GOA Trial Site Report

Improving annual ryegrass (*Lolium rigidum*) knockdown- assessment of various glyphosate formulations, rates and adjuvant combinations - Alectown 2018

Trial Code:	GOWE05318-2
Year:	Autumn, 2018
Location:	Alectown
Trial Partners:	Craig Ward

Keywords

Annual ryegrass, *Lolium rigidum*, resistance, knockdown, glyphosate, paraquat, wetter, surfactants, GOWE05318-2, Alectown.

Take home messages

- To ensure adequate ryegrass control with glyphosate use robust rates
- Know the glyphosate resistance status of ryegrass populations to determine rate requirements for better control.
- Adding wetter or using glyphosate products with built-in surfactants can improve control, however, an alternative may be to increase the glyphosate rate.

Background

Annual ryegrass (ARG) is expressing increasing levels of resistance to various herbicides across the Orana Region[1]. One of the most concerning is developing resistance to glyphosate, rendering it useless for fallow or pre-sowing knockdown control. The remaining effectiveness of glyphosate needs to be protected as much as possible to prolong its useful life.

Growers have numerous options available to try to maintain and maximise the effectiveness of glyphosate. For example, the choice of glyphosate product which may contain different surfactant packages, the form and the concentration of the active ingredient, the choice to add additional surfactants and rate of glyphosate.

Research has shown that glyphosate resistant ARG is rate responsive- that is increasing the glyphosate rate will increase control. Increasing glyphosate rates may also contribute to more effective control by "… counteracting poor application, improving control of older plants, stressed plants or overcoming reduced efficacy caused by using poor quality water or treating plants covered by dust. Higher label rates can also improve glyphosate activity of plants exposed to higher temperatures that can arise in early autumn or late spring"[2].

Active glyphosate generally is poorly absorbed by plants and many commercially available glyphosate formulations generally have surfactants or adjuvants included to bolster performance by aiding in droplet retention on the target and absorption by the plant. Despite the inclusion of these surfactants,

[1] See GOA report: http://www.grainorana.com.au/documents?download=29
[2]https://grdc.com.au/resources-and-publications/grdc-update-papers/tab-content/grdc-update-papers/2015/02/optimising-the-impact-of-glyphosate

additional surfactants use is common. Wetter TX is most commonly recommended on various glyphosate product labels suggesting improvement in ARG control under specific circumstances (i.e. Roundup Ultra®Max recommendation to add in late winter and spring). However, there are a range of alternate surfactants also available.

Glyphosate also comes in a range of salt forms and concentrations. Some of these products are often considered premium and are often promoted as likely to result in better spray outcomes.

Aim

This trial aimed to investigate key choices growers have available to improve control of populations of ARG suspected of glyphosate resistance. Specific investigation focused on

- A range of alternate additional surfactants
- Rate of glyphosate applied

Methods

Trial design was a small plot randomised complete block strip design with three replicates. It was established in a growers' paddock with visible ARG population.

Herbicide treatments were applied using an ATV mounted boom. A double knock treatment of 2 L/ha paraquat was applied to half of each plot (split design).

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.

Commercial resistance testing indicated ARG resistance to glyphosate was 20% survival when using 0.5 L/ha Roundup CT®. Resistance was not detected at higher rates. The resistance report is included in the annex.

Table 1. Trial site details

Trial Establishment Date	Autumn, 2018
Soil Type	Red Clay Loam
Previous Crop	Canola
ARG resistance status	Detailed in appendix- Suspected resistance

Table 2. Alectown site treatment list.

Product	Rate		Adjuvant	Rate	Adjuvant	Rate
	mL/ha	(g ai/ha)				
Roundup CT®	500	225	Wetter TX	0.20%	-	-
	750	337.5	Wetter TX	0.20%	-	-
	1000	450	Wetter TX	0.20%	-	-
	1250	562.5	Wetter TX	0.20%	-	-
	1500	675	Wetter TX	0.20%	-	-
	500	225	Activator	0.13%	-	-
	500	225	LI 700	0.50%	-	-
	500	225	BS1000	0.10%	-	-
	500	225	Wetter TX	0.20%	LI700	0.50%
	500	225	LI700	0.50%	Liase	2.00%
	500	225	Liase	2.00%	-	-
	500	225	Wetter TX	0.20%	Activator	0.13%
	500	225	Liase	2.00%	Activator	0.13%
	500	225	-	-	-	-
Glyphosate 62% IPA	363.0	225	-	-	-	-
	363.0	225	Terwet	4.00%	-	-
	363.0	225	Terwet	8.00%	-	-
	363.0	225	Terwet	12.00%	-	-
Untreated control (UTC)	-	-	-	-	-	-

Table 3. Application records

First application	**Date Applied**	17/8/2017	**Temp (°C)**	**Wind (km/h)**	**Wind Dir.**	**Humidity (%)**
	Start time	09:30	14.2	3-5	NNW	40.9%
	Finish Time	10:20	**Δt**	6.1	**% Cloud**	5%
	Water rate (L/ha)	100	**Nozzle**	AIXR015	**Pressure**	3
	Equipment	ATV	**Speed**	7-8 km/hr		

Results

Full results are tabled is in appendix at the end of the document.

Impact of product rate: Lowest application rate of 225 g ai/ha of Roundup CT® provided the lowest level of control at 54% of ARG. Level of control increased with glyphosate rate, up to 93% at the highest rate of 1500 mL/ha Roundup CT® or 675g ai/ha (**Figure 1**).

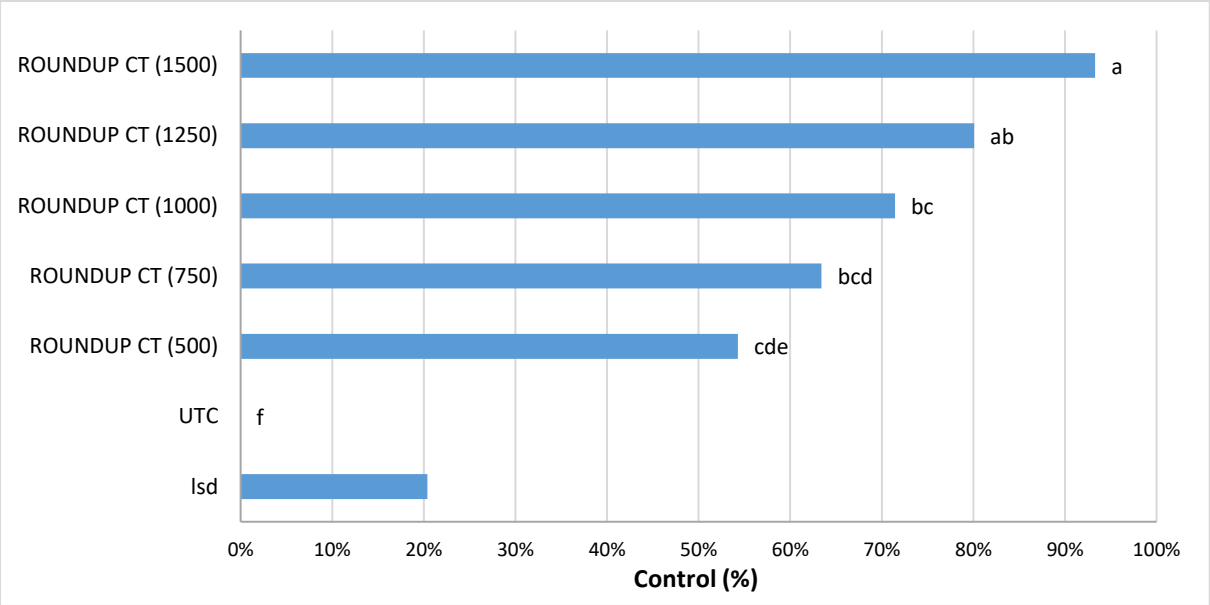

Figure 1. Percentage control (compared to nil for untreated) for four rates of Roundup CT® assessed 28 days after initial application (DAA1). All Roundup CT® treatments were applied with Wetter TX at 2%.

Impact of additional surfactants: Where Roundup CT® was applied at 500 mL/ha (225g ai/ha) without any adjuvant control was approximately 40%. Glyphosate 62% IPA was used at the same active rate with control significantly lower at 13%. The addition of various adjuvants to Roundup CT® at 500 mL/ha did not significantly improve control, with the exception of LI700 and Liase where control was 64% (**Figure 2**).

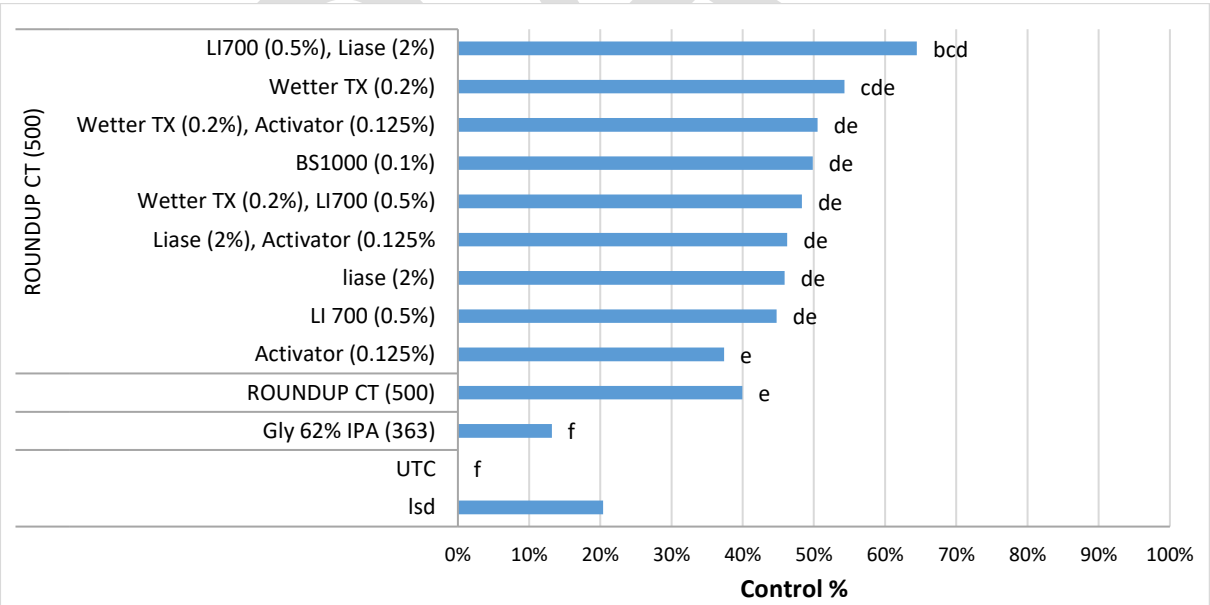

Figure 2. Percentage control for Roundup CT®, glyphosate 62% IPA and Roundup CT® with various adjuvant packages. All treatments used the equivalent rate of active ingredient (glyphosate) (i.e. equivalent to 500 mL/ha Roundup CT® or 225g ai/ha). Treatments followed by the same letter are not significantly different. Assessed 28DAA1.

Discussion

Moderate to high ARG population existed in this trial with 380 plants/m^2 in the UTC.

The trial site was selected on advice from the grower and advisor for suspected ARG population resistance to glyphosate because of past poor control. This was confirmed by commercial resistance testing. ARG resistance was assessed at 20% survival when using 0.5 L/ha Roundup CT®. While relatively low resistance, this represents a significant threat if not addressed with appropriate action.

Control of ryegrass increased with increased application rates, with the population extremely rate responsive. However, because resistance tests showed only a 20% ARG resistance level, the trial is not conclusive in demonstrating that increasing glyphosate application rate can improve control of glyphosate resistant ARG.

Addition of various adjuvants to Roundup CT® did not improve efficacy in this trial (with the exception of the combination of Liase and LI700). Low level of control achieved by glyphosate 62% IPA (with no wetter), suggests that the adjuvant already built into Roundup CT® was more than sufficient in this situation.

Results of this trial would suggest that determination of the resistance status of an ARG population would allow for more effective use of glyphosate and improved ongoing management of resistance toward it.

Conclusion

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

Adding wetter or using glyphosate products with built-in surfactants can improve control, however, an alternative may be to increase the glyphosate rate.

Acknowledgements

The research undertaken as part of this project is made possible by the significant contributions of growers through both trial cooperation and the support of the GRDC, the authors would like to thank them for their continued support. Special thanks go out to Craig Ward who hosted this trial.

DISCLAIMER — TECHNICAL

product or manufacturer referred to. Other products may perform as well or better than those specifically referred to.

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.

Appendix –

Figure 3- 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

Ryegrass control 28 days after the application of various glyphosate treatments.

Product	Adjuvant	plants/m^2	LSD	Control (%)	LSD
UTC		380	a	0%	f
Glyphosate 62% IPA (363)		329	a	13%	f
Glyphosate 62% IPA (363)	Terwet (4%)	169	bcd	55%	cde
	Terwet (8%)	60	ef	83%	ab
	Terwet (12%)	64	ef	82%	ab
ROUNDUP CT® (500)	Wetter TX (0.2%)	171	bcd	54%	cde
ROUNDUP CT® (750)		133	cde	63%	bcd
ROUNDUP CT® (1000		100	def	71%	bc
ROUNDUP CT® (1250		71	ef	80%	ab
ROUNDUP CT® (1500		24	f	93%	a
ROUNDUP CT® (500)		224	b	40%	e
ROUNDUP CT® (500)	Activator (0.125%)	233	b	37%	e
	BS1000 (0.1%)	191	bc	50%	de
	LI 700 (0.5%)	204	bc	45%	de
	LI700 (0.5%), Liase (2%)	127	cde	64%	bcd
	Liase (2%)	200	bc	46%	de
	Liase (2%), Activator (0.125%)	193	bc	46%	de
	Wetter TX (0.2%), Activator (0.125%)	184	bcd	51%	de
	Wetter TX (0.2%), LI700 (0.5%)	196	bc	48%	de
lsd		85		20%	