GOA Trial Site Report

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

Trial Code:	GOWE05318-1
Season/Year:	Autumn, 2018
Location:	Narromine
Trial Partners:	Richard Tink and Matt Shephard

Keywords

Annual ryegrass, *Lolium rigidum*, resistance, knockdown, glyphosate, paraquat, wetter, surfactants, GOWE05318-1, Narromine.

Take home messages

- When correctly applied, low rates of glyphosate can be highly successful in controlling non-resistant ARG
- Knowing the resistance status of ryegrass populations allows for a more appropriate selection of the most suitable ARG control management option

Background

Annual ryegrass (ARG) is expressing increasing levels of resistance to various herbicides across the Orana Region[1]. One of the most concerning to many growers 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 to endeavour to maintain and maximise glyphosate effectiveness. For example, choice of glyphosate product which different surfactant packages, the form and concentration of active ingredient, choice of added surfactants and rate of glyphosate applied.

Control of glyphosate resistant ARG is commonly rate responsive- that is increasing application rate will improve 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 is generally poorly absorbed by plants and is why many commercially available glyphosate formulations have surfactants or adjuvants included to bolster performance by aiding target droplet retention and plant absorption. Despite the inclusion of surfactants to commercial glyphosate products, additional surfactant use is common. Wetter TX is most commonly

[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

recommended on various glyphosate product labels. Labels generally suggest improved ARG control under specific circumstances (i.e. Roundup Ultra®Max recommendation to add in late winter and spring). However, there are a range of other alternate surfactants available.

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

Aim

This trial investigates important agronomic choices growers have available to control populations of ARG suspected of glyphosate resistance- Aspects specifically evaluated include

- Effectiveness of a range of alternate additional surfactants when added to glyphosate
- The rate of glyphosate product applied to control ARG

Methods

A small plot randomised complete block strip design with three replicates was used. The trial was established in 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.

Both the grower and advisor suspected the ARG population had significant glyphosate resistance because of past poor control. However, commercial testing after the trial commenced did not detect any resistance (detailed in the appendix). Hence the research achieved outcomes relevant to ARG populations with little or no glyphosate resistance.

Table 1. Trial site details

Trial Establishment Date	Winter, 2018
Soil Type	Sandy Red Loam
Previous Crop	Wheat
ARG resistance status	Detailed in appendix- Suspected resistance

Table 2. Narromine 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**	9/8/2017	**Temp (°C)**	**Wind (km/h)**	**Wind Dir.**	**Humidity (%)**
	Start time	16:40	17.1	0.4-1.0	S	41.4%
	Finish Time	15:00	**Δt**	7.1	**% Cloud**	5%
	Water rate (L/ha)	100	**Nozzle**	AIXR015	**Pressure**	3
	Equipment	ATV	**Speed**	7-8 km/hr		

Results

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

There was a moderate but consistent population of ARG. Approximately 250 ARG/m^2 were counted in the UTC at the final assessment.

Impact of product rate: There was no influence of rate, with the lowest application rate of 225 g ai/ha, regardless of product or adjuvant (with the exception of glyphosate 62% IPA), provided the best results in terms of reduced weed population (**Figure 1**).

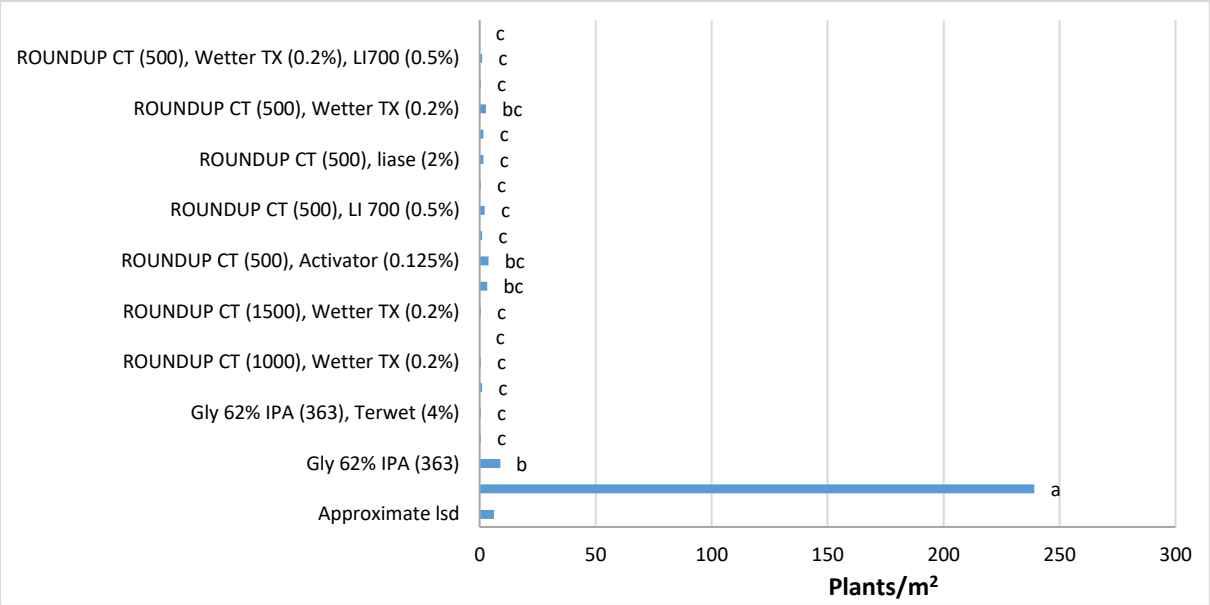

Figure 1. Plant counts 37 days after initial application (DAA1).

Impact of additional surfactants: Roundup CT® @ 500 mL/ha (225 g ai/ha) controlled 98.6% of the ARG population. Any improved performance from the addition of adjuvants was not measurable. Glyphosate 62% IPA (with no adjuvant) resulted in a slightly (but significant) lower level of control (96.3%) than most other treatments.

Discussion

There was a moderately high population of ARG with around 250 plants/m^2 measured in the UTC.

Both the grower and advisor suspected the ARG population had significant glyphosate resistance because of past poor control. However, commercial testing did not detect any resistance (detailed in the appendix). What the situation does question is why has there been such poor commercial experiences with this ARG population? Could it be related to application set up, water quality for spraying or timing to name a few?

High levels of control were achieved at the lowest rate of glyphosate. In light of the resistance tests, which showed no resistance in the population, the trial is not conclusive in demonstrating that increasing application rate can improve control of glyphosate resistant ARG. However, the trial does confirm that correctly applied, low rates of glyphosate can be highly successful in controlling ARG.

An attempt was made in this research to determine if rate responsiveness of Roundup CT® (or other glyphosate formulations) was because of increasing glyphosate active rate or because of adding a particular wetter. There was a subtle difference in the performance of the glyphosate 62% IPA when compared to is use with various rates of Terwet, giving an indication that adjuvants play a role in increasing efficacy. However, this trial was not conclusive in terms of rate responsiveness.

Results of this trial suggest that determining resistance status of ARG populations would allow for fine tuning glyphosate use and the ongoing management of resistance toward it.

Conclusion

When correctly applied, low rates of glyphosate can be highly successful in controlling non-resistant ARG

Know the glyphosate resistance status of given 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.

Acknowledgements

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DISCLAIMER — TECHNICAL

Appendix –

Figure 2- 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** Alisons	
		Survival	Rating
Roundup CT @ 0.5L/ha + 0.2% Wetter TX	Group M	0	S
Roundup CT @ 0.75L/ha + 0.2% Wetter TX	Group M	0	S
Roundup CT @ 1.0L/ha + 0.2% Wetter TX	Group M	0	S
Roundup CT @ 1.25L/ha + 0.2% Wetter TX	Group M	0	S
Roundup CT @ 1.5L/ha + 0.2% Wetter TX	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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Ryegrass control 30 days after the application of various glyphosate treatments.

Product (rate ml/ha)	Adjuvant	A	(plants/m^2)	
UTC (0)			239.2	a
Glyphosate 62% IPA (363)			8.9	b
Glyphosate 62% IPA (363)	Terwet (12%)		0.6	c
	Terwet (4%)		0.6	c
	Terwet (8%)		1.1	c
ROUNDUP CT® (500)	Wetter TX (0.2%)		2.8	bc
ROUNDUP CT® (750)			0.0	c
ROUNDUP CT® (1000)			0.6	c
ROUNDUP CT® (1250)			0.0	c
ROUNDUP CT® (1500)			0.6	c
ROUNDUP CT® (500)			3.3	bc
ROUNDUP CT® (500)	Activator (0.125%)		3.9	bc
	BS1000 (0.1%)		1.1	c
	LI700 (0.5%)		2.2	c
	LI700 (0.5%)	Liase (2%)	0.6	c
	Liase (2%)		1.7	c
	Liase (2%)	Activator (0.125%)	1.7	c
	Wetter TX (0.2%)	Activator (0.125%)	0.6	c
	Wetter TX (0.2%)	LI700 (0.5%)	1.1	c
Approximate lsd			6.2	