	-
	1000	-	-	-	-
	1500	-	-	-	-
	2000	-	-	-	-
Roundup CT®	500	Boxer Gold®	2500	Wetter TX	0.20%
	500	clethodim	250	Uptake™	0.50%
	500	Sledge®	150	Wetter TX	0.20%
	500	Sharpen®	34	Hasten™	1.00%
	500	Verdict™	150	Uptake™	0.50%
	500	-	-	Wetter TX	0.20%
Verdict™ 520	150	-	-	Uptake™	0.50%
	300	-	-	Uptake™	0.50%
Untreated control (UTC)	-	-	-	-	-

Table 3. Application records

Date Applied	17/8/2018	Temp (°C)	Wind (km/h)	Wind Dir.	Humidity (%)
Start time	10:30 am	16.8	2-5	NW	41.4%
Finish Time	11:20 am	**Δt**	7.2	**% Cloud**	5%
Water rate (L/ha)	100	**Nozzle**	AIXR015	**Pressure**	3
Equipment	ATV	**Speed**	7-8 km/hr		

Results

ARG population in the trial was high, over 250 plants/m^2 (assessed in the UTC).

The site was selected because grower and agronomist suspected ARG resistant to glyphosate and commercial testing confirmed this. The population was found to have low levels of glyphosate resistance with 20% survival to glyphosate (Roundup CT® at 500 mL/ha). ARG population was also

found to be moderately resistant to Verdict™ with 65% survival. Resistance to clethodim was not detected.

Group A herbicides: Application of clethodim at the lower rate (250 mL/ha) was the only Group A herbicide treatment that significantly reduced the ARG population but no too commercially acceptable levels and the higher rate of 500mL/ha did not reduce the population significantly below the UTC. (**Figure 1**).
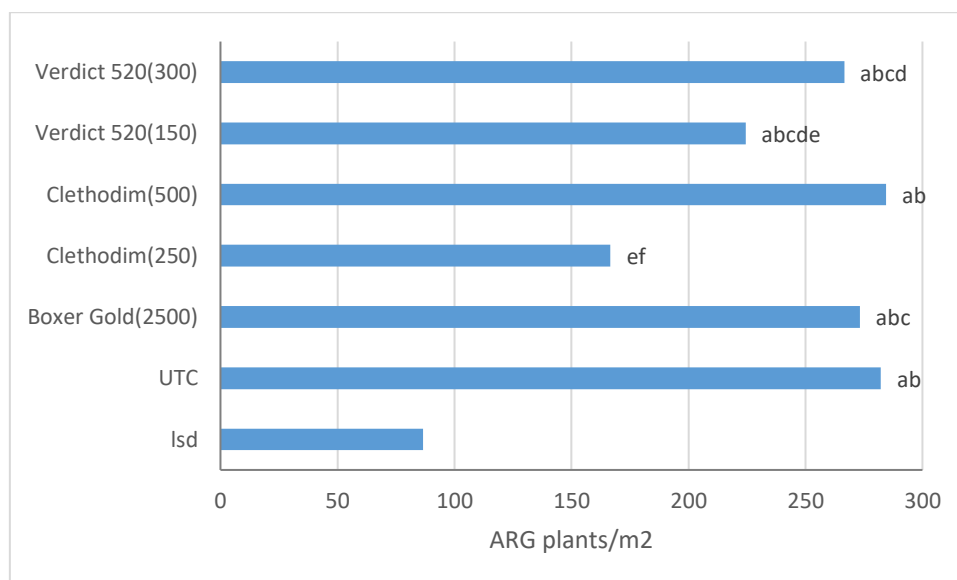

Figure 1. ARG plant counts/m^2 for a single application of selected Group A herbicides and Roundup CT, 28 days after initial application (DAA1).

Glyphosate tank mixes: Roundup CT (500 mL/ha) did not significantly reduce the numbers of ARG when compared to UTC. The addition of Verdict™, Sledge®, clethodim or Sharpen® did not result further reductions in plant numbers. Tank mixes of Boxer Gold® and Roundup CT® did significantly reduce the ARG population when compared to performance of either product as a standalone though the level of control (~70% would not be considered commercially acceptable (**Figure 2**).
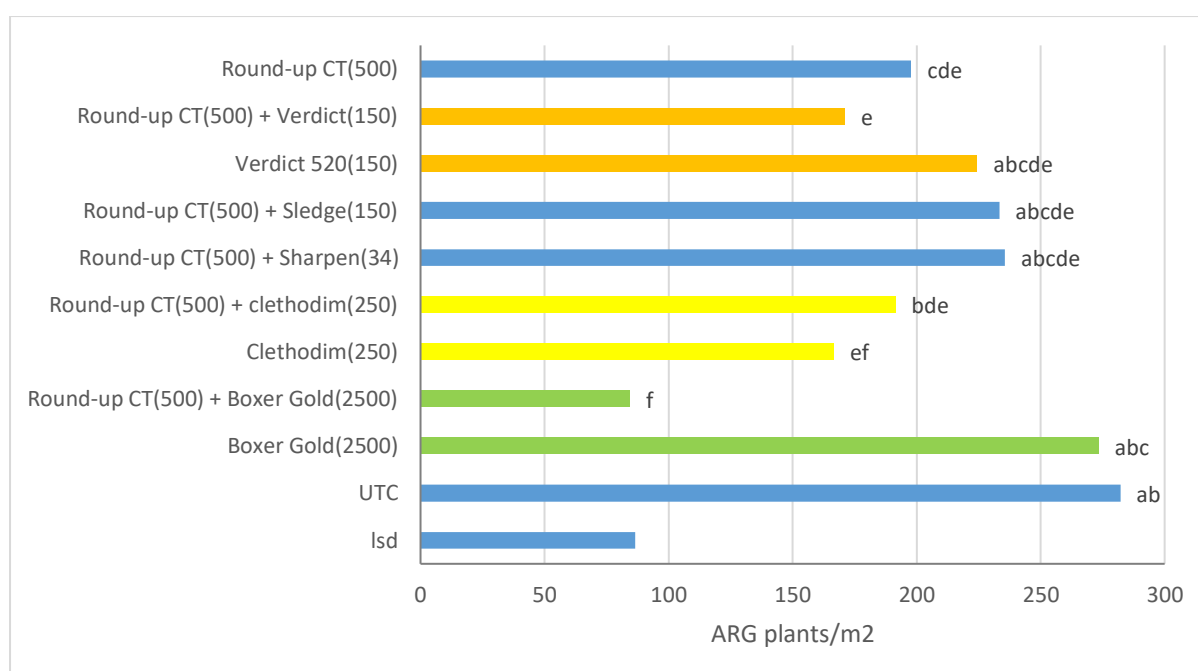

Figure 2. Ryegrass population counts for selected herbicides tank mixed with Roundup CT®, 28 DAA1.

Paraquat at 2000mL/ha did reduce the ARG population compared to the UTC but the level of control would not be considered commercially acceptable. However control at the higher rates of paraquat was similar to the control chieved by Roundup CT. The lowest rate of paraquat did not reduce the population below that of the UTC.

Both rates of Alliance® resulted in similar outcomes to paraquat at the higher rates. Tank mixing a lower rate of paraquat (1000 ml/ha) with Boxer Gold® tended to improve the level of control, however paraquat with Balance® or diuron provided no improved benefit but none provided control that would be considered commercially acceptable. (**Figure 3**).
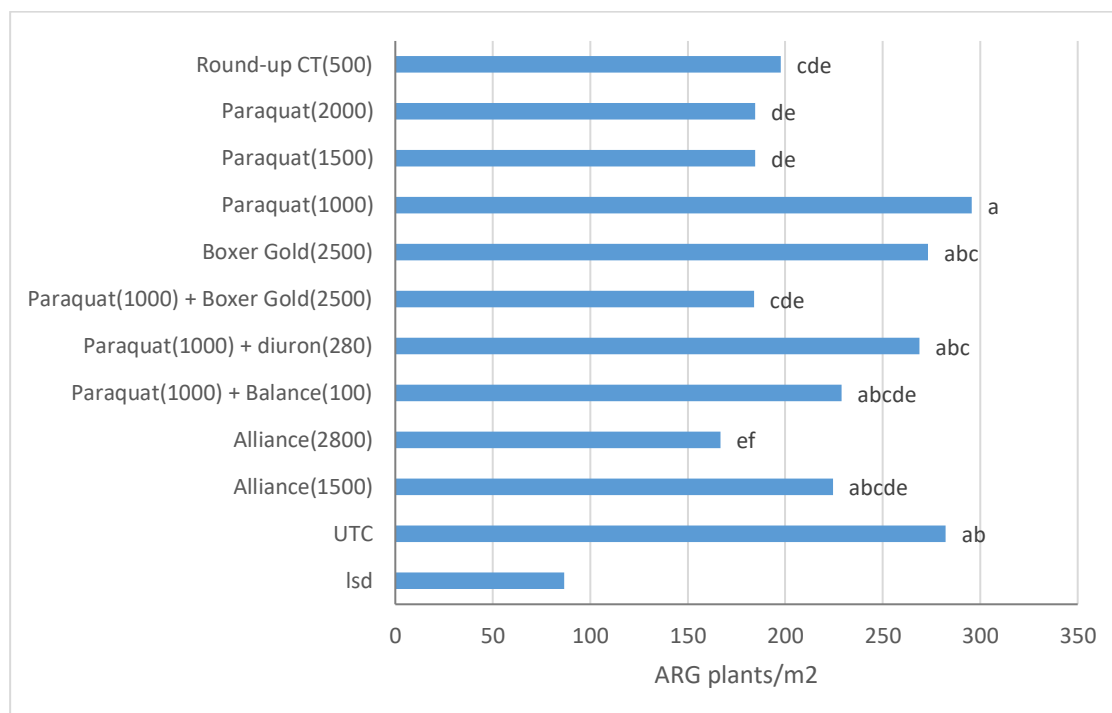

Figure 3. Ryegrass population counts (compared to UTC) for paraquat, selected herbicides tank mixed with paraquat and Alliance®. Assessed 28 DAA1.

Discussion

The trial site was selected because grower and agronomist suspected ARG resistant to glyphosate, because of previous poor control. Commercial testing detected low levels of resistance and 20% survival to glyphosate (Roundup CT® at 500 mL/ha). This rate is below label recommendations for ARG control. ARG glyphosate resistance at sub lethal glyphosate rate provides the dilemma to the query of "the difference between a sub-lethal dose and resistance".

ARG population at this site was also found to be moderately resistant to Verdict™ with 65% survival. Resistance to clethodim was not detected. While clethodim at 250 mL/ha did reduce ARG population to a level similar to Roundup CT® @ 500 mL/ha this is not considered as commercially acceptable control.

The ARG population at the trial site was also quite large and as such may have reduced the the potential to control the populations present. While Roundup CT® @ 500 mL/ha only reduced ARG population by about 25%, it provided a good opportunity to assess the effectiveness of various tank mix partners. However, in this trial only the addition of Boxer Gold® significantly reduced ARG population and suggests a positive synergistic relationship as it improved both products compared to their standalone performance.

Paraquat (2000 mL/ha) and Alliance® (2800mL/ha) reduced ARG plant population, though no greater than that of the Roundup CT® at 500 mL/ha. Adding various tank mix partners to paraquat did not improve ARG control.

Drought conditions badly impacted on this trial. Because of lack of rain the landholder did not sow their normal winter crop. At the time of herbicides application ARG had a range of ages, from 3 leaf to multi-tillering. It is likely that dry conditions greatly contributed to low levels of ARG control via the various herbicide treatments. In a nearby trial that assessed various glyphosate rates and adjuvants good control, up to 93 percent, was achieved a robust rate of Roundup CT® (1500 mL/ha).

Results from this trial reinforces the importance of favourable environmental conditions for acceptable control, especially if relatively lower herbicide rates are being used. At this site none of the options tested proved to be a suitable alternative to glyphosate, which highlights the importance of adopting an integrated weed control management strategy to prolong its effectiveness.

Conclusion

Knowing the glyphosate resistance status of an ARG populations is important to determine correct herbicide options and rates for effective control as although there was resistance detected at this site it was only a low level and higher rates of glyphosate would likely to have provided good control.

Whilst none of the treatments applied in this trial achieved commercially acceptable control a number of options tested showed very little improvement in control over what could be achieved by robust rates of glyphosate alone. Paraquat was one of the best performing options tested but only achieved control of 31%.

While the trial was inconclusive in finding an alternative herbicide knockdown for controlling ARG, it highlighted the importance of suitable seasonal conditions for effective herbicide function, and the necessity of higher rates of glyphosate, especially in more marginal environmental conditions. It also highlights the importance of sound decisions to maintain effective life of glyphosate.

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 Wards	
		Survival	Rating
Select 350ml/ha + 1% Hasten	Group A - Dims	0	S
Select 500ml/ha + 1% Hasten	Group A - Dims	0	S
Verdict 100ml/ha + 1% Hasten	Group A - Fops	65	RR
Intervix 750ml/ha + 1% Hasten	Group B - Imidazolinones	0	S
Paraquat 1L/ha + 0.2% BS1000	Group L	0	S
Roundup CT + Wetter TX (0.5L/ha + 0.2%v/v)	Group M	20	R
Roundup CT + Wetter TX (0.75L/ha + 0.2%v/v)	Group M	0	S
Roundup CT + Wetter TX (1L/ha + 0.2%v/v)	Group M	0	S
Roundup CT + Wetter TX (1.25L/ha + 0.2%v/v)	Group M	0	S
Roundup CT + Wetter TX (1.5L/ha + 0.2%v/v)	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 5.   Ryegrass control 30 days after the application of various glyphosate treatments.

Product 1	Rate 1	Product 2	Rate 2	Adjuvant	Rate	ARG/m²		Control (%)	
Alliance®	1500					224	abcde	13%	bcdefg
	2800					167	ef	32%	bcde
Boxer Gold®	2500					273	abc	-4%	fg
Clethodim	250			Uptake™	0.50%	167	ef	35%	abcd
	500			Uptake™	0.50%	284	ab	-7%	fg
Paraquat	1000	Balance®	100			229	abcde	14%	bcdefg
	1000	Boxer Gold®	2500			184	cde	43%	ab
	1000	diuron	280			269	abc	4%	defg
Paraquat	1000					296	a	-17%	g
	1500					184	de	31%	bcde
	2000					184	de	31%	bcde
Roundup CT®	500	Boxer Gold®	2500	Wetter TX	0.20%	84	f	66%	a
		clethodim	250	Uptake™	0.50%	191	bde	38%	abc
		Sharpen®	34	Hasten™	1.00%	236	abcde	11%	cdefg
		Sledge®	150	Wetter TX	0.20%	233	abcde	11%	cdefg
		Verdict™	150	Uptake™	0.50%	171	e	33%	bcd
				Wetter TX	0.20%	198	cde	25%	bcdef
Verdict™ 520	150			Uptake™	0.50%	282	ab	0%	efg
	300			Uptake™	0.50%	224	abcde	15%	bcdefg
UTC						267	abcd	-6%	fg
lsd						87			bcdefg

Figure 6. List of products and active ingredients

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