

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

Trial Code: GOWE04919-2
Season/Year: Autumn, 2019
Location: “Tichborne”, Parkes
Trial Partners: Mark Kinsey and Cameron Corke

Keywords

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

Take home messages

- Confirming resistance status through testing rather than assumptions of resistance of ARG populations is important to determine useful herbicide options and rates for effective control.
- Poor seasonal conditions were experienced at this trial but none of the treatments tested offered any reasonable level of control and should not be relied upon for control of ARG

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 control in fallows and pre-winter crop sowing. Glyphosate effectiveness needs to be protected as much as possible to prolong its useful life.

This trial focused on testing various knockdown options (including glyphosate tank mixes) for the control of glyphosate resistant ARG.

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

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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 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 and the application record is presented in Table 3.

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.

Table 1. Trial site details

| | |
|-----------------------------------|---|
| Trial Establishment Date | Winter, 2019 |
| Soil Type | Red Chromosol |
| Previous Crop | Wheat |
| Weed Size (at application) | 3-6 leaf |
| ARG resistance status | Resistant to Group A fops and Group B Imidazolinones, details in appendix |

Table 2. Treatment list (note a list of products, chemical groups and active ingredients is 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 | - | - | - | - |
| Roundup CT® | 2000 | - | - | - | - |
| | 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% |
| Verdict™ 520 | 500 | - | - | Wetter TX | 0.20% |
| | 150 | - | - | Uptake™ | 0.50% |
| Verdict™ 520 | 300 | - | - | Uptake™ | 0.50% |
| | 500 | - | - | Uptake™ | 0.50% |
| Untreated control (UTC) | - | - | - | - | - |

Table 3. Application record

| Date Applied | 16/4/2019 | Temp (°C) | Wind (km/h) | Wind Dir. | Humidity (%) |
|--------------------------|-----------|---------------|-------------|-----------------|--------------|
| Start time | 10:10 am | 25.2 | 2-5 | E | 37.9% |
| Finish Time | 10:55 am | Δt | 9.2 | % Cloud | 5% |
| Water rate (L/ha) | 100 | Nozzle | DG015 | Pressure | 3 bar |
| Equipment | ATV | Speed | 7-8 km/hr | | |

Results

Full result tables are documented in the annex.

ARG population was high, over 140 plants/m² (assessed in the UTC).

While the site was selected because grower and agronomist suspected ARG resistant to glyphosate, commercial testing did not detect resistance. However, ARG population was found to be moderately resistant to Verdict™ with 70% survival and 15% resistance to Intervix. Resistance to clethodim was not detected.

Many treatments did not result in plant populations lower than untreated control. Only paraquat at the higher rates, Alliance at the highest rate and Roundup/Clethodim tank mix significantly reduced ARG populations (**Figure 1**) but would not be considered commercially acceptable levels of control.

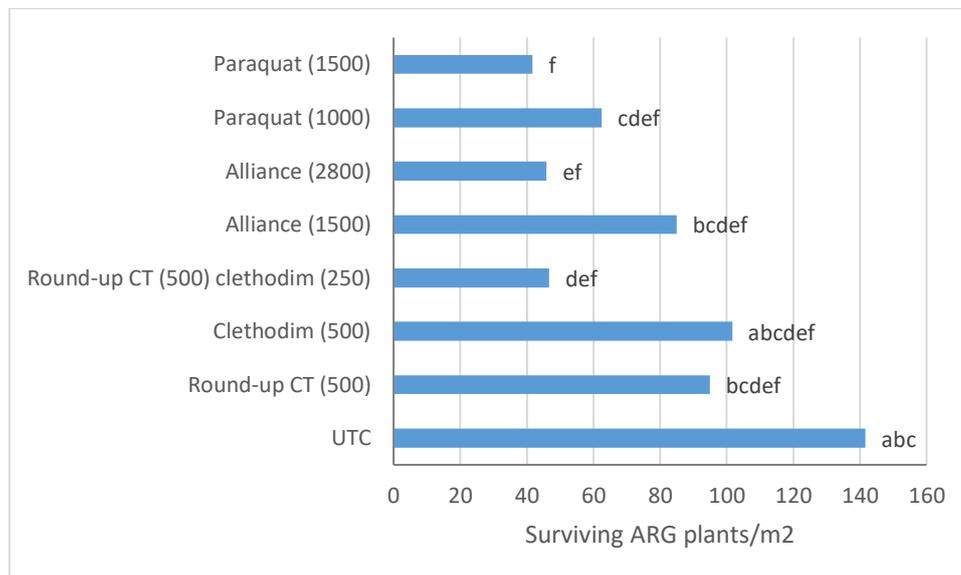


Figure 1. Surviving plants (compared UTC) following a single application of selected knockdown herbicides, 21 days after initial application.

Discussion

Trial site was selected on advice by the grower and advisor as they suspected resistance to glyphosate because of past poor control. Commercial resistance testing did not confirm glyphosate resistance, however it did detect ARG resistance to Verdict and Intervix.

Reduction in ARG population by standalone Group A herbicides provided no indication that these products can provide any level of control under difficult seasonal circumstances. Similarly, application of Glyphosate at sub lethal doses did not result in significant change in plant numbers.

While Roundup CT® @ 500 mL/ha did not significantly reduce ARG population, it provided a good opportunity to assess effectiveness of various tank mix partners. Of which only the glyphosate-clethodim combination resulted in significant reduction in ARG numbers compared to UTC. While the treatment suggests a positive synergistic relationship these results (less than 70% control) would not be considered commercially acceptable.

Best performing herbicide at this site, paraquat @ 2l/ha, reduced ARG population from 140 to 30 plants/m² or roughly 80% control, but not considered commercially acceptable.

Paraquat (1500 and 2000 mL/ha) and Alliance® (2800mL/ha) reduced ARG population, though statistically no greater than Roundup CT® at 500 mL/ha. Adding various tank mix partners to paraquat (1000 ml/ha) did not improve ARG control.

Drought conditions badly impacted on this trial. Lack of rain prevented the landholder from sowing 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 various herbicide treatments. In a nearby trial that assessed various glyphosate rates and adjuvants even a robust rate of Roundup CT® (1500 mL/ha) failed to provide good levels of control.

Results from this trial reinforces the importance of favourable environmental conditions for acceptable weed control, especially if lower end label rates are used. Success was not achieved in finding any suitable alternatives to glyphosate, which highlights the importance of adopting an integrated weed control management strategy to prolong its effectiveness.

Conclusion

Knowing (rather than assuming) glyphosate resistance status of an ARG populations is important to determine correct herbicide options and rates for effective control.

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. It also highlights the importance of sound decisions to maintain effective life of glyphosate.

Acknowledgements

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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 Tichborne | |
|--------------------------------------|--------------------------|--------------------------|--------|
| | | Survival | Rating |
| Paraquat 1L/ha + 0.2% BS1000 | Group L | 0 | S |
| 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 | 70 | RR |
| Intervix 750ml/ha + 1% Hasten | Group B - Imidazolinones | 15 | RR |
| 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 |

Ryegrass control 30 days after the application of various glyphosate treatments.

| Product 1 | Rate 1 | Product 2 | Rate 2 | Adjuvant | Rate | ARG/m ² | |
|--------------|--------|-------------|--------|-----------|-------|--------------------|--------|
| Alliance® | 1500 | | | | | 85 | bcdef |
| | 2800 | | | | | 46 | ef |
| Boxer Gold® | 2500 | | | | | 96 | bcdef |
| Clethodim | 250 | | | Uptake™ | 0.50% | 126 | abcde |
| | 500 | | | Uptake™ | 0.50% | 102 | abcdef |
| Paraquat | 1000 | Balance® | 100 | | | 152 | ab |
| | 1000 | Boxer Gold® | 2500 | | | 140 | abcd |
| | 1000 | diuron | 280 | | | 95 | bcdef |
| Paraquat | 1000 | | | | | 63 | cdef |
| | 1500 | | | | | 42 | f |
| | 2000 | | | | | 29 | f |
| Roundup CT® | 500 | Boxer Gold® | 2500 | Wetter TX | 0.20% | 85 | bcdef |
| | | clethodim | 250 | Uptake™ | 0.50% | 47 | def |
| | | Sharpen® | 34 | Hasten™ | 1.00% | 37 | ef |
| | | Sledge® | 150 | Wetter TX | 0.20% | 190 | a |
| | | Verdict™ | 150 | Uptake™ | 0.50% | 148 | ab |
| | | | | Wetter TX | 0.20% | 95 | bcdef |
| Verdict™ 520 | 150 | | | Uptake™ | 0.50% | 124 | abcdef |
| | 300 | | | Uptake™ | 0.50% | 136 | abcd |
| UTC | | | | | | 142 | abc |
| lsd | | | | | | 89 | |

GOA Trial Site Report

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 |