Sustaining Group J and K herbicides in high break crop intensity rotations

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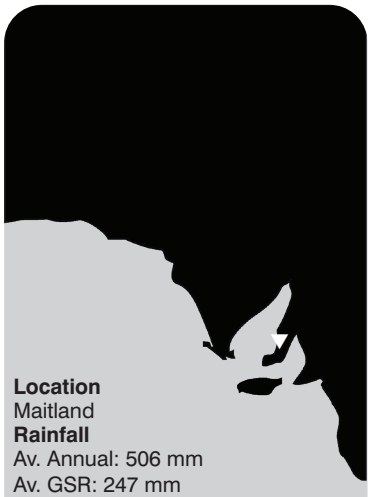

Location
Maitland
Rainfall
Av. Annual: 506 mm
Av. GSR: 247 mm
2018 Total: 416 mm
2018 GSR: 246 mm
Soil type
Clay
Soil test
pH 6.8
Nutrients on 0-10 cm soil layer (mg/kg): Ammonium N 2, Nitrate N 23, P Colwell 55, K Colwell 541
Plot size
10 m x 1.35 m
Trial design
Randomised complete block design

Key messages

- **Resistance in ryegrass to pre-emergence herbicides such as Boxer Gold® and Sakura® has been confirmed in high break crop intensity (HBCI) systems.**
- **These herbicides need to be rotated with other mode of action herbicides, especially with Group D propyzamide in the break crop phase.**
- **Adoption of practises to stop ryegrass seed set during the crop season, and/or collecting seed with harvest weed seed control (HWSC) systems, are potential options to delay the spread of herbicide resistance.**

Why do the trial?

The availability of improved herbicide tolerant break crop options - such as triazine tolerant (TT) canola, Group B imidazolinone (IMI) tolerant (Clearfield®) canola, PBA Hurricane XT lentil, and now PBA Bendoc faba bean - along with relatively higher pulse prices, improved agronomic and disease characteristics, and harvest efficiency, have resulted in an expansion of the area sown to pulses and canola in South Australia (SA). Heavy reliance on Group A - particular the dim chemistry in break crops - has contributed to increased ryegrass resistance to these herbicides, making its control challenging. Consequently, herbicides with different modes of action (Groups D, J and K) are being used to manage Group A dim-resistant ryegrass in high break crop intensity (HBCI) rotations (rotations having at least two break crops in the last 5 to 6 years). The research studies were carried out to investigate the implications of intensive use of Group J and K herbicides on resistance of ryegrass, and its control, in HBCI rotations in SA.

How was it done?

Ryegrass resistance in high break crop intensity paddocks

A total of 36 focus paddocks with HBCI rotations were selected across the Mid North, Yorke Peninsula, lower Eyre Peninsula, upper Eyre Peninsula, South East and SA Mallee regions. The selected paddocks had either IMI tolerant break crops (PBA Hurricane XT lentil or Clearfield® canola) or non-IMI break crops (conventional lentil, conventional canola/TT canola, field pea, chickpea, faba bean, lupin) grown at least twice in the last 5 to 6 years. Ryegrass seeds were collected prior to harvest in 2017. These were screened for resistance in outdoor pot trials conducted between autumn and spring 2018.

Research trial

A research trial was established at Maitland (Yorke Peninsula) in 2018 that included new pre-emergent herbicide Ultro® (active carbetamide, Group E), currently in development, applied as incorporated by sowing (IBS). Ultro 1700 IBS + clethodim post-emergence (POST) (500 g/ha) was compared to grower practices of Boxer Gold® IBS (2500 g/ha) + clethodim POST (500 g/ha), Sakura® IBS (118 g/ha) + clethodim POST (500 g/ha) and propyzamide IBS (1000 g/ha) + clethodim POST (500 g/ha), for controlling ryegrass in lentil. The experiment was sown on 22 June, 2018. The assessments on ryegrass seed set were just near the crop harvest. The statistical analysis was done with ANOVA through GENSTAT version 20.

What happened?

Herbicide resistance screening

Herbicide resistance screening recorded clethodim (Group A dim) resistant ryegrass in 46% of samples and developing clethodim resistance in a further 21% of samples tested (Figure 1). Such resistance limits the effectiveness of break crops as rotational tools. Resistance development to Group J and K herbicides, Boxer Gold® and Sakura®, was confirmed in ryegrass (Figures 2 and 3) and is of further concern for HBCI rotations. One quarter of the ryegrass populations exhibited resistance to Boxer Gold® (≥20% survivors). Half of the ryegrass biotypes resistant to Boxer Gold® originated from HBCI paddocks on lower Eyre Peninsula where canola is the dominant break crop grown. Biotypes with ≥ 20% survival to Sakura® were not detected, although 1-20% survival in pot trials (developing resistance) was confirmed in one third of ryegrass populations (Figure 2), again predominately from the lower Eyre Peninsula.

Ryegrass resistance levels to Group J and K herbicides observed in this survey were compared to herbicides used in the paddocks in the last five years. The paddock with the highest levels of resistance to Group J and K herbicides had both Boxer Gold and Sakura used twice in the last five years. Further, the second-ranked paddock for resistance had Boxer Gold® used three times, and Sakura® once, in the last five years. These results suggest the judicious use of Group J and K chemistries is required in HBCI rotations, particularly in the break crop phase and the integration of alternative options such as Group D propyzamide should be considered. As a rule of thumb, herbicides from the same mode of action should not be used for two consecutive years on the same land. Also, care must be taken to ensure survivors are not able to set seed, by adopting tactics such as shrouded inter-row spraying, crop topping and wick wiping where possible. In addition to these, harvest weed seed collection measures such as narrow windrow burning, chaff carts, Harrington seed destructor, chaff tramlining and baling need to be explored to reduce ryegrass seed entering the soil seedbank (Walsh *et al*, 2017).

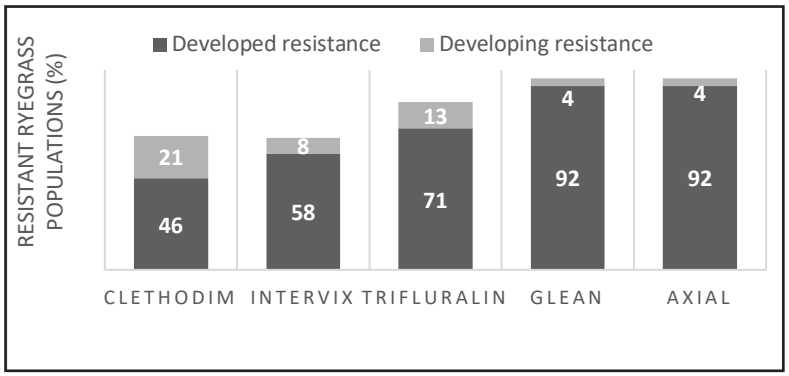

Figure 1. Developed resistance (where ≥ 20% survival was confirmed in pot tests) and developing resistance (where 1-20% survival was confirmed in pot tests) to Group A, B and D herbicides.

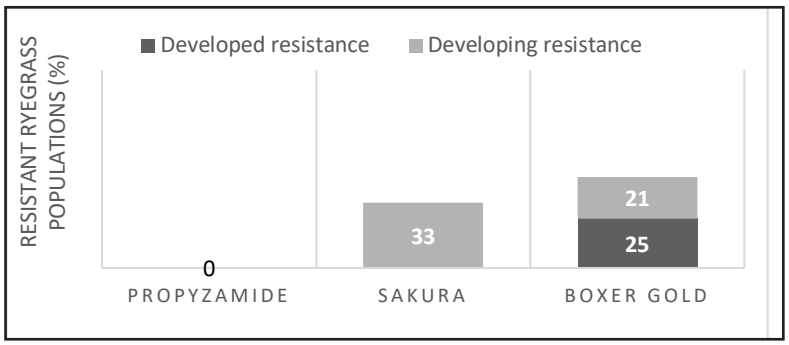

Figure 2. Developed resistance (where ≥ 20% survival was confirmed in pot tests) and developing resistance (where 1-20% survival was confirmed in pot tests) to Group D, J and K herbicides.

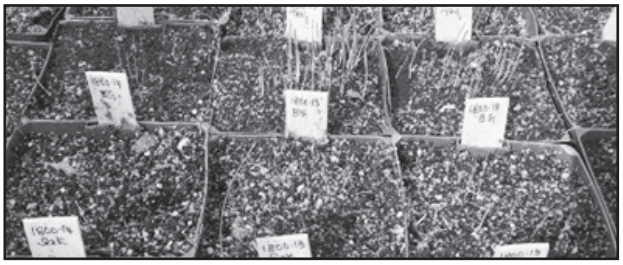

Figure 3. Boxer Gold resistant ryegrass

Figure 4. Sakura resistant ryegrass

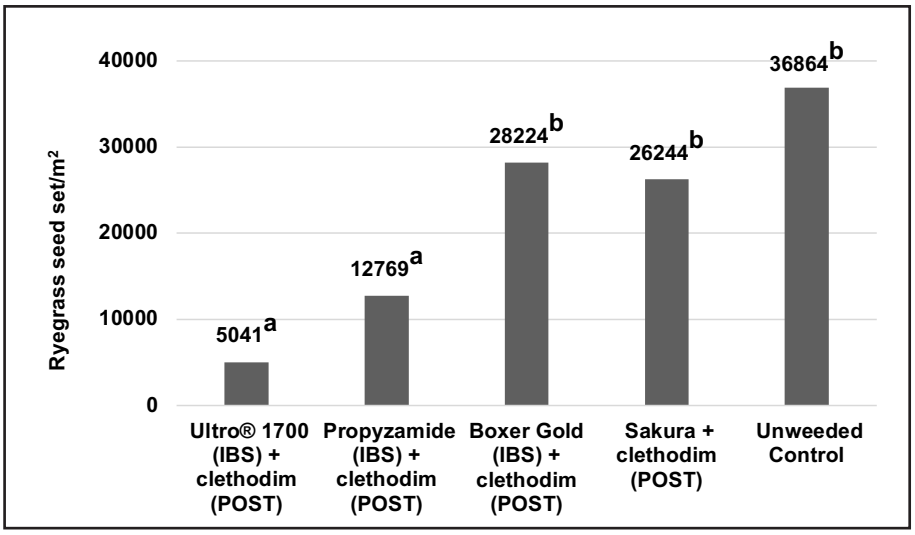

Figure 5. Ryegrass seed set in lentil at Maitland in 2018. Bars labelled with the same letter are not significantly different (P≤0.05).

Research trial results

Boxer Gold and Sakura did not provide statistically different levels of ryegrass set control compared to the untreated control at Maitland in 2018 (Figure 5). In the herbicide resistance screening work discussed earlier, this trial site paddock was found to have ryegrass populations resistant to Group J and K herbicides, and paddock history revealed that both Boxer Gold and Sakura were used twice in this paddock during the last five years. This highlights the magnitude of impact that can result from loss of effectiveness of Group J and K herbicides due to regular use in a relatively short period of time. Developing resistance to these herbicides is a concern for both cereal and break crop phases.

Further, in this experiment, Ultro resulted in the lowest ryegrass seed set in lentil, and was statistically similar to the level of control achieved with propyzamide. Ultro was safe for the lentil crop at the tested rate of 1700 g/ha and recorded the highest yield of 1.64 t/ha amongst different herbicide treatments (data not shown). Registration of this herbicide could reduce selection pressure on Group A, D, J and K herbicides in break crops.

What does this mean?

Resistance development in ryegrass to pre-emergence Group J and K herbicides such as Boxer Gold® and Sakura® has been confirmed in HBCI systems. Diverse integrated weed management strategies including rotating modes of action with Group D propyzamide in break crop phase in HBCI systems, adopting proven strategies for stopping ryegrass seed set such as crop topping, and collecting remaining seed through harvest weed seed collection measures, are important to delay resistance build-up to these herbicides.

Acknowledgements

The research undertaken as part of this project is made possible by the significant contributions of growers through trial cooperation, and strategic investment of GRDC and SARDI in project DAS00168BA.

Reference

Walsh M., Ouzman J., Newman P., Powles S. and Llewellyn R. (2017). High levels of adoption indicate that harvest weed seed control is now an established weed control practice in Australian cropping. Weed Technology 31: 341-347.