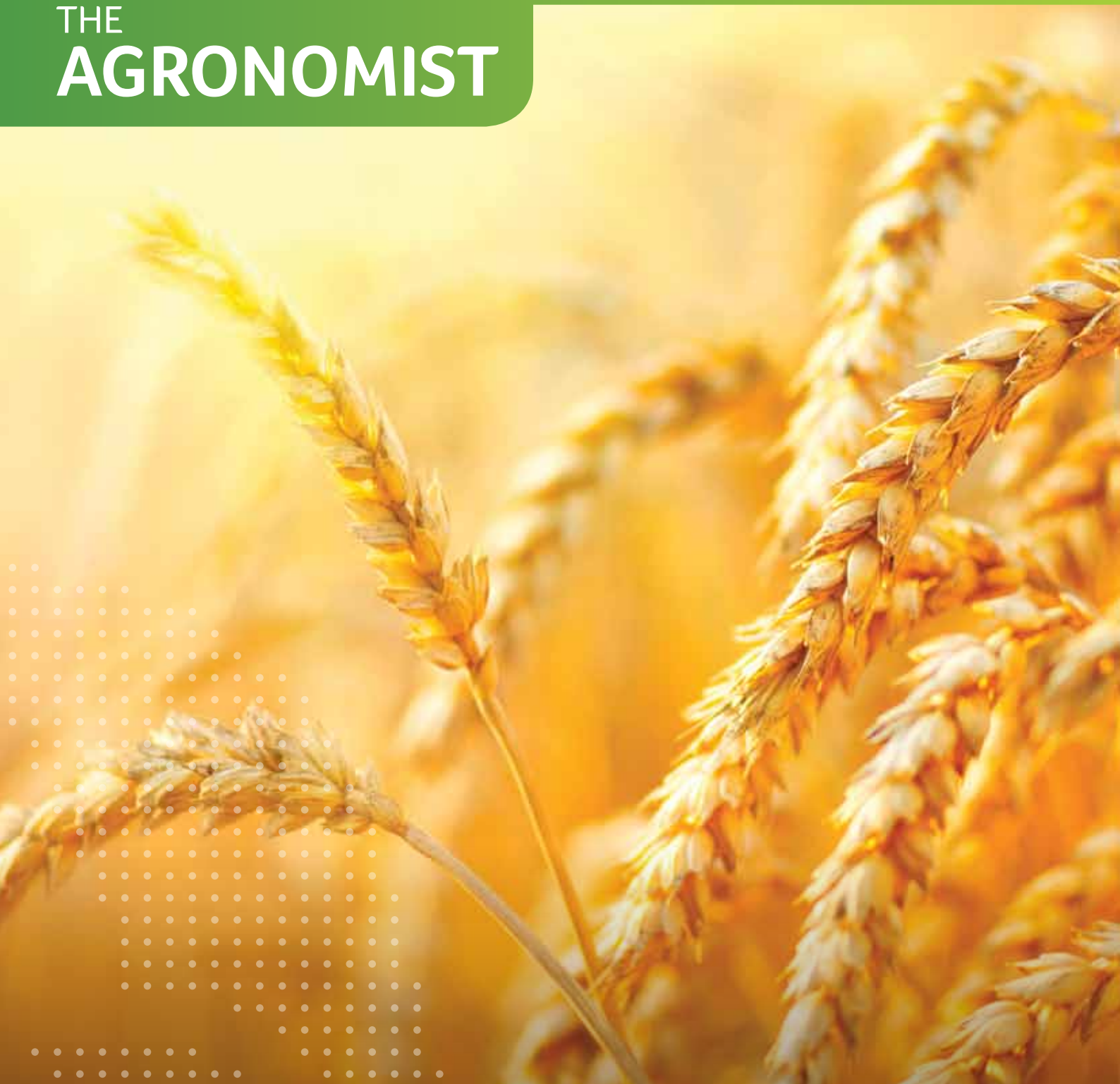


NEWS, VIEWS AND PRODUCT REVIEWS TO HELP YOU  
MAXIMISE YOUR YIELD AND PROTECT YOUR CROPS  
AND LIVESTOCK

# THE AGRONOMIST

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# Final message for 2023 from Nutrien Ag Solutions

This will be the final edition for 2023 our next edition will be February 2024. We would like to thank the below list of suppliers for making this newsletter possible. We wish you the best of luck with your harvest and we hope you have a safe and merry festive season.



# Subsoil constraints can often go hand-in-hand

Lucy Burrows – Clarke and Stokes Agriservices, Esperance Agronomist

## KEY MESSAGES

- Sodicity, dispersive/hard-setting subsoils and boron toxicity often go hand-in-hand
- Boron toxicity can be viewed as a symptom of other subsoil constraints
- Treating dispersive soils with gypsum can allow boron to leach out of the root zone

Of the 18 million hectares of arable soil in WA, 57% of those soils are sodic. These soil types are often sand over clay duplexes with pH, sodium and salinity increasing with depth. Several chemical constraints occur simultaneously in sodic soil exposing crops to a hostile growing environment.

### Sodicity

Soils referred to as sodic mean they have a high proportion of sodium ions compared to other cations (e.g. magnesium and calcium). A high amount of sodium impacts the soil structure ultimately decreasing the flow of water through the profile, limiting leaching, leading to the accumulation of boron and salt.

### Boron toxicity

Boron is an essential plant element whose role is not fully understood but is known to play a role in cell division, is a necessary part of the cell wall and is important for pollen and fruit development. It may also be involved in protein synthesis and translocation of sugars (Hall, n.d). Boron is an element that has a very narrow window between plants becoming deficient or experiencing toxicity.

Boron toxicity shows up in the oldest leaves first as it is not very mobile within the plant. In barley it displays dark brown spots surrounded by necrotic areas on the leaf tips and margins. These visual symptoms do not show up on wheat or oats.

The source of boron in the soil varies throughout WA from:

- Tourmaline rocks.
- Marine sediments.
- Aeolian sediments from salt lakes.

### Where boron toxicity occurs and what does it mean?

Boron toxicity occurs in Mallee regions with <550 mm annual rainfall, alkaline soils and sodic subsoils. High levels of boron generally occur in the same areas as sodic soils across WA, however this does not mean all soils that are sodic are boron toxic. The level of boron concentrations in the soil increase to a depth of 1 metre and exponentially increase when soil pH levels range

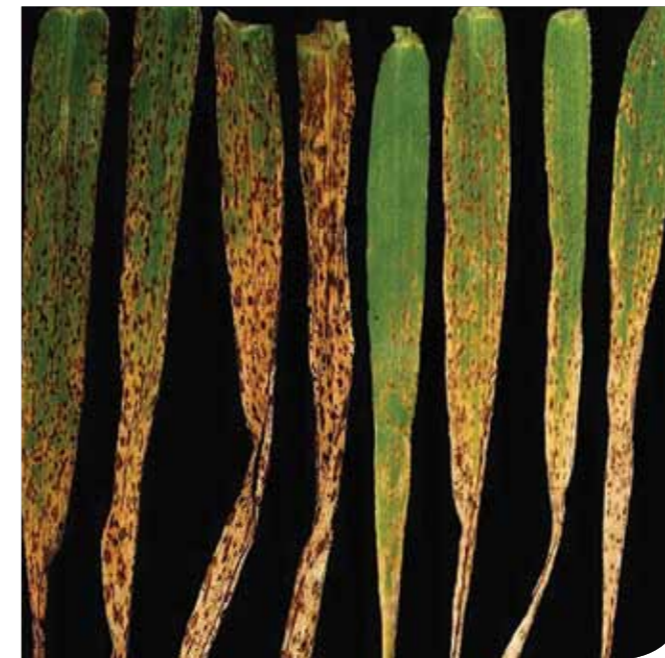


FIGURE 1. Barley leaf symptoms of boron toxicity. Source: DPIRD.

between pH 7.0 – pH 9.0. As well as occurring in sodic soil types, a limited number of studies have shown that boron is closely connected to high salinity levels in the profile, so it is likely that if you have a sodic and saline subsoil that boron toxicity will occur (Barrett-Lennard, Hall, Parker & Munir, 2022). (See figure 2).

Toxicity typically shows leaf symptoms in barley in dry conditions, generally in later plant growth stages which correlates with increased water uptake by the crop. It is thought that when conditions are good crops may not have to push roots very far down into the subsoil and effects of boron toxicity are reduced. However, in drier seasons when crops are forced to extend roots further into the subsoil to access moisture, crops will see more pronounced symptoms. A plant's response can vary also depending on the varietal tolerance, how far down the profile high boron concentrations occur, rainfall and other subsoil factors affecting the pattern of root growth such as salinity or sodicity (Moore, 2001).

It is difficult to measure yield loss, if any, from boron toxicity, however it can provide an indication of what soil types are present on your farm and other potential subsoil constraints that are in play. Management options for overcoming boron toxicity is limited to growing more tolerant varieties. The perfect scenario would be to have crops that grow on alkaline, sodic soil be tolerant to both salinity and boron, as well as be economical. But we don't live in a perfect world, so we have two important crops in which barley is more saline tolerant than wheat but boron sensitive.

Yield losses in wheat on sodic soil can be as much as 30-60% compared to soils without constraints, and so

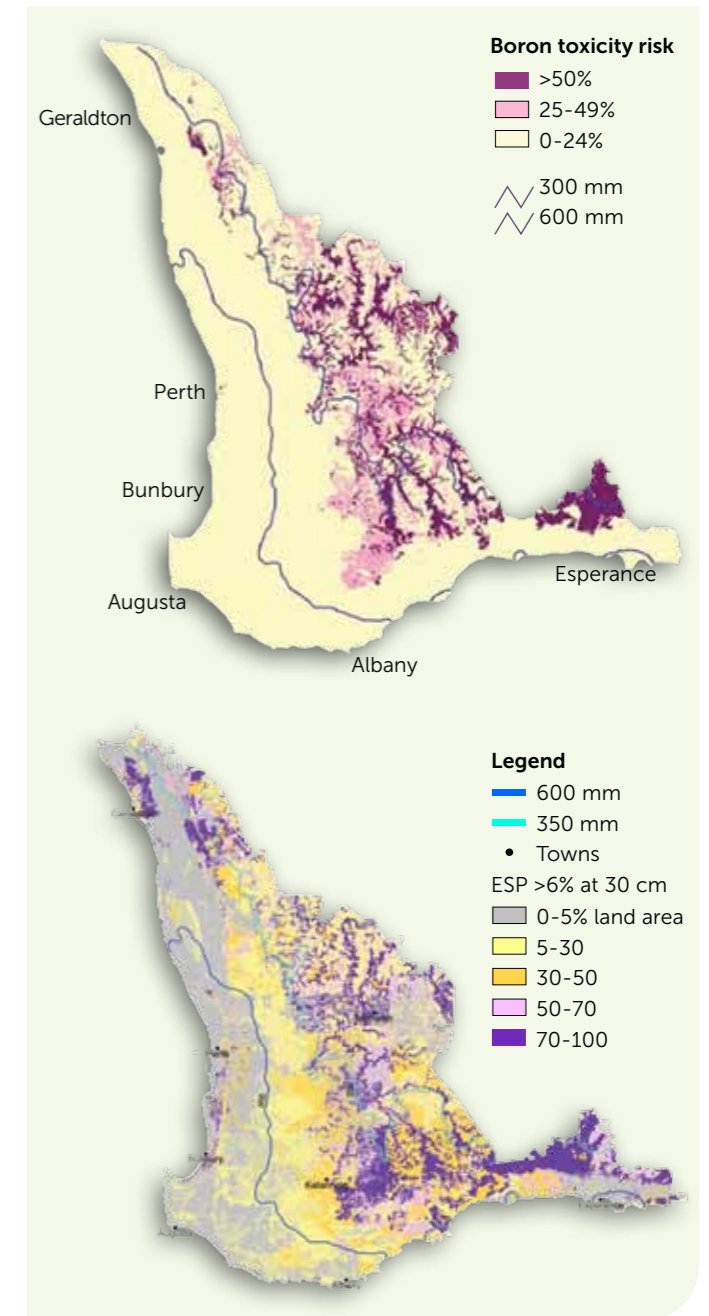


FIGURE 2. Top: Areas that experience boron toxicity in WA. Bottom: Areas of WA that have sodic subsoils with an Exchangeable Sodium Percentage (ESP) >6 at 30 cm depth. Source: DPIRD/MySoil.

perhaps the answer to tackling boron toxicity is to get a better understanding of what's happening in the subsoil (Barrett-Lennard, Hall, Parker & Muir, 2022). Discuss with your advisor about conducting comprehensive soil sampling tests to at least 30 cm to determine what subsoil interactions are happening on your farm. Boron toxicity is spatially variable so unreliable in a soil test, but understanding constraints such as sodicity and managing for these through amelioration methods such as gypsum will decrease dispersion and soil strength, increase water access through the profile to allow salts and toxins to leach beyond the root zone.

# Paraquat – Make every shot count

Richard Stone – Research & Extension Agronomist

## KEY MESSAGES

- **Paraquat resistant Annual ryegrass; it's here!**
- **Maximise every shot of paraquat by:**
  - **Optimising weed coverage – total spray volume is very important**
  - **Maximising control – add an effective Group 14 (G) tank-mix partner**
- **Consider all of the WEED smart Big 6 tactics**

### The paraquat problem

Annual ryegrass (*Lolium rigidum* – ARG) resistance to glyphosate has been present in WA grain growing regions for more than a decade (AHRI, 2019), however in 2022, the first documented case of ARG resistance to glyphosate **and** paraquat was confirmed by Dr. Roberto Busi at AHRI (AHRI, 2022).

While not quantified, research observations suggest paraquat resistance may follow glyphosate resistance in ARG populations (Planfarm, 2023), which poses a real challenge for WA growers given the general prevalence and dependence on both these knockdown herbicides for weed control in our cropping systems.

What practical solutions can growers implement immediately to prolong paraquat's efficacy on ARG?

### Strategies and tactics

#### The strategic view

For any weed/herbicide interaction, a strategic approach to resistance management which includes more than just herbicide choice is required, and the ARG/paraquat situation is no exception.

WEED smart's Big 6 provides a practical framework for herbicide resistance management, and employs six tactical components ([www.weedsmart.org.au/big-6](http://www.weedsmart.org.au/big-6)):

- Crop/pasture rotations.
- Crop competition.
- Optimisation of spray efficacy.
- Mixing and rotating herbicides.
- Preventing weed seed set.
- Using harvest weed seed control.

While all of the Big 6 components are important, for ease of implementation and/or relatively low cost, **optimising spray efficacy** and **mixing/rotating herbicides** are the two tactics which really represent the 'low hanging fruit' in terms of prolonging paraquat's efficacy.

### Paraquat efficacy; rate, conditions, but don't forget coverage

Let's consider the first 'low hanging fruit'. When thinking about optimising spray efficacy (i.e., maximising control), **application rate** and **suitable spraying conditions** are often the main considerations prior to loading the spray tank. After all, sub-lethal rates and poor spraying conditions are a sure recipe for accelerating resistance development, right?

That is correct, however **spray coverage** is also important, particularly when using paraquat to control ARG. Plants don't transport paraquat in their vascular systems, so it has no systemic activity. Therefore, optimising foliar coverage is critical for maximising control.

So how do we optimise coverage? By selecting the correct nozzle/pressure/speed combination to align **total spray volume** and **ideal droplet size** – both need to be in the recommended range of the product label to ensure the best coverage. Although a total spray volume of 50 - 70 L/ha typically used in a knockdown situation will enable the hectares to be covered quickly, these rates will not provide adequate coverage to maximise paraquat's control of ARG. A quick glance at any paraquat label will reveal a recommended total spray volume of 100 L/ha or higher, and a medium droplet size (200-250µ).

The results of trial work carried out by Nutrien at Lake Wallambin (South of Koorda) in early May 2023 highlight

the importance of total spray volume recommendations on paraquat labels. Paraquat (1.2 L/ha of a 240 g/L product) was applied to tillering ARG using the label recommended medium droplet size range (226 - 325µ) with two different total spray volume rates; 65 L/ha and 100 L/ha. ARG brownout and final control were significantly improved when the total spray volume was increased from 65 L/ha to 100 L/ha. In fact, the higher total spray volume achieved over 80% final control despite the paraquat rate being marginal for the ARG growth stage, whereas the lower total spray volume rate provided poor suppression only (see figure 1; Total spray volume rate effect on Annual ryegrass control).

The right total spray volume and droplet size will ensure the correct rate applied in the right conditions does the best job possible, ultimately assisting in prolonging paraquat's effectiveness.

### Paraquat mixes; add an effective product, effective rate, and don't forget the adjuvant

So, what about the second 'low hanging fruit' in the WEED smart Big 6? Paddock experience has clearly demonstrated that applying a single herbicide year after year on subsequent ARG populations creates an ideal environment for resistance development – either via genetic mutation (target site resistance), or through an increase in detoxification mechanisms (metabolic resistance), or both in the case of the ARG/glyphosate interaction (GRDC, 2021).

CONTROL OF RYEGRASS x WATER RATE

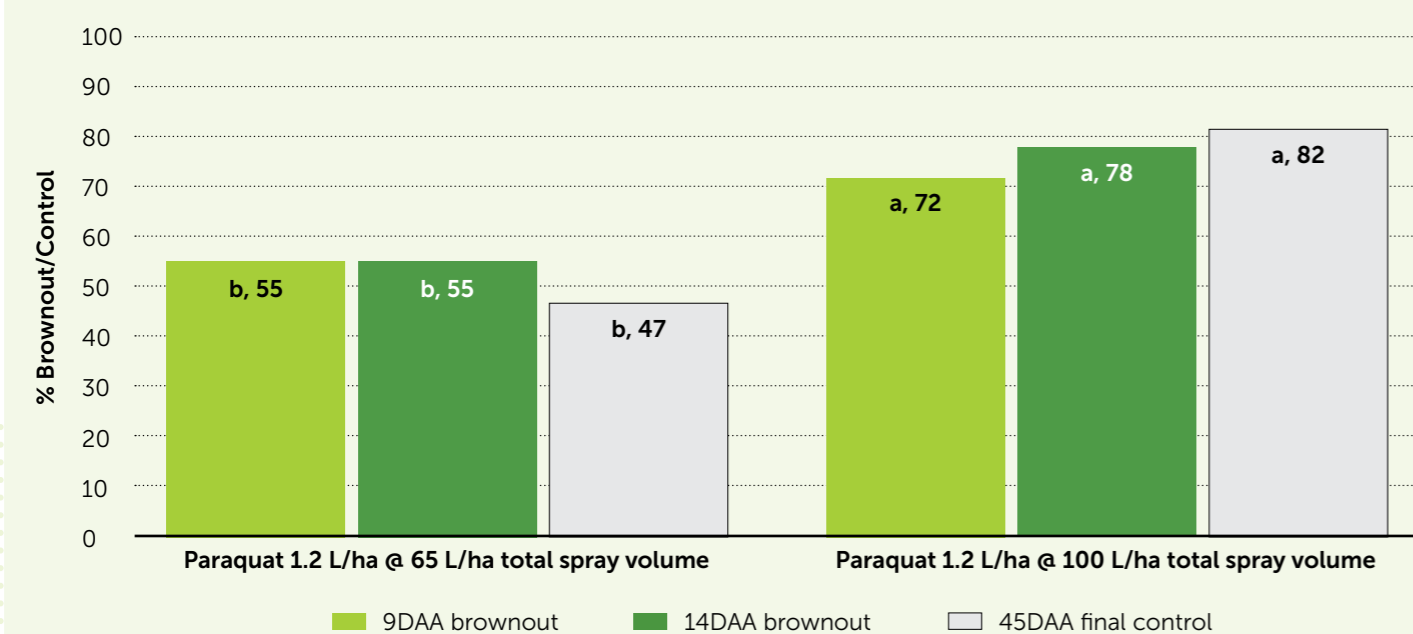


FIGURE 1. Paraquat applied at 2 different water rates, 65 L/ha and 100 L/ha. At the same paraquat applied rate (1.2 L/ha), 100 L/ha water rate resulted in almost double the control of annual ryegrass as 65 L/ha water.

CONTROL OF RYEGRASS x TERRAD'OR AND ADJUVANT RATE

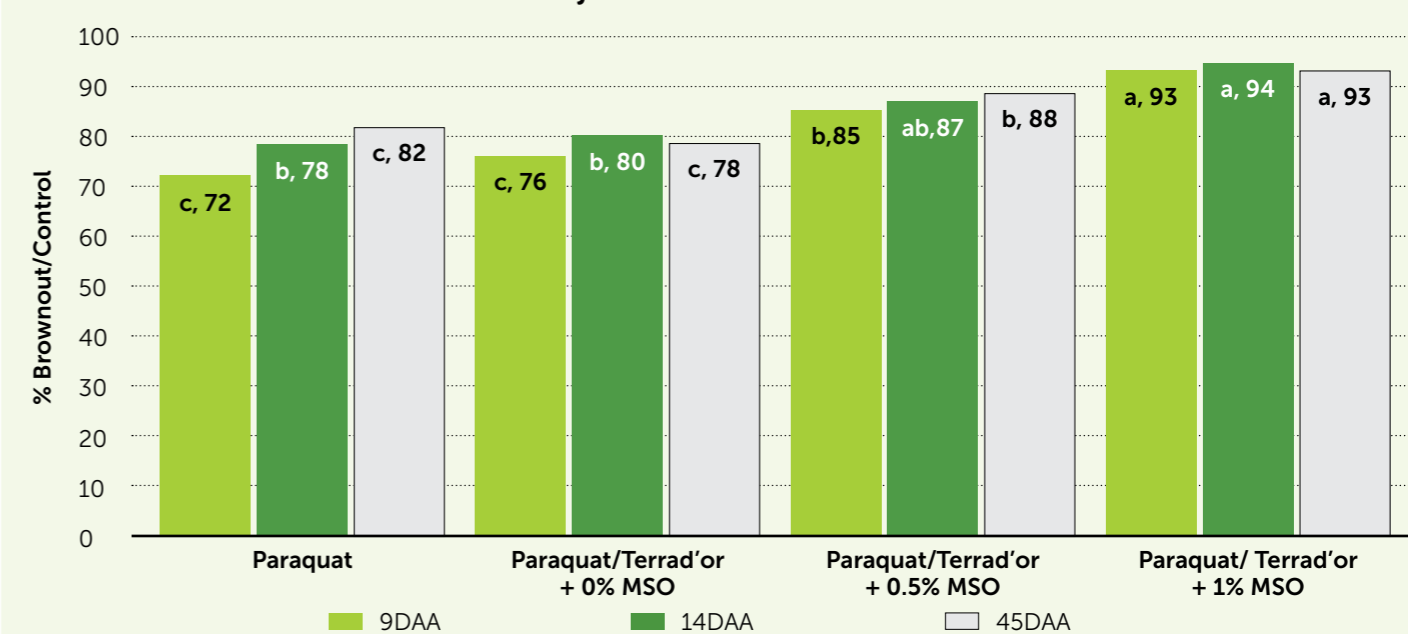


FIGURE 2. Paraquat mixing partner and adjuvant rate effect on annual ryegrass control (Paraquat 1.2 L/ha, Terrad'or 20 g/ha, total spray volume 100 L/ha). By adding Terrad'or, and most importantly, the adjuvant at the right rate, final control of annual ryegrass increased by 10% over straight paraquat.

# Paraquat – Make every shot count, cont'd

Richard Stone – Research & Extension Agronomist

Research modelling and glasshouse trials, however, have demonstrated that tank mixing a second, effective mode of action (MOA) can delay the development of target site and metabolic resistance, therefore prolonging the efficacy of a given herbicide, particularly when used as part of a rotational herbicide strategy (AHRI, 2019, 2021).

Terrad'or® and Sharpen® (Group 14, formerly G) are ideal paraquat (Group 22, formerly L) tank-mixing partners because they both provide highly effective, complementary activity for the control of ARG when applied at label rates (including the correct adjuvant and rate). Furthermore, at the time of writing, there is no known ARG resistance to Group 14 herbicides in Australia (CropLife Australia, 2023). An additional component of Nutrien's research activity conducted at Lake Wallambin in 2023 investigated the potential benefits to ARG control when Terrad'or® was tank-mixed with paraquat.

Paraquat (1.2 L/ha of a 240 g/L product) was applied to the same tillering ARG population in a total spray volume of 100 L/ha and compared with treatments which added Terrad'or® (20 g/ha) without the label required methylated seed oil (MSO), and with 0.5% or 1% MSO (the label required rate). Although initial ARG brownout was slightly increased, the addition of Terrad'or® to paraquat **without** the required adjuvant **did not improve final control** compared to paraquat alone. The addition of 0.5% MSO to the paraquat/Terrad'or® tank-mix significantly increased initial ARG brownout and final control, while the label-required 1% MSO rate provided a further significant increase in both, achieving 93% final control compared to 82% for paraquat alone (see figure 2; Paraquat mixing partner and adjuvant rate effect on Annual ryegrass control). For the record, similarly complimentary results were displayed in paraquat/Sharpen® tank mixes in an adjacent trial at the same site.

So, tank-mixing an effective Group 14 herbicide/adjuvant package with a lethal paraquat rate not only maximises ARG control when applied in the right conditions, but the combination of MOA's also provides a superior resistance management strategy compared to applying paraquat alone. In achieving maximum ARG control by two different MOA's, paraquat's effectiveness will ultimately be prolonged.

## Don't neglect the rest

While adopting high enough total spray volume rates to optimise coverage, and tank-mixing paraquat with an effective Group 14 product to maximise control are relatively simple tactics to implement and/or represent low-cost partial solutions to the paraquat resistance problem, they are just that – part of the solution, not the total answer. AHRI research is currently investigating the potential of various pre-emergent herbicide/paraquat tank-mixes on paraquat-resistant ARG populations, and some promising preliminary results have been achieved.

However, it's important to note, only three of the six WEED smart Big 6 tactical components focus on herbicide use! The remaining three focus on system cultural practices, and while they may present greater or lesser challenges and/or risks to adopt into current cropping systems, they are still extremely important in the over-all resistance management strategy.

## References

1. [www.ahri.uwa.edu.au/metabolic-glyphosate-resistant-ryegrass-its-all-about-expression](http://www.ahri.uwa.edu.au/metabolic-glyphosate-resistant-ryegrass-its-all-about-expression)
2. [www.ahri.uwa.edu.au/webinar-first-cases-of-glyphosate-and-paraquat-resistant-ryegrass-in-wa](http://www.ahri.uwa.edu.au/webinar-first-cases-of-glyphosate-and-paraquat-resistant-ryegrass-in-wa)
3. [www.planfarm.com.au/landine/glyphosate-is-now-our-biggest-resistance-issue](http://www.planfarm.com.au/landine/glyphosate-is-now-our-biggest-resistance-issue)
4. [www.ahri.uwa.edu.au/ryegrass-resists-sakura-the-same-way-wheat-does](http://www.ahri.uwa.edu.au/ryegrass-resists-sakura-the-same-way-wheat-does)
5. [www.grdc.com.au/news-and-media/news-and-media-releases/national/2021/february/researchers-find-key-herbicide-resistance-gene](http://www.grdc.com.au/news-and-media/news-and-media-releases/national/2021/february/researchers-find-key-herbicide-resistance-gene)
6. [www.ahri.uwa.edu.au/mixing-herbicides-wins-again](http://www.ahri.uwa.edu.au/mixing-herbicides-wins-again)
7. [www.croplife.org.au/resources/programs/resistance-management/herbicide-resistant-weeds-list](http://www.croplife.org.au/resources/programs/resistance-management/herbicide-resistant-weeds-list)

# Roundup Ultramax – A great choice on difficult to control weeds

Graham Doust & Tom Shaw – Farm Services Agronomists

## KEY MESSAGES

- **Roundup Ultramax performance in controlling weeds stands out against other glyphosate formulations when compared gram for gram in trials**

Does value exist in purchasing a premium glyphosate product? Glyphosate products can differ in their ability to control difficult weeds, performance in marginal conditions, rainfastness, and tank mix compatibility. Roundup Ultramax is a versatile, robust product that performs well, particularly in challenging scenarios.

## Difficult to control weeds

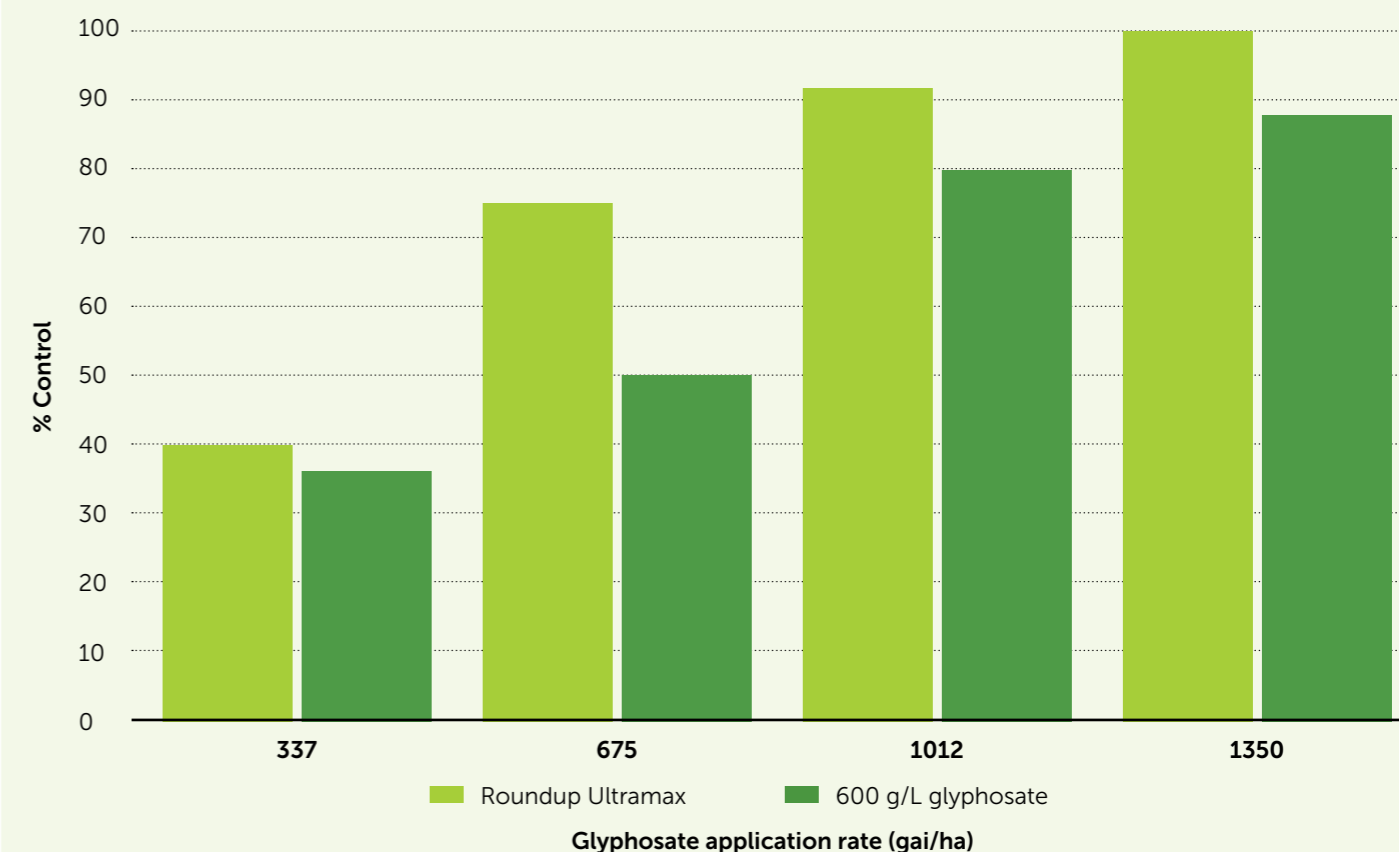
In 2020, a SLR Agriculture trial, funded by Bayer, compared the efficacy of Roundup Ultramax to a 600 g/L glyphosate on an annual ryegrass population in Tammin known to have high levels of glyphosate resistance. The trial was done in mid-September, in warm conditions, with marginal moisture underneath.

The research found that gram for gram, in a challenging scenario, Roundup Ultramax provided significantly higher levels of control than a competitor product. (See figure 1).

Dr Peter Boutsalis (Plant Science Consulting, SA), investigated the efficacy of three glyphosate formulations in controlling susceptible and glyphosate resistant populations of brome grass. While all products performed well on the susceptible population, Roundup Ultramax gave more robust control of the resistant population. (See figure 2).

Why does Roundup Ultramax work so well? Ultramax is a highly soluble potassium salt formulation with a superior surfactant package that moves quickly across a leaf surface, and into the plant. The result is that more of the applied glyphosate reaches its target compared to other glyphosate products. Further, this quick movement into the plant means that Ultramax is rainfast in 30 min, and sowing can occur within 1 hour of spraying.

## REDUCTION IN BIOMASS (%) – ANNUAL RYEGRASS



**FIGURE 1.** Reduction in biomass (%) – annual ryegrass – 15 days after application – North Tammin, 2020. On a direct gram for gram comparison with a competitor 600 g/L glyphosate product, Roundup Ultramax gave superior control of annual ryegrass with known resistance. Source: SLR agriculture.

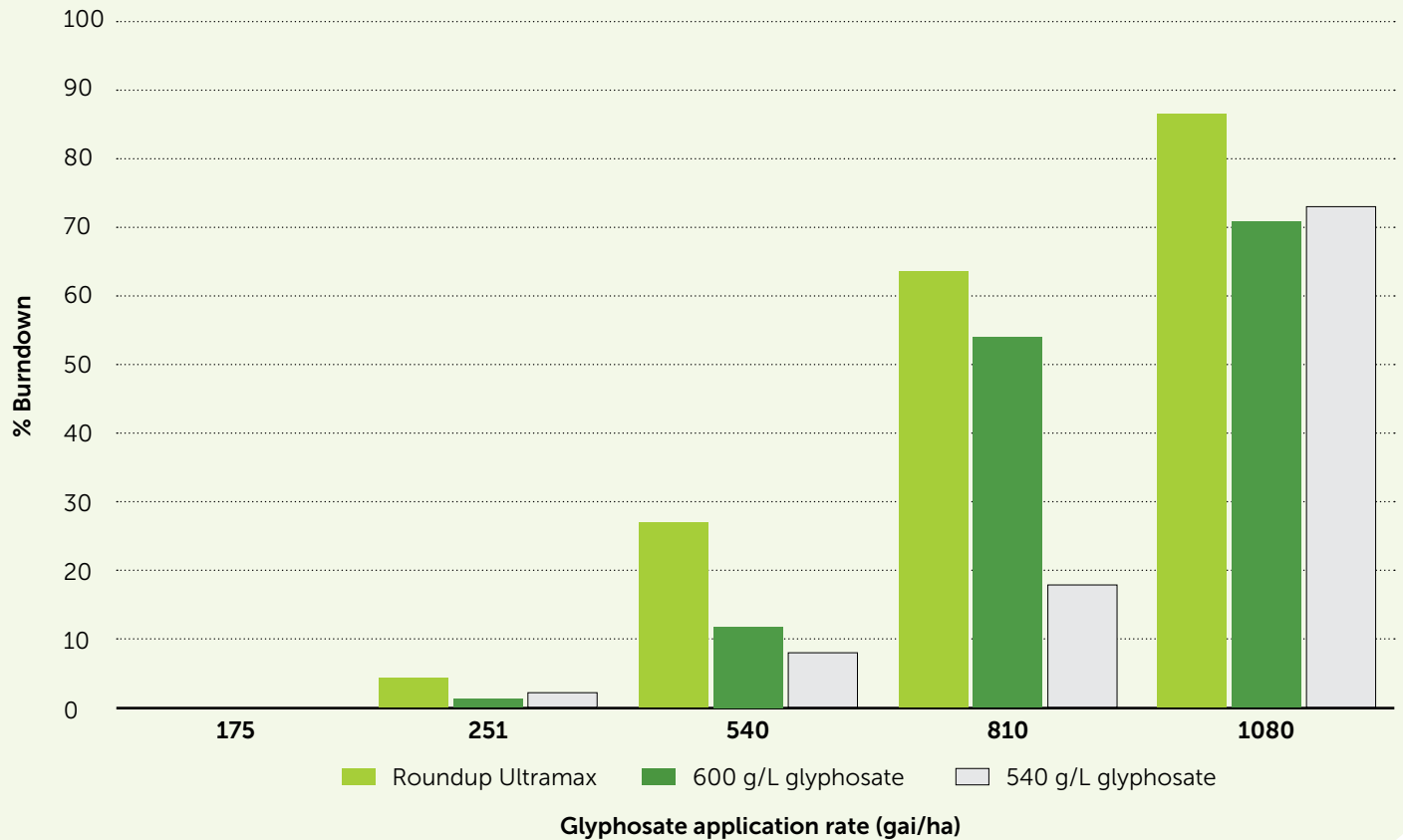
# Roundup Ultramax – A great choice on difficult to control weeds, cont'd

Graham Doust & Tom Shaw – Farm Services Agronomists

Growers should always target complete weed control by using the best available glyphosate product, and by

integrating other weed control options to ensure the sustainability of glyphosate.

## BURNDOWN % – ANNUAL RYEGRASS



**FIGURE 2.** Burndown % of a glyphosate resistant brome grass biotype treated with Roundup Ultramax, a 600 gai glyphosate and 540 gai glyphosate product. Treatments applied at 3-4 leaf. Roundup Ultramax gave better control of this brome grass biotype than competitor glyphosate products. Source: Plant Science Consulting and Bayer Crop Science.

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