Pre-emergent herbicide control of Annual Ryegrass; can we do it better?

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Key words

Annual Ryegrass, pre-emergents, herbicide, resistance, tank mixes

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Take home message

- Herbicide resistance in annual ryegrass (ARG), predominately to post emergent options such as Select®, is increasing at an alarming rate
- Pre-emergent herbicides can be an effective tool, particularly in fields where heavy ARG infestations occurs, however it is important to choose the right pre-emergent strategy
- Many of the traditional pre-emergent herbicide strategies used in the Orana Region (often not exclusively targeting ARG), tend to provide limited or no effective ARG control
- Only a few standalone herbicide options provide commercially acceptable levels of ARG control
- Tank mixing of multiple herbicides often resulted in increased levels of control with the added benefit of providing more consistent outcomes
- When planning pre-emergent strategies growers should strongly consider using more than one herbicide to maximise ARG control

Background

Annual ryegrass is expressing increasing levels of resistance to various chemistries across the Orana Region, of particular concern is resistance to in-crop herbicides such as clethodim or Select®. It is vitally important to extend the useful life of the herbicides that are still working, the use of pre-emergents could contribute to this by reducing weed burdens and the subsequent pressure placed on in-crop herbicides.

Many farmers in the GOA region already use pre-emergent herbicides to control a number of weeds, however it has been questioned if these provide adequate control of ARG and if there are not better options than the standard practices.

Grain Orana Alliance (GOA) initiated 16 trials in the winter seasons of 2014 and 2015 across the main crops grown in the region, i.e. wheat, canola, chickpeas, lupins, and field peas, testing more than 40 pre-emergent herbicide options to assess their potential to reduce ARG establishment.

The Research

During the winter of 2014 and 2015 GOA established small plot replicated trials looking at various options for pre-emergent control of ARG. Trials were situated in commercial paddocks with known ryegrass infestations near Parkes, Dubbo, Narromine, Warren, Gilgandra Wellington and Trangie.

The aim of the trials was to compare the effectiveness of a range of pre-emergent options on reducing ARG establishment in the five main crops grown in the Orana Region. In each of the crop types

between 15 to 18 different herbicides or herbicide combinations were investigated, the majority of which were registered. In those registered situations the full label rate was used[1] unless a specific tank mix with lower rates was registered on one of the product labels. Applications were made as per label direction including the following incorporation methods or application timings such as those listed below:

- Incorporated by sowing (IBS)
- Post Sowing, Pre-Emergent (PSPE)
- Post Emergent (PE)

One unregistered option was, and are referred to as Product X in this paper. This product was included as there was either some discussion of impending registrations in the near future or because the product may have shown potential value in the past and future registration may be sought. Table 1 below details the main herbicides investigated in this trial.

Table 1. Pre-emergents included in the trials on various crops with the application methods and rate[1]

Active Ingredient	Common Trade Names	Incorporation method/Timing	Rate Range
Atrazine 900 g/kg	Gesaprim® granules	IBS, IBS/PE, PE, PSPE	1.1 - 2.2 kg/ha
Tri-Allate 500 g/L	Avadex® Xtra	IBS	3.0 L/ha
Isoxaflutole 750 g/kg	Balance® 750 WG	PSPE	100 g/ha
Prosulfocarb 800 g/L, S-metolachlor 120 g/L	Boxer Gold ®	IBS, IBS/PSPE	2.5 L/ha
Diuron 900 g/kg	Diuron 900 WDG	IBS, PSPE	0.83 - 1.1 kg/ha
S-Metolachlor 960 g/L	Dual Gold®	PSPE	0.5 – 1.0 L/ha
Triasulfuron 750 g/kg	Logran® 750WG	IBS	20 g/ha
Metribuzin 750 g/kg	Metribuzin 750 WG	IBS, PSPE	200 – 380 g/ha
Dimethenamid-P 720 g/L	Outlook®	IBS	1 kg/ha
Propyzamide 500 g/L	Rustler®	IBS	1 L/ha
Pyroxasulfone 850 g/kg	Sakura®	IBS	118 g/ha
Simazine 900 g/kg	Simazine 900DF	IBS, PSPE	1.1 – 2.2 kg/ha
Pendimethalin 455 g/L	STOMP® Xtra	IBS	2.3 L/ha
Terbuthylazine 750 g/kg	Terbyne®	IBS, PSPE	1.0 – 1.4 kg/ha
Trifluralin 480 g/L	Triflur X®, Treflan 480®	IBS	0.7-3.0 L/ha

All applications were made using ATV mounted spray boom with AIXR110-015 nozzles at 50 cm spacing, 100l/ha water, 3 bar pressure, speed 7 km/hr.

Findings-

Single product performance

A number of standalone products were tested that represent a range of commonly used pre-emergent chemistries as well as some of the newer actives.

[1] Trifluralin was tested at a number of rates given the wide rate range on the label and increased potential for crop damage at the higher rates

The more traditional chemistries used in the Orana Region such as simazine (Chickpeas, Lupins) or Terbyne (lupins, chickpeas, field peas) were not particularly effective in reducing the ARG populations. An example of this is in chickpeas, where both simazine and Terbyne achieved less than a 40% reduction in numbers (

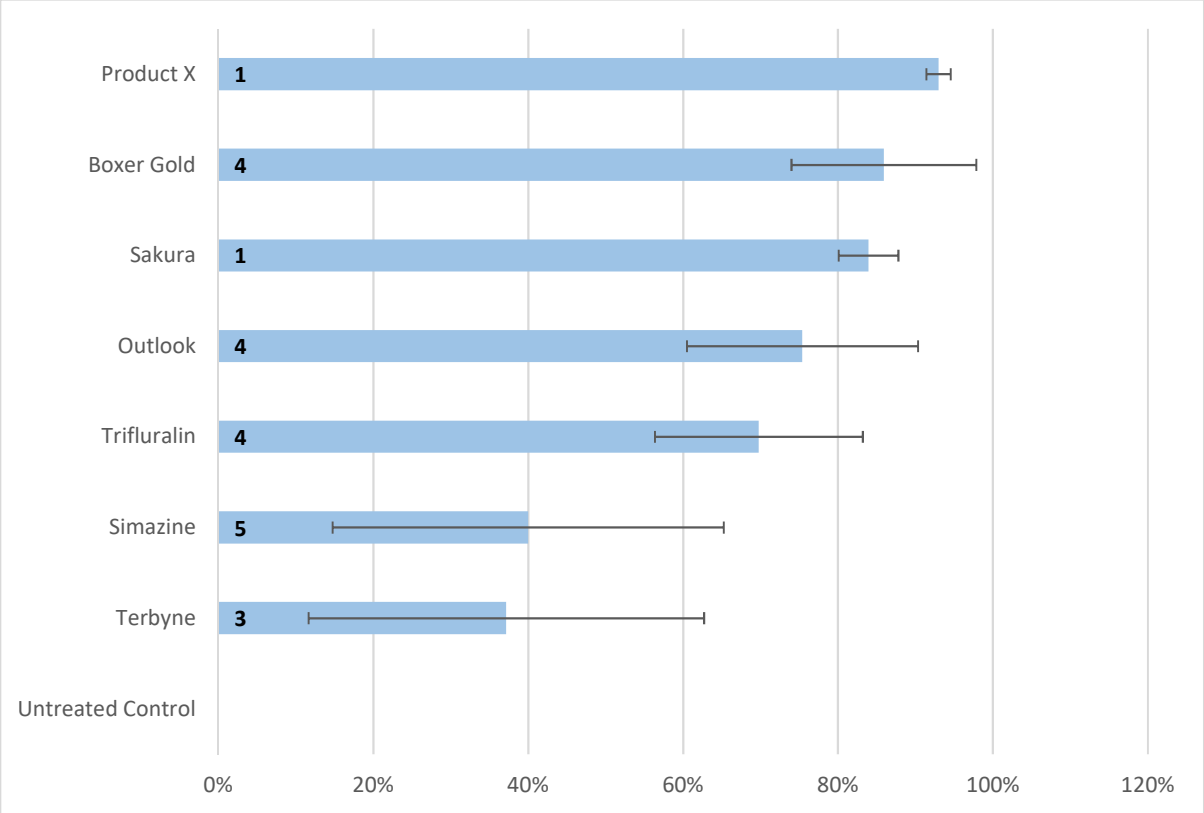

Figure 1). However, a number of other products did perform better across a number of crops for both years. For example, Product X, Boxer Gold and Sakura all provided over 80% reduction in populations.

In the following charts the error bars represent one standard deviation above and below the mean and the number at the base of the bar refers to the number of trials in which the product was included.

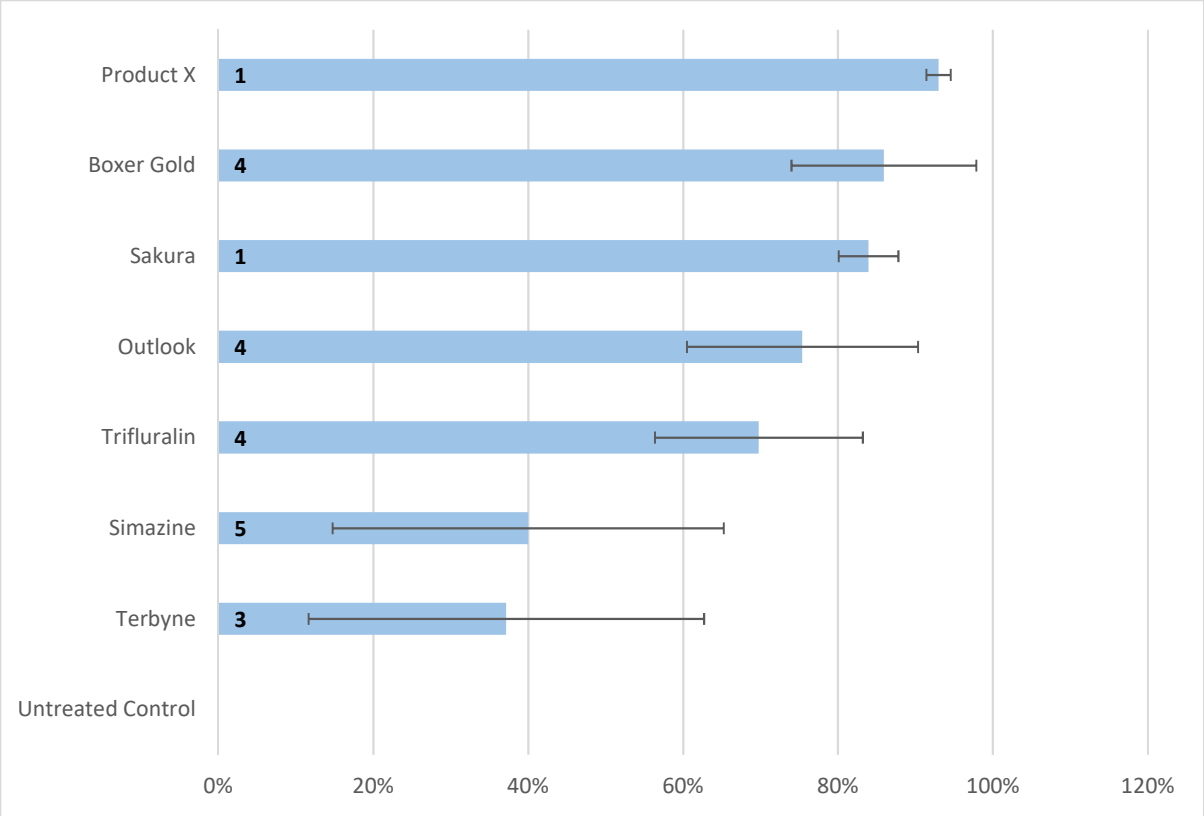

Figure 1. Percentage reduction in emergence of Annual Ryegrass in Chickpeas compared to the untreated control in response to application of various stand-alone pre-emergent applications.

It is also worth noting the relative variability in effectiveness by some pre-emergent options as shown by the error bars in Figure 1. For example, the common options of simazine or Terbyne demonstrated a range of control from 15% to 65%. Trifluralin, Outlook and Boxer Gold showed much lower levels of variability in control. Sakura and Product X showed very low levels of variability, which is in part driven by the fact that the results for these products are only from one trial.

Multiple product performance

Approximately 32 tank mixes were tested within the group of trials and it was found that mixes not only tended to improve the levels of control of ARG over single product applications, they also reduced the degree of variability in control.

Figure 2 contains a box and whisker plot of the results from these trials. The box represents the control achieved in 50% of cases, the line bisecting the box is the median level of control and the whiskers at the ends indicate the control achieved in the remaining cases. The dots represent outliers or results outside the normal distribution.

As illustrated in Figure 2 below the application of a single product resulted in an average control of 75% but with control falling between 54% to 85% control in half of the products tested. With mixes containing two products the median level of control increased 85% with the range of resultant control contracting to a range of 70% to 90%, again in half of the mixes tested. Three way mixes resulted in the median level of control increasing to 93% but with even tighter range of outcomes of 84% to 98% control.

Further to this, the dots in Figure 2 represent results falling outside the general distribution. In the cases including one or two way mixes it can be seen there are a number of such cases. In the cases involving three way mixes only one case of such a circumstance is detailed.

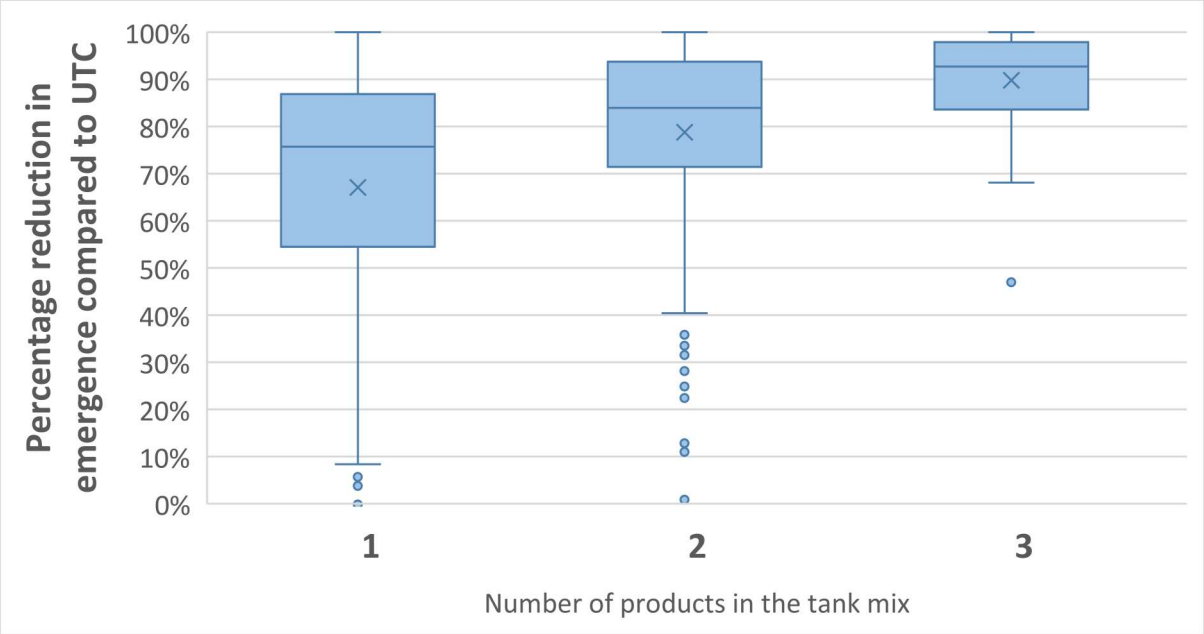

Figure 2. Percentage reduction in emergence of Annual Ryegrass compared to untreated control where one (1), two (2) and three (3) products were applied as a tank mix.

To help better understand this relationship, Figure 3 details a small number of specific herbicides and mixes. When mixing chemistries that showed reasonable levels of control as stand-alone products, the resulting effectiveness was often further enhanced. That is, the effectiveness was not limited to the level achieved by the most effective option in the mix. For example, atrazine, trifluralin and propyzamide provided reasonable levels of control of approximately 60, 78 and 83% respectively when applied alone. However, when mixed under various combinations the control increased to a level of greater than 90% (Figure 3).

In addition, the degree of variability in control decreased similarly, as discussed above. In this example the worst result for the two product mix (Propyzamide and Atrazine – 90%) outperformed the average result of the best single product option (Propyzamide) at 83%.

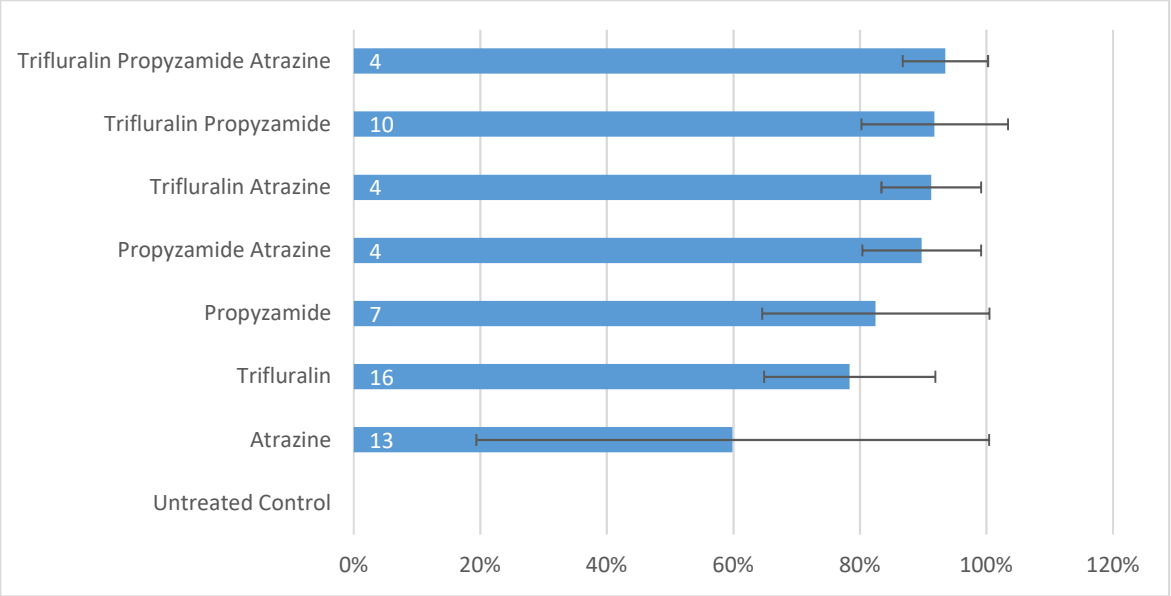

Figure 3. Percentage reduction in emergence of Annual Ryegrass compared to the untreated control in response to application of various combinations of atrazine, trifluralin and propyzamide.

There are exceptions, not always does the addition of a tank mix partner improve the levels of control. In the example below (Figure 4) Terbyne and Trifluralin on their own resulted in 48% and 78% control respectively. However when these two products were tank mixed the resulting control was only marginally better than Trifluralin by itself at 80%.

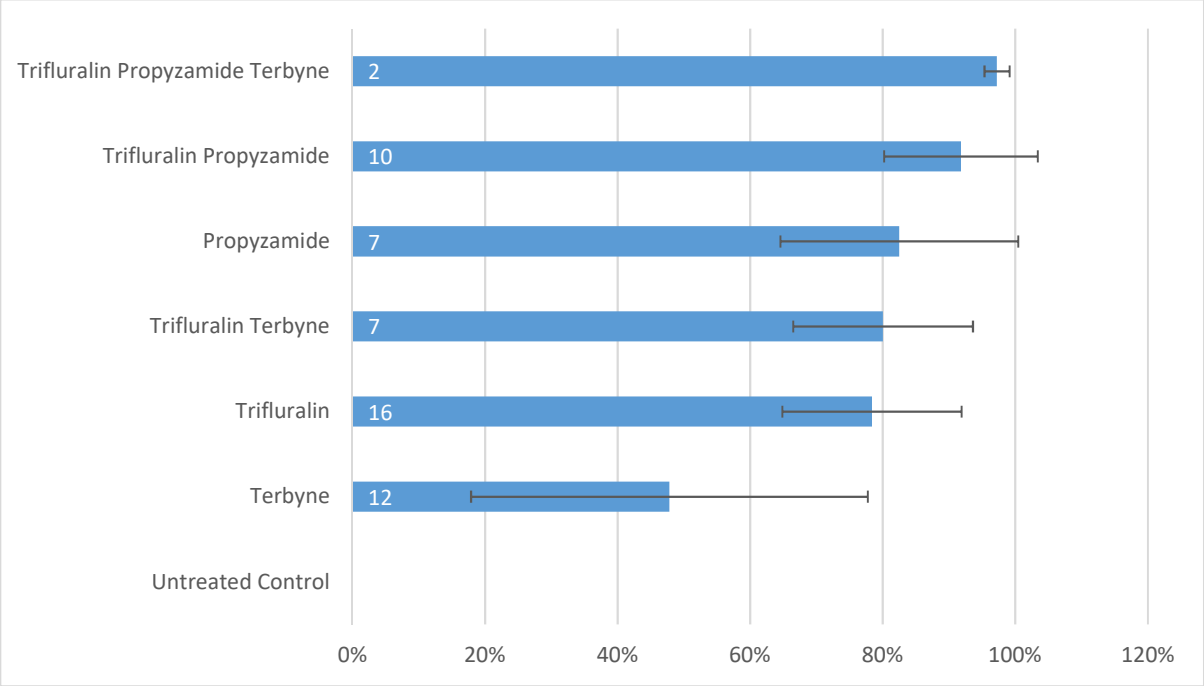

Figure 4. Percentage reduction in emergence of Annual Ryegrass (%) (when compared to the untreated control) for various combinations of trifluralin Terbyne and propyzamide.

Discussion

The results of these trials confirm that the common district practice of using a single product pre-emergent strategy was often not particularly effective on ARG, however with some modifications significant improvements in the level of control could be achieved.

Simply changing from one product to another sometimes improved the level of ARG control but was not always consistent and in nearly every trial conducted there was a more effective 'tank mix' option.

Increasing the number of tank mix partners often improved control of ARG where two product strategies often outperformed one product strategies, and three way strategies generally outperforming everything else.

This research would also tend to suggest that increasing the number of tank mix partners also increased the reliability on the final level of ARG control. With a number of tank mix combinations resulting in better than 97% control over a number of trials with only +/- 2% range of outcomes.

Recent research[2] looking at resistance to glyphosate has found that tank mixing knockdown herbicides has actually delayed the onset of herbicide resistance. The data developed from this series of trials would tend to sit well with that theory, with the level of control increasing and degree of variability decreasing with increasing partners in the tank mix. This decreases the exposure of other herbicides to high weed numbers and also results in lower levels of seed bank replenishment. Ultimately easing the pressure on other control measures used in herbicide resistance strategies.

Conclusions

Pre-emergents can provide useful control of ARG and therefore should be considered as part of an Integrated Weed Management Strategy particularly for heavier infestations of ARG in the Orana Region.

Traditional stand-alone pre-emergent herbicides used in the Orana Region do not always provide adequate or reliable levels of control of ARG. However, these products can be combined with a number of effective pre-emergent herbicides to increase both the level and consistency of control. Combining pre-emergent herbicides is likely to be more effective than simply changing products.

The selection of components of any tank mixes is still important and not really covered in this paper. Further information and evidence should be sought before deciding on a pre-emergent strategy as well as considering and abiding by the herbicide label directions and rates.

This work has shown the potential effectiveness of pre-emergent herbicides, in some trials weed burdens of 300 plants/m2 of ARG were reduced to less than one plant/m2. This level of effectiveness must be beneficial to reducing pressure applied to many of our in crop herbicides and therefore extending their useful life.

It should be remembered that information gained though these trials will only form part of the solution or management of this issue and weed populations must be targeted at every other chance. Over reliance on these would ultimately result in their failure as well (due to resistance development).

[2] Evans, J.A., Tranel, P.J., Hager, A.G, Schutte, B., Chenxi, W., Chatham, L.A., Davis, A.S. Managing the evolution of herbicide resistance, Pest Management Science, May, 2015. 10.1002/ps.4009. farmers who used 2.5 herbicide modes of action (MOA's) on average per application were 83 times less likely to have glyphosate resistance than growers that had mixed 1.5 MOA's on average

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