Glyphosate resistance in annual ryegrass is on the increase: Is it developing in your fencelines?

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Key messages

- The results of the 2013 harvest survey showed over 40 per cent of annual ryegrass samples collected displayed some degree of resistance to glyphosate. As glyphosate resistance can develop in fencelines before moving into the crop, controlling seed set along fencelines is imperative.
- A single application of a mixture of Uragan® (bromacil) and paraquat early in the season gives excellent weed control in fencelines; however this product is highly residual and is not suitable for all situations.
- A two spray or double knock strategy (which can include cultivation or another non-herbicide treatment) is often required for complete control in fencelines with the first application early in the season followed by another one later in the season (after the seeding and post-harvest operations are over). Tank mixes of residual herbicides plus a knockdown give the best control for the first application.
- The addition of Alliance® (mixture of amitrole and paraquat) as the knockdown gives good broadleaf control. Glyphosate can still be used BUT intensive monitoring and complete seed set is required to prevent resistance from developing

Aims

During the past three years, the Northern and Esperance Advisor Groups (set up as part of the GRDC-funded Glyphosate, Paraquat and 2,4-D resistance project) conducted two glyphosate resistance surveys across WA in 2013 to raise the awareness of glyphosate resistance in annual ryegrass in WA's wheatbelt and determine how widespread it was. The two groups also conducted a series of fenceline trials for annual ryegrass and other weed control and resistance management.

From the resistance surveys it was found that forty per cent of the samples tested had some glyphosate resistance. While the majority had weak (or developing) resistance, 10 per cent showed higher levels of resistance to robust rates of glyphosate.

Fencelines can be a 'breeding' ground for glyphosate resistance evolution due to the lack of crop competition, its repeated usage and the often late applications when weeds are large and harder to control. Controlling weeds that grow on fencelines is important to prevent their move into cropping fields taking their resistance status with them.

The aim of the fenceline work was to explore herbicide and application timing alternatives to control annual ryegrass and other weeds in fencelines and prevent the onset of resistance.

Method

In 2012, 13 herbicide treatments (applied as either single herbicides (glyphosate, paraquat, Amitrole® T, glufosinate or Alliance®) or as a mixture of a residual herbicide with paraquat) were compared with glyphosate at two trial sites (Esperance and Dalwallinu). The herbicides were applied in August.

In 2013, two earlier (but single) application times (May and early July) of a further range of herbicides were explored in four locations, Miling, Dandaragan, Geraldton and South Stirlings.

Different combinations of two consecutive applications were investigated in 2014 (see Table 2), once early in the year with a tank mix of a residual herbicide and paraquat, followed by another one later in the season (after the seeding and post-harvest operations were over). Cultivation and slashing were included in some of the treatments in some of the sites. This was compared with a single but later application in July or August, which is a common time to control weeds in fencelines. Uragan® (bromacil) which

was registered for fencelines in 2013 (the only bromacil product registered for this use), was included as a single tank mix application with paraquat in the early timing.

All of the trial sites were associated with grower groups and there were six trial sites in 2014 (see Table 1); Northampton (NAG group), Buntine (Liebe Group), Doodlakine (Kellerberrin Grower Group), East Wagin (East Wagin Top Crop Group), Woogenellup (Stirlings to Coast Grower Group) and Esperance Downs Research Station, Gibson (SEPWA).

Table 1: The location, plot size, treatment timing (See Table 2) and application details and weed species at each of the six trials sites in 2014.

NORTHAMPTON	Scott Bridgeman's property on Chilimony Rd, Northampton
Application Timing	Various (T1 -26/05/14 , T2 – 18/06/14, T3 – 27/07/14, T4 – 06/08/14 for cultivation, 08/08/14 for spray)
Weed Species	Annual ryegrass, wild radish, capeweed, doublegee, clover, volunteer cereals
BUNTINE	Ross Fitzsimmon's property on Dinnie Rd, East Buntine
Application Timing	Various (T1 -27/5/14 , T2 – 03/07/14, T3 – 06/08/14, T4 – 20/08/14)
Weed Species	Annual ryegrass, wild radish, brome grass, capeweed
EAST WAGIN	Brad Nalder's property on Behn Ord Rd.
Herbicides application	Various (T1 -15/05/14 , T2 – 31/07/14, T3 – 19/08/14, T4 – 27/08/14
Weed Species	Annual ryegrass, wild radish, wild turnip, marshmallow, fleabane
WOOGENELLUP	Craig Pieper's property off Woogenellup Road, Woogenellup
Application Timing	Various (T1 -13/05/14 , T2 – 31/07/14, T3 – 18/08/14, T4 – 28/08/14
Weed Species	annual ryegrass, cape weed, flat weed, wireweed, lovegrass, clover
DOODLAKINE	Kevin Walsh's property on Barnes Rd, Doodlakine
Application Timing	Time 1 -13/6/14 , Time 2 – 5/8/14, Time 3 – 26/08/2014
Weed Species	annual ryegrass, barley grass, capeweed, iceplant
ESPERANCE	Esperance Downs Research Station, Gibson (385527.19mE 6281242.9mN zone: 51)
Application Timing	Various (T1 -24/06/14 , T2 – 08/08/14, T3 – 15/08/14, T4 – 28/08/14
Weed Species	annual ryegrass, capeweed, marshmallow, clover, volunteer canola

Table 2: 14 weed control treatments at six trial sites. (Note: Some of the treatments differed at the different trial sites; All = all sites, NH = Northampton, Bu = Buntine, Dood = Doodlakine, Wa = East Wagin, SS = Woogenellup, EDRS = Gibson near Esperance)

Treatment No	First application	Timing	Second application	Timing	Location
1	simazine granules @ 4 kg/ha + Alliance® @ 4 L/ha	T1	atrazine granules @ 2.2 kg/ha + paraquat 250 @ 3.6 L/ha	T4	All
2	simazine granules @ 4 kg/ha + Alliance® @ 4 L/ha	T1	cultivate	T4	NH, Bu, Dood, Wa, SS, EDRS
3	simazine granules @ 4 kg/ha + Alliance® @ 4 L/ha	T1	Nil	T4	NH, Bu
4	simazine granules@ 4 kg/ha+ 2,4-D @ 700 mL/ha + paraquat 250 @ 3.6 L/ha	T1	atrazine granules @ 2.2 kg/ha + paraquat 250 @ 3.6 L/ha	T4	All
5	simazine granules @ 4 kg/ha+ 2,4-D @ 700 mL/ha + paraquat 250 @ 3.6 L/ha	T1	cultivate	T4	NH, Bu, Dood, Wa, SS, EDRS
6	simazine granules @ 4 kg/ha + 2,4-D @ 700 mL/ha + paraquat 250 @ 3.6 L/ha	T1	Nil	T4	NH, Bu
7	Uragan® (bromacil) @ 3.5 kg/ha + paraquat 250 @ 3.6 L/ha	T1	Nil	T4	All
8	Uragan® (bromacil) @ 5 kg/ha + paraquat 250 @ 3.6 L/ha	T1	Nil	Nil	All
9	Cavalier® (oxyflurofen) @ 4 L/ha + paraquat 250@ 3.6 L/ha	T1	atrazine granules @ 2.2 kg/ha + paraquat 250 @ 3.6 L/ha	T4	All
10	Slash	T3	atrazine granules @ 2.2 kg/ha + paraquat 250 @ 3.6 L/ha	T4	NH, Bu, Dood, Wa, SS, EDRS
11	simazine granules @ 4 kg/ha + 2,4-D @ 700 mL/ha + paraquat 250 @ 3.6 L/ha (July/Aug timing)	T2	Nil	Nil	All

12	simazine granules @ 4 kg/ha + 2,4-D @ 700 mL/ha + paraquat 250 @ 3.6 L/ha (July/Aug timing)	T2	atrazine granules @ 2.2 kg/ha + paraquat 250 @ 3.6 L/ha	Nil	Wa
13	Cultivate	T2	atrazine granules @ 2.2 kg/ha + paraquat 250 @ 3.6 L/ha	T4	NH, Bu
14	Control	Nil	Nil	Nil	All

Results

From all trials

- A single application of Uragan® (bromacil) plus paraquat in May (or June in Esperance) gave complete control of all weeds (annual ryegrass, wild radish, mallow, capeweed, turnip, clover, volunteer cereals) at all sites over both rates (350 and 500 kg/ha) (see Figures 1, 2 and 3).
- Uragan appears expensive (see Table 3) however only one application is needed to control all weeds (including summer weeds) for at last one year. As bromacil is highly residual, there is a risk of soil erosion where there is no vegetation to hold onto it and a risk to the crop if soil is blown onto it. It is toxic to trees so can only be used where there is no remnant vegetation. Adama™ is continuing trials in 2015 to investigate weed control at lower rates which will reduce the cost and the potential environmental hazards.
- At most locations (Buntine, Doodlakine, Woogenellup and Gibson), an application of either simazine + Alliance® or simazine, 2,4-D and paraquat in May followed by a second application of atrazine and paraquat in August gave better than 95 per cent control. The addition of Alliance gave slightly better control especially where there were broadleaf weeds (three years results). At Northampton however, the level of control for annual ryegrass was lower than expected. It is possible that there is developing triazine resistance in annual ryegrass on this site as most of the other weed species were controlled (not tested as yet). Another possibility is that the soil microorganisms are breaking down the triazines quickly and reducing their residual activity. This is the subject of a new study at UWA, particularly for the northern wheatbelt soils.
- Delaying the application of the first spray reduced the control by 30 per cent (10 to 30 per cent across all sites).
- Slashing later in the season then spraying with atrazine and paraquat showed promise in the southern areas (80-98 per cent control) where the season was later and there had been more rain. There was poor control (56-59 per cent) in the northern trial sites.
- The use of cultivation as a control option did not generally work well in this series of trials except when used as the second control knock in August at Buntine.

Table 3: The cost of the herbicide treatments ($/km based on a 3 m wide fence line)

First treatment	**Active ingredient**	**Cost ($/km)**
simazine @ 4 kg/ha	simazine	8
paraquat 250 @ 3.6 L/ha	paraquat	5
Alliance® @ 4 L/ha	amitrole and paraquat	20
atrazine granules @ 2.2 kg/ha	atrazine	8
2,4-D @ 700 mL/ha	2,4-D	1.20
Uragan® @ 3.5 kg/ha + paraquat (3.6 L/ha)	bromacil and paraquat	73
Uragan® @ 5 kg/ha + paraquat (3.6 L/ha)	bromacil and paraquat	103
simazine @ 4 kg/ha + 2,4-D @ 700 mL/ha paraquat (3.6 L/ha)	simazine and paraquat	14
simazine @ 4 kg/ha + Alliance® @ 4 L/ha	simazine, amitrole and paraquat	28
Second treatment		
atrazine granules @ 2.2 kg/ha + paraquat 250 @ 3.6 L/ha	atrazine and paraquat	13

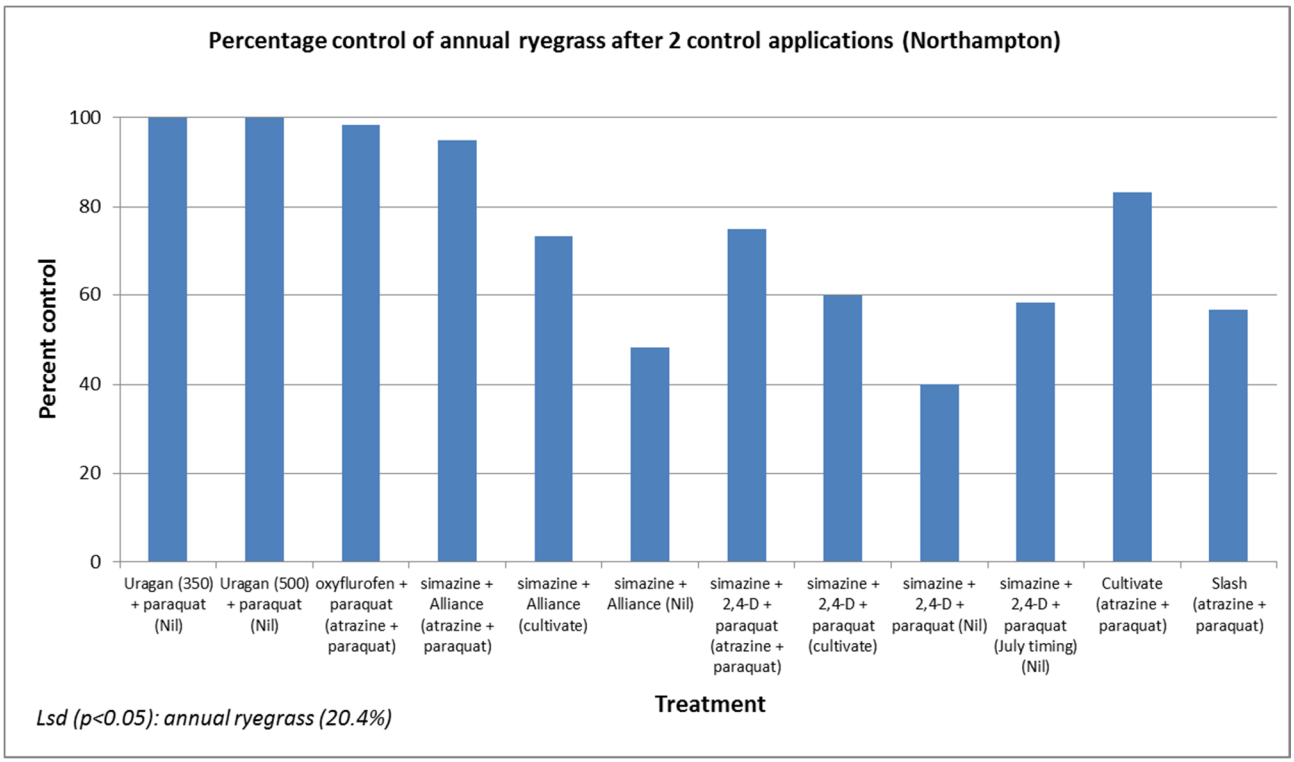

Figure 1: Control (per cent compared to untreated) of annual ryegrass after application of 12 herbicide treatments at Northampton (NAG Group trial site 2014). (Note: second application in brackets)

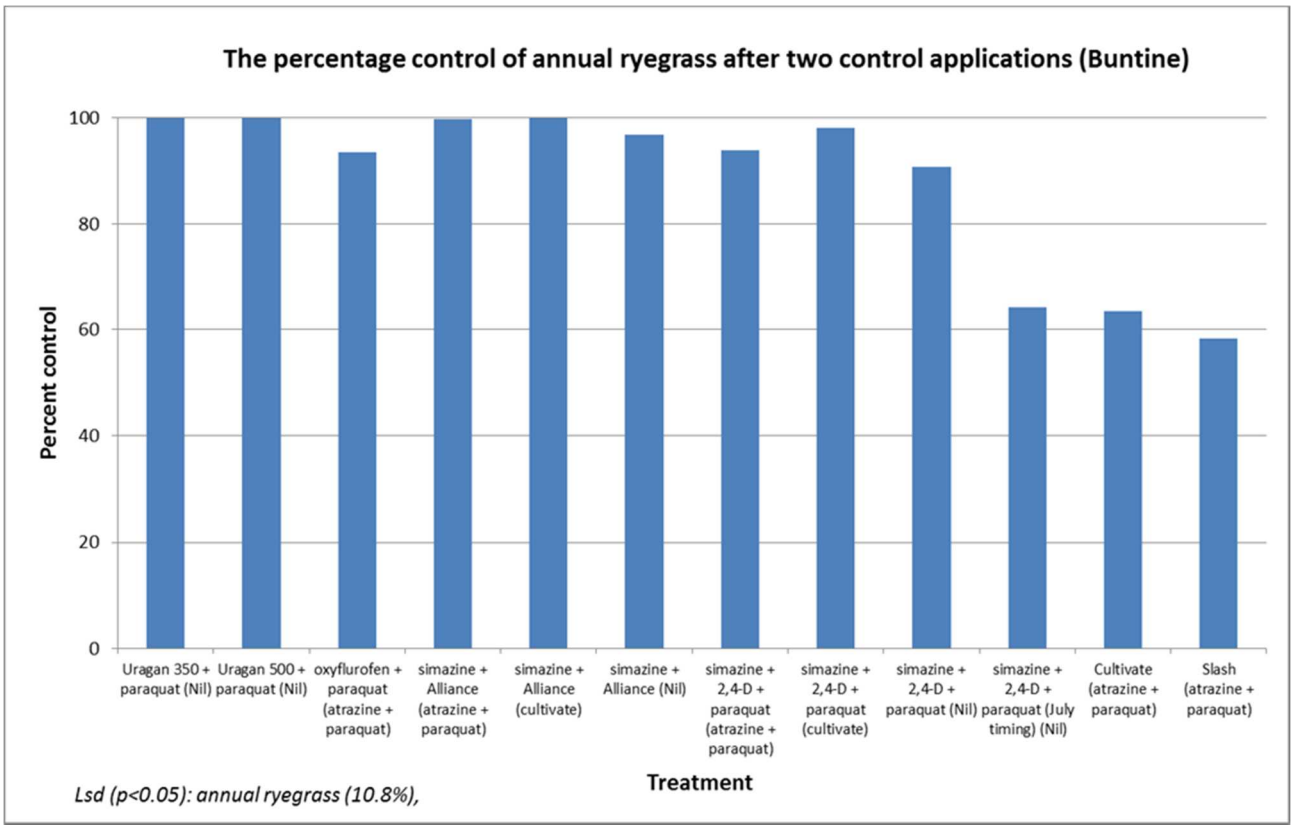

Figure 2: Control (per cent compared to untreated) of annual ryegrass after application of 12 herbicide treatments at Buntine (Liebe Group main trial site 2014). (Note: second application in brackets)

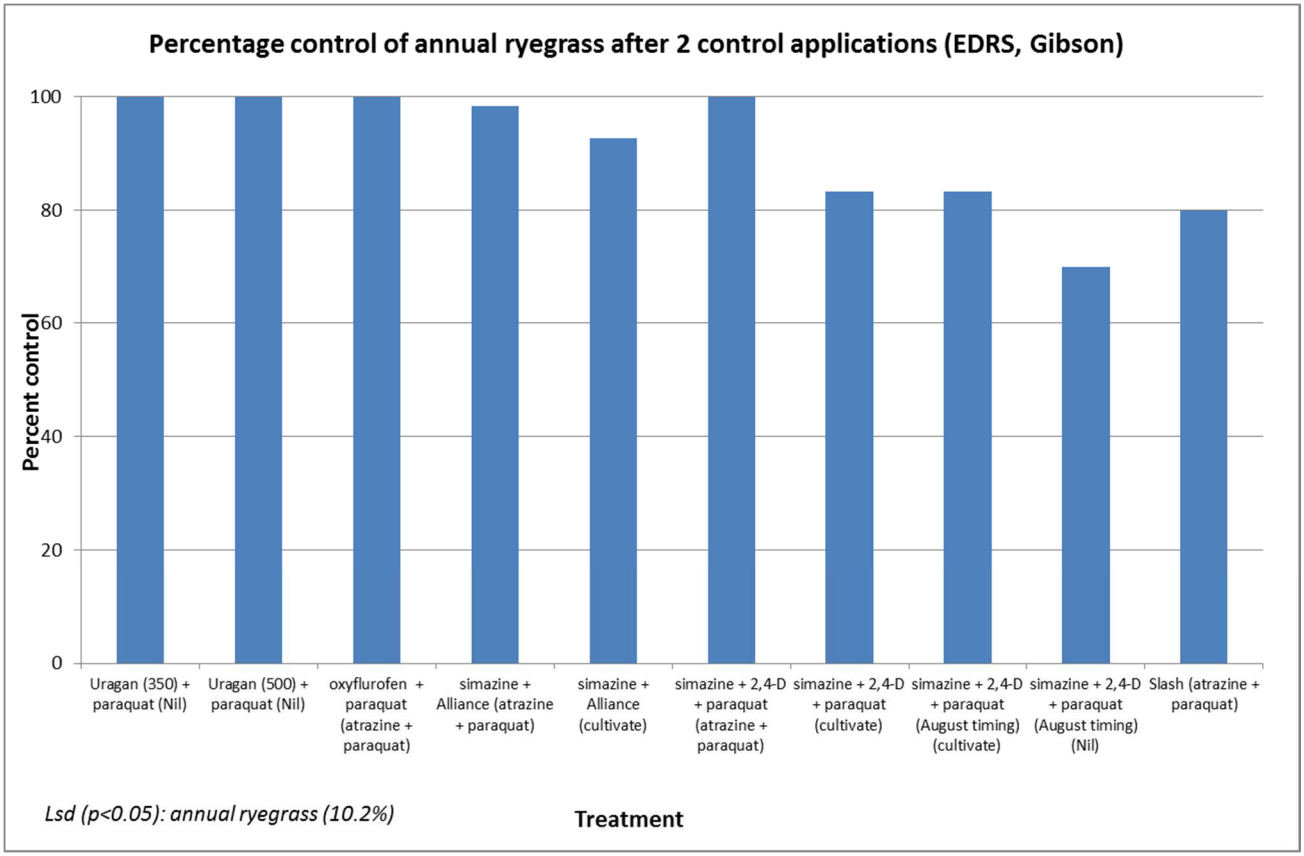

Figure 6: Control (per cent compared to untreated) of annual ryegrass after application of 10 herbicide treatments at Esperance Downs Research Station (Note: second application in brackets).

Key words

Glyphosate, resistance, herbicide, weed control, fencelines

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