Management of Group A, J and K resistant annual ryegrass in pulses

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Key findings

- Ultro® (a new Group E herbicide with active carbetamide) and Group D propyzamide proved equally effective for annual ryegrass control in lentil and chickpea.
- Boxer Gold® and Sakura® herbicides need to be rotated with other mode of action herbicides, especially with Group D propyzamide and Group E Ultro, in the pulse crop phase.
- Integrated weed management tactics of wick wiping and clipping + wick wiping reduced annual ryegrass seed set.

Why do the trial?

The increased adoption of herbicide tolerant break crops, such as triazine tolerant (TT) canola, Group B imidazolinone (IMI) tolerant Clearfield® canola and XT lentil, has produced an increased reliance on Group A chemistry (fops and dims) to control annual ryegrass, leading to rapid development of resistance to these herbicides.

There is currently an increase in the uptake of alternative pre-emergent chemistry like Group D, J and K herbicides for managing dim-resistant annual ryegrass in break crops. However, annual ryegrass populations starting to evolve resistance to these Group J and K herbicides in South Australia (Aggarwal *et al*. 2019) might lead to severely reducing herbicide options available for the control of annual ryegrass in pulse crops. Therefore, research trials were conducted to identify effective management options for annual ryegrass resistant to Group A, J and K herbicides in lentil and chickpea. The preliminary work was presented in Eyre Peninsula Farming Systems (EPARF) 2019, pp 146-148.

How it was done?

Plot size	1.35 m x 10.0 m	**Fertiliser**	MAP @ 80 kg/ha
Seeding date	Lentil May 16, 2019 & May 25, 2020 Chickpea May 29, 2019		
Location	Hart, SA		

Research trials were sown at the Hart field site (Mid-North) with SARDI Group C tolerant lentil germplasm line (M043) in 2019, PBA Hurricane XT and Group C lentil germplasm line GIA 2004L in 2020, and kabuli chickpea Genesis 090 in 2020. The new pre-emergent herbicide Ultro® (active carbetamide, Group E) was included for controlling annual ryegrass applied as incorporated by sowing (IBS) in all three trials. Ultro (IBS) + clethodim post-emergence (POST) at 5-node growth stage was compared to growers' practices of propyzamide (IBS) + clethodim (POST), Boxer Gold® (IBS) + clethodim (POST), Sakura® (IBS) + clethodim (POST) in lentil 2019 and chickpea 2020 trials (Table 1).

In addition, the potential of integrated weed management tactics such as clipping and clipping + wick wiping annual ryegrass at embryo development stage was studied in addition to pre-emergent herbicides in 2020 lentil (Figures 1 and 2) and chickpea trials (Table 2). A gravity-based wick wiper was used for wick wiping with Glyphosate + LVE MCPA + water mixed 1:1:1, and clipping of annual ryegrass growing above the crop canopy was done manually. All herbicide doses are mentioned in terms of the commercial product (Tables 1, 2 and 3; Figures 1, 2 and 3). Seeds of annual ryegrass resistant to Group A clethodim, Group J and K herbicides were broadcast at 250 and 500 seeds/m2 in 2019 and 2020, respectively. This was completed ahead of seeding and weed seeds were incorporated prior to IBS herbicide application with a shallow pass of the seeder with roller attached to it. Ryegrass head density and seed set was assessed near crop harvest from three randomly selected spots using a quadrant of 50 cm × 50 cm. The dead heads resulting from wick wiping treatments were not included in the final head count in 2020 trials. Harvesting of lentil was completed on October 29, 2019 and November 17, 2020 and chickpea on December 9, 2020.

Results and discussion

Effect on annual ryegrass in lentil

In 2019, propyzamide (IBS) + clethodim (POST) and Ultro (IBS) + clethodim (POST) proved equally effective for Group A, J and K resistant annual ryegrass control (Table 1). Both of these Group D and Group E herbicide treatments proved more effective than growers' practices of Sakura (IBS) + clethodim (POST) and Boxer Gold (IBS) + clethodim (POST) for reducing annual ryegrass head density and seed set. Furthermore, herbicide treatment propyzamide (IBS) + clethodim (POST) and Ultro (IBS) + clethodim (POST) reduced annual ryegrass seed set up to 99% and 97%, respectively over unsprayed control.

In 2020, propyzamide (IBS) and Ultro (IBS) proved equally effective for controlling Group A, J and K resistant annual ryegrass (Figures 1 and 2). Both herbicides resulted in a 74-78% reduction in annual ryegrass head density and a 74-76% reduction of seed set, compared to the unsprayed control in Group C lentil. Furthermore, integrated weed management tactics of wick wiping annual ryegrass at embryo development stage resulted in 54% and 69% reduced head density and seed set, respectively, as compared to no clipping/wick wiping.

The treatment of clipping alone did not prove effective in reducing annual ryegrass head density and its seed set, as the clipped annual ryegrass plants could regrow, producing a similar seed set to no clipping/wick wiping. Both combined treatments of clipping and wick wiping reduced annual ryegrass head density and its seed set, as compared to clipping alone and no clipping/wick wiping, but were not significantly different to the treatment of straight wick wiping.

Table 1. Annual ryegrass management in Group C lentil at Hart in 2019.

Herbicide treatment		Ryegrass heads/m^2	Ryegrass seed set/m^2
T_1	Sakura 118 (IBS) + clethodim 500 (POST)	19.6^{c}	650^{c}
T_2	Boxer Gold 2500 (IBS) + clethodim 500 (POST)	57.3^{b}	2228^{b}
T_3	Propyzamide 1000 (IBS)	6.2^{cd}	246^{cd}
T_4	Propyzamide 1000 (IBS) + clethodim 500 (POST)	0.6^{def}	23de
T_5	Ultro 1700 (IBS)	4.7^{de}	156de
T_6	Ultro 1700 (IBS) + clethodim 500 (POST)	3.1^{def}	108de
T_7	Unweeded control	136.7^{a}	5506^{a}

Figures labelled with the same letter are not significantly different (P≤0.05).

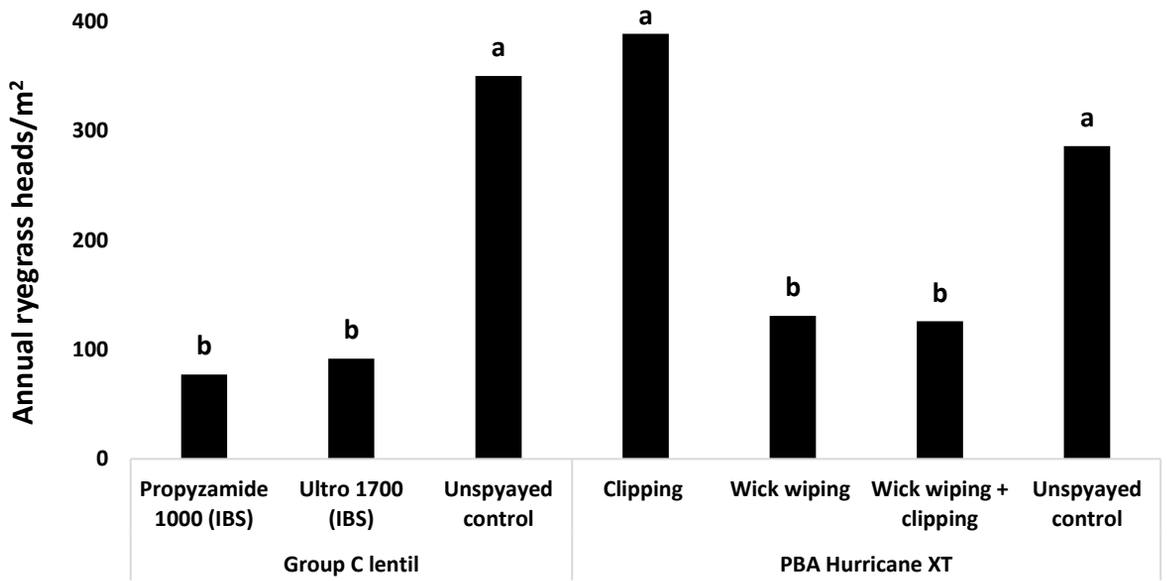

Figure 1. Annual ryegrass head density response to weed control treatments in lentil at Hart 2020. Bars labelled with the same letters are not significantly different (P≤0.05).

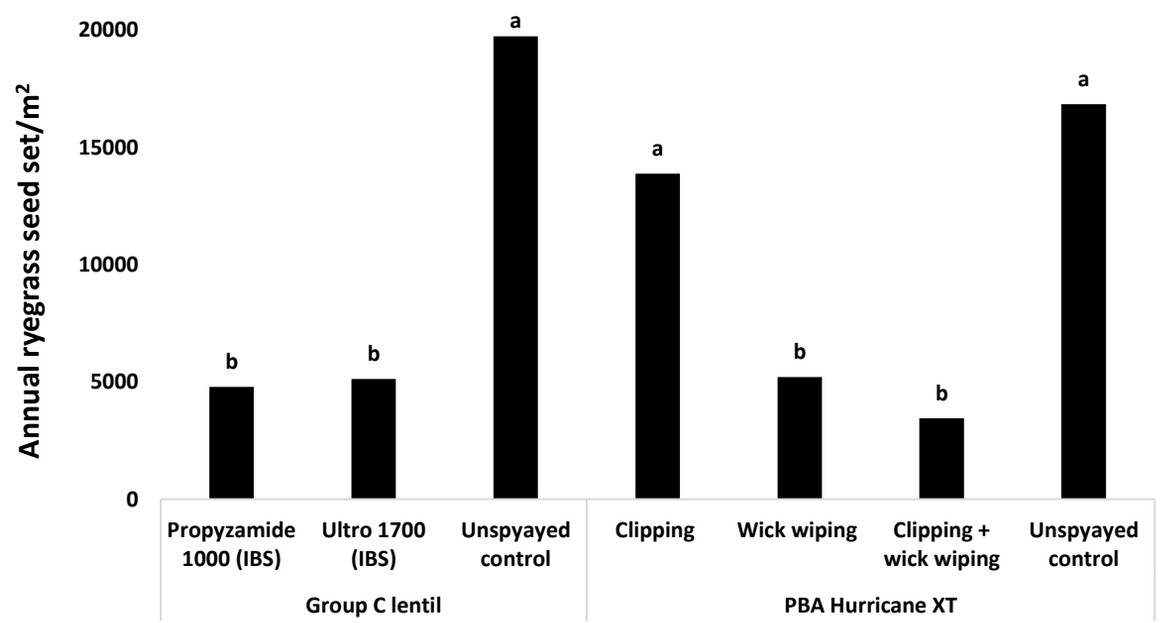

Figure 2. Annual ryegrass seed set response to weed control treatments in lentil at Hart 2020. Bars labelled with the same letters are not significantly different (P≤0.05).

Effect on Annual ryegrass in chickpea

Application of propyzamide (IBS) + clethodim (POST) and Ultro (IBS) + clethodim (POST) proved equally effective for Group A, J and K resistant annual ryegrass control in chickpeas (Table 2). Annual ryegrass produced 62 heads in propyzamide (IBS) + clethodim (POST) that were 83% and 70% less than Boxer Gold (IBS) + clethodim (POST) and Sakura 118 (IBS) + clethodim (POST), respectively. Similarly, Ultro (IBS) + clethodim (POST) reduced annual ryegrass heads density by 71% and 51% relative to Boxer Gold (IBS) + clethodim (POST) and Sakura 118 (IBS) + clethodim (POST), respectively. Ryegrass seed production reflected the similar trends observed in head density data. Application of propyzamide (IBS) + clethodim (POST) and Ultro (IBS) + clethodim (POST) resulted in

a reduction in annual ryegrass seed set as compared to both Boxer Gold (IBS) + clethodim (POST) and Sakura 118 (IBS) + clethodim (POST).

Furthermore, a protective inter-row spray of Spray.Seed before chickpea canopy closure proved equally effective to pre-emergent herbicides propyzamide and Ultro for annual ryegrass control. As in lentil crop, integrated weed management tactics of wick wiping and clipping + wick wiping proved more effective in reducing annual ryegrass head density and its seed set, compared to clipping alone.

Table 2. Ryegrass management in chickpeas at Hart in 2020. Numbers with the same letter in a column are not significantly different (P≤0.05).

Herbicide treatment		**Ryegrass heads/m²**	**Ryegrass seeds/m²**
T_1	Boxer Gold 2500 (IBS) + Clethodim 500 (POST)	357^{ab}	23256^{a}
T_2	Sakura 118 (IBS) + clethodim 500 (POST)	210^{c}	12679^{b}
T_3	Propyzamide 1000 (IBS) + clethodim 500 (POST)	62^{d}	3819^{c}
T_4	Ultro 1100 (IBS) + clethodim 500 (POST)	104^{d}	6610^{c}
T_5	Protective inter-row spray of Spray.Seed before canopy closure	104^{d}	6384^{c}
T_6	Clipping at reproductive stage	380^{a}	11946^{b}
T_7	Clipping + wick wiping	221^{c}	4264^{c}
T_8	Wick wiping at reproductive stage	266^{bc}	4343^{c}
T_9	Unsprayed control	426^{a}	26896^{a}

Effect on grain yield of lentil

In 2019, all the herbicide treatments resulted in a significantly higher lentil grain yield over the unsprayed control (Figure 3). Application of Ultro (IBS) + clethodim (POST) produced similar grain yield as achieved with Propyzamide (IBS) + clethodim (POST) and Sakura (IBS) + clethodim (POST). Poor annual ryegrass control with Boxer Gold (IBS) + clethodim (POST) resulted in the lowest lentil yield as compared to other pre-emergent herbicides. In 2020, propyzamide (IBS) application produced similar lentil grain yield (0.73 t/ha) as achieved with Ultro (IBS) (0.82 t/ha).

Effect on grain yield of chickpeas

Application of propyzamide (IBS) + clethodim (POST) produced higher grain yield compared to growers' practice of Boxer Gold (IBS) + clethodim (POST), and Sakura (IBS) + clethodim (POST) (Table 3). Application of Ultro (IBS) + clethodim (POST) produced similar yields as with propyzamide (IBS) + clethodim (POST) and Sakura (IBS) + clethodim (POST).

Integrated weed management tactics of wick wiping and clipping + wick wiping, though resulting in similar annual ryegrass seed set as in propyzamide (IBS) + clethodim (POST) and Ultro (IBS) + clethodim (POST), produced chickpea yields no different to the unsprayed control. This was due to the competition from annual ryegrass before applying agronomic tactics of wick wiping and clipping + wick wiping. Therefore, early season annual ryegrass control with pre-emergent herbicides is crucial for achieving good chickpeas yields, and late season weed seed set control tactics such as wick wiping and clipping + wick wiping reduce the weed seed burden for the following seasons' crops.

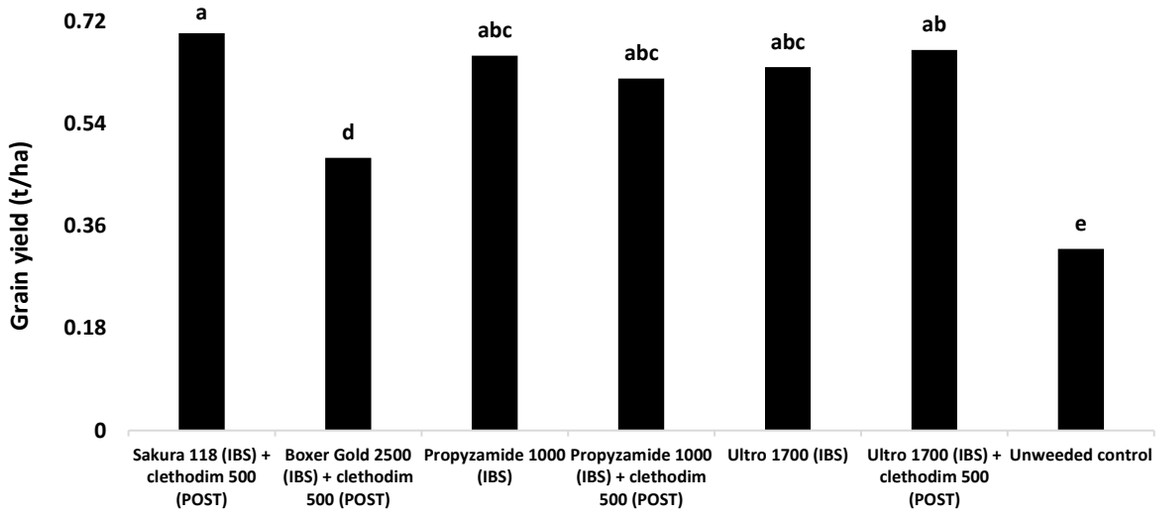

Figure 3. Lentil grain yield at Hart 2019. Bars labelled with the same letters are not significantly different (P≤0.05).

Table 3. Chickpea grain yield response to ryegrass management at Hart in 2020. Numbers with the same letter are not significantly different (P≤0.05).

Herbicide treatment		Grain yield (t/ha)
T_1	Boxer Gold 2500 (IBS) + Clethodim 500 (POST)	0.98^{c}
T_2	Sakura 118 (IBS) + clethodim 500 (POST)	1.27^{b}
T_3	Propyzamide 1000 (IBS) + clethodim 500 (POST)	1.64^{a}
T_4	Ultro 1100 (IBS) + clethodim 500 (POST)	1.39^{ab}
T_5	Protective inter-row spray of Spray. Seed before canopy closure	1.29^{b}
T_6	Clipping at reproductive stage	0.51^{d}
T_7	Clipping + wick wiping	0.54^{d}
T_8	Wick wiping at reproductive stage	0.44^{d}
T_9	Unsprayed control	0.52^{d}

What does this mean?

Availability of the new mode of action herbicide Ultro (active carbetamide, Group E) makes it an important tool, along with Group D propyzamide, in reducing selection pressure for existing Group J and K pre-emergent, and dim chemistry post emergent herbicides for annual ryegrass control in pulse crops. In addition, adopting proven strategies for stopping annual ryegrass to set seeds such as crop topping and wick wiping, and collecting remaining seed through harvest weed seed collection measures across different phases of the crop rotation, are important to reduce soil weed-seed bank and delay resistance build-up to herbicides.

Ultro (IBS) + clethodim (POST)

Unsprayed control

Figure 3. Ryegrass management in lentil at Hart in 2019.

Propyzamide (IBS)

Ultro (IBS)

Unweeded control

Figure 4. Ryegrass management in lentil at Hart in 2020.

Ultro (IBS) + clethodim (POST)

Propyzamide (IBS) + clethodim (POST)

Sakura (IBS) + clethodim (POST)

Boxer Gold (IBS) + clethodim (POST)

Interrow spray of spray. seed

Unsprayed control

Figure 5. Ryegrass management in chickpeas at Hart in 2020.

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References

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