Group B herbicide tolerance in lentil and faba bean on the Eyre Peninsula

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Location
Yeelanna
Rainfall
Av. Annual: 411 mm
Av. GSR: 330 mm
2019 Total: 360 mm
2019 GSR: 334 mm
Soil type
Clay loam over red clay
Soil test
pH at 10 to 30 cm: 7.8
Plot size
1.75 m x 10 m x 3 reps
Trial design
Experimental: Split Plot

Location
Tooligie
Rainfall
Av. Annual: 311 mm
Av. GSR: 249 mm
2019 Total: 235 mm
2019 GSR: 222 mm
Soil type
Loamy sand
Soil test
pH at 10 to 30 cm: 7.9
Plot size
1.75 m x 10 m x 3 reps
Trial design
Experimental: Split Plot

Location
North Block (Coulta)
Rainfall
Av. Annual: 519 mm
Av. GSR: 435 mm
2019 Total: 479 mm
2019 GSR: 402 mm
Soil type
Loamy sand over loamy clay
Soil test
pH at 10 to 30 cm: 5.4
Plot size
1.75 m x 10 m x 3 reps
Trial design
Experimental: Split Plot

Key messages

- **High levels of crop safety were observed in imidazolinone tolerant lentil varieties, with no grain yield loss from any simulated residue treatments of sulfonylurea herbicides, or post-emergent applications of imidazolinone herbicides, at North Block in 2018, or Tooligie in 2019.**
- **High levels of crop safety were observed in the imidazolinone tolerant faba bean variety, with no grain yield loss from any simulated residue treatments of sulfonylurea herbicides, or post-emergent applications of imidazolinone herbicides, at Yeelanna in 2019.**
- **Access to herbicide tolerance traits will provide growers with an increased opportunity to diversify their cropping rotations and increase in-crop control options, specifically for broadleaf weed control in areas with high weed burdens.**

Why do the trial?

To make full use of in-crop rainfall, stored soil moisture and nutrients, and prevent weed seed contamination, the control of weeds in a pulse break crop phase is essential. Currently, herbicides are the primary method of weed control in broadacre cropping systems. However, there are limited options for broadleaf weed control in pulse crops, as there are few effective broadleaf post emergent herbicides available for use in faba bean and lentil. Along with limited control options, the presence of possible herbicide residues, such as sulfonylureas (SU), from previous crops are major deterrents for including pulses in a cropping rotation where there is an increased risk of herbicide damage. In recent years, Group B herbicide tolerant (HT) lentil and faba bean varieties have been released to Australian growers and have proven very popular for giving more flexible weed control options, particularly for late emerging broadleaf weeds. The Group B herbicide tolerance traits not only provide growers with in-crop options for broadleaf weed control, but also allow these pulse crops to be grown on Group B (including SU) herbicide residues, which can persist from previous crop applications for up to 24 months or longer, depending on rainfall (minimum of 700 mm) and soil pH (as per DuPont™ Glean® and Tackle® WG product labels).

The aim of these trials was to evaluate the levels of tolerance to simulated residues and post-emergent applications of Group B herbicides in lentil XT varieties, and a faba bean mutant derived line with Group B herbicide tolerance traits.

How was it done?

The performance of the HT lentil varieties PBA Hurricane XT and PBA Hallmark XT, as well as the HT faba bean variety PBA Bendoc were compared across a range of Group B herbicide treatments (Table 1). Treatments of metsulfuron-methyl, chlorsulfuron and triasulfuron were applied prior to sowing and incorporated by sowing (IBS), to demonstrate “simulated” SU residues

Table 1. Herbicide treatments compared in the 2018 and 2019 trials. IBS = Incorporated by sowing.

Chemical	Chemical family	Application rate	Application timing
Metsulfuron-methyl 600 g/kg	SU	7 g/ha	IBS
Chlorsulfuron 750 g/kg	SU	12 g/ha	IBS
Triasulfuron 750 g/kg	SU	10 g/ha	IBS
Imazamox 33 g/L + Imazapyr 15 g/L	IMI	750 g/L	Post-emergent
Imazethapyr 700 g/kg	IMI	100 g/ha	Post-emergent

**Note that some herbicides are currently unregistered for use in lentil and faba bean and these treatments were included for experimental purposes only. The results within this document do not constitute a recommendation by the author or author's organisation for that particular use. Permits for the use of Intercept® are now available for the lentil XT and faba bean IMI HT lines. A reminder that any off-label herbicide use can result in crop damage; and product label rates, permits, plant-back periods and directions for use must be adhered to.*

Table 2. Faba bean and lentil varieties included in the herbicide response trials, along with site location and year the trials were conducted.

Year	Site	Crop type	Variety
2018	North Block	Faba bean	Nura
2018	North Block	Faba bean	PBA Bendoc
2018	North Block	Lentil	PBA Hallmark XT
2019	Yeelanna	Faba bean	Nura
2019	Yeelanna	Faba bean	PBA Bendoc
2019	Yeelanna	Faba bean	Samira
2019	Yeelanna & Tooligie	Lentil	PBA Hallmark XT
2019	Yeelanna & Tooligie	Lentil	PBA Hurricane XT
2019	Yeelanna & Tooligie	Lentil	PBA Jumbo 2

Two post-emergent imidazolinone (IMI) treatments of imazamox + imazapyr and imazethapyr were applied at the 5 node growth stage. Each trial was arranged as a split-plot design with herbicide assigned to the whole plot and variety assigned to the sub-plot, with three replications of each treatment.

In 2018 and 2019, combined lentil and faba bean herbicide trials were established at North Block and Yeelanna, while the Tooligie site in 2019 looked at lentil herbicide evaluation alone (Table 2). Throughout the duration of the trials, a number of measurements were taken including the normalised difference vegetation index (NDVI), plant height, biomass yield, herbicide damage score and grain yield. The data was analysed using Genstat 20th edition.

What happened?

Below average rainfall was received in both 2018 and 2019 seasons at all sites which may impact results.

At the 2018 North Block site, both simulated residue as well as post-emergent treatments had no effect on grain yield, NDVI or grain quality for PBA Hallmark XT (data not shown). The average yield was 1.5 t/ha at this site. Similarly, PBA Bendoc's grain yield was not affected by simulated residue or post-emergent herbicide treatments (Figure 1). Nura was unaffected by both post-emergent IMI treatments, however, it suffered a 52% and 74% reduction in grain yield from chlorsulfuron and metsulfuron-methyl, respectively, compared to the nil.

From the results of the lentil herbicide trials conducted in 2019 at Yeelanna, it was found there was no effect of any of the herbicide treatments on the grain yield of PBA Hallmark XT. PBA Hurricane XT also had no grain yield reduction from any post-emergent herbicide treatments, but was affected by the metsulfuron-methyl IBS herbicide treatment with a 31% reduction in grain yield (Figure 2). PBA Jumbo 2, a commercial line without HT traits, suffered severe reductions in grain yield from all IBS and post-emergent Group B herbicide treatments, with no grain obtained from trial plots treated with metsulfuron-methyl, and imazamox + imazapyr.

Results from the replicated lentil herbicide trial in 2019 at Tooligie indicated very similar findings to what was found at Yeelanna (Figure 3). No grain yield reduction was found in both Group B tolerant lentil varieties, PBA Hallmark XT and PBA Hurricane XT, from any herbicide treatments. However, PBA Jumbo 2 recorded significant yield reductions from all herbicide treatments, with between 94% and 88% yield loss from all IBS treatments, and 93% and 58% yield loss from the imazamox + imazapyr, and imazethapyr, post-emergent herbicide treatments respectively.

The IMI tolerant faba bean variety PBA Bendoc recorded no reduction in grain yield from all herbicide treatments, with an average yield of 3.6 t/ha at Tooligie in 2019 (Figure 4).

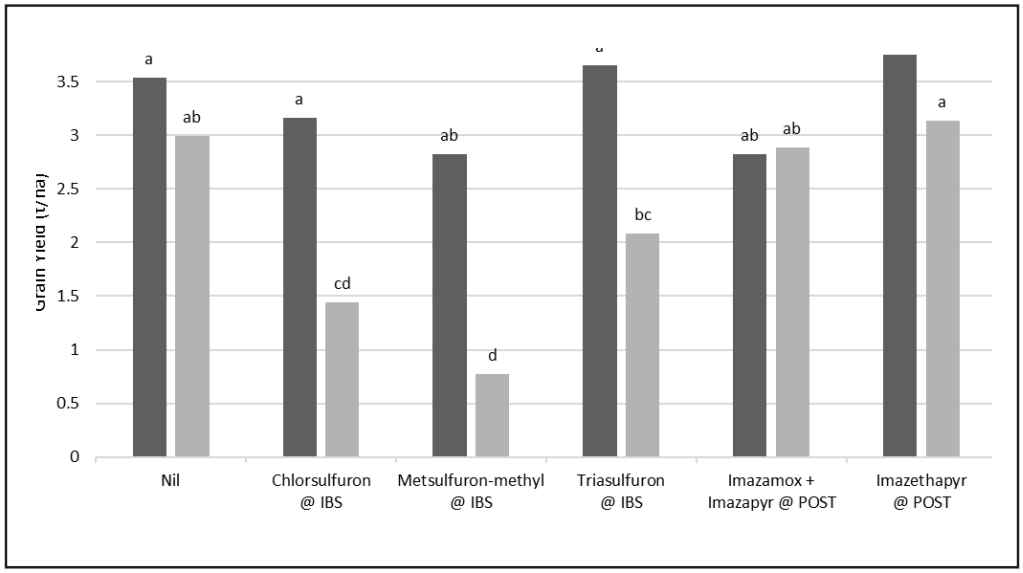

Figure 1. Grain yield response of faba bean varieties to Group B herbicides at North Block, 2018. Bars labelled with the same letter are not significantly different (P≤0.05).

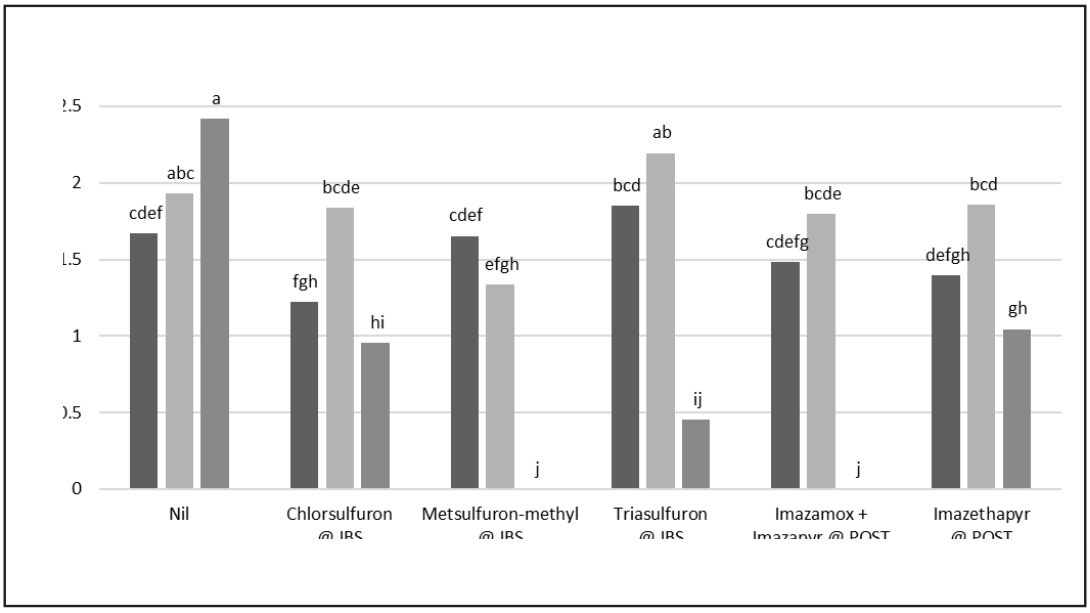

Figure 2. Grain yield response of lentil varieties to Group B herbicides at Yeelanna, 2019. Bars labelled with the same letter are not significantly different (P≤0.05).

However, both Nura and PBA Samira, commercial varieties without the herbicide tolerance traits, recorded losses in grain yield from all IBS herbicide treatments (ranging from 36% to 100%, and 24% to 80%, respectively), and the imazamox + imazapyr post-emergent herbicide treatment (35% and 33%, respectively). No loss in grain yield was recorded for the imazethapyr post-emergent herbicide treatment.

What does this mean?

High levels of tolerance were observed in both the commercially available XT lentils and HT faba bean (PBA Bendoc), for both simulated SU residues and IMI post-emergent herbicide application. Tolerance to these herbicide chemistries within pulse species, such as lentil and faba bean, provides growers with the option of using an in-crop herbicide application for the suppression of broadleaf weeds, that would previously not be available. This is particularly important when considering weed seed burdens and weed control options if dry sowing is implemented to maximise yield potential, while optimising operations for growers. Intercept® (imazamox + imazapyr) is now permitted for use as a post-emergent herbicide application in IMI tolerant lentils, applied at the 3 to 6 node growth stage, and IMI tolerant faba beans, applied at the 4 to 5 leaves unfolded growth stage.

In conditions such as dry sowing, a delayed break in the season or receiving minimal summer/autumn rainfall, herbicide residual effects can become far more pressing on crop rotation choices. The decision as to which pulse to grow, and where, should be based on a matter of risk and rotation need. The presence of SU herbicide residues in the soil profile from previous crop rotations has been recognised for having a significant negative impact on pulse crop performance.

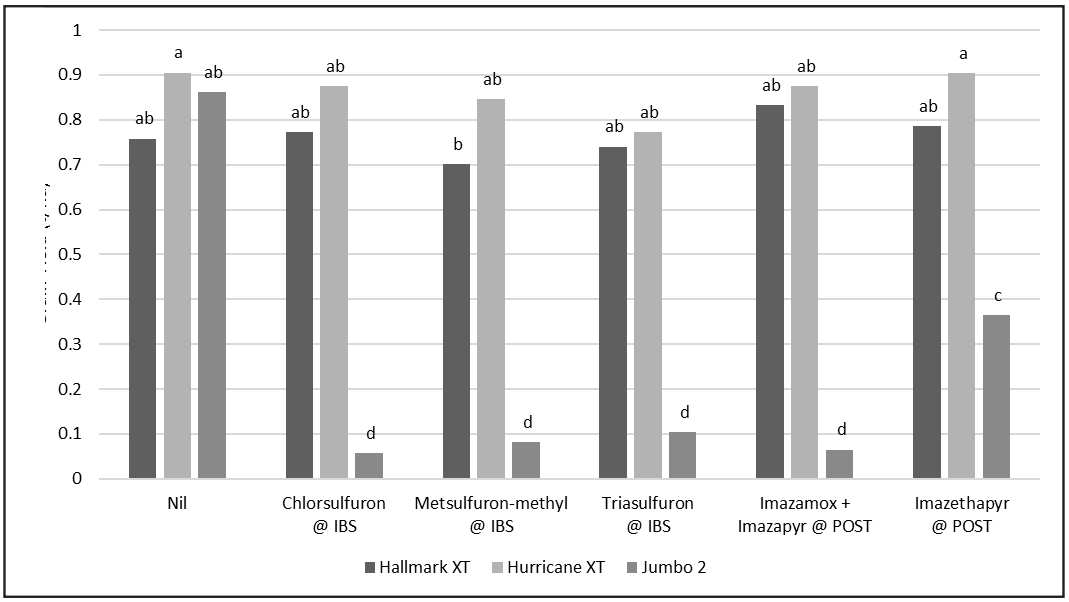

Figure 3. Grain yield response of lentil varieties to Group B herbicides at Tooligie, 2019. Bars labelled with the same letter are not significantly different (P≤0.05).

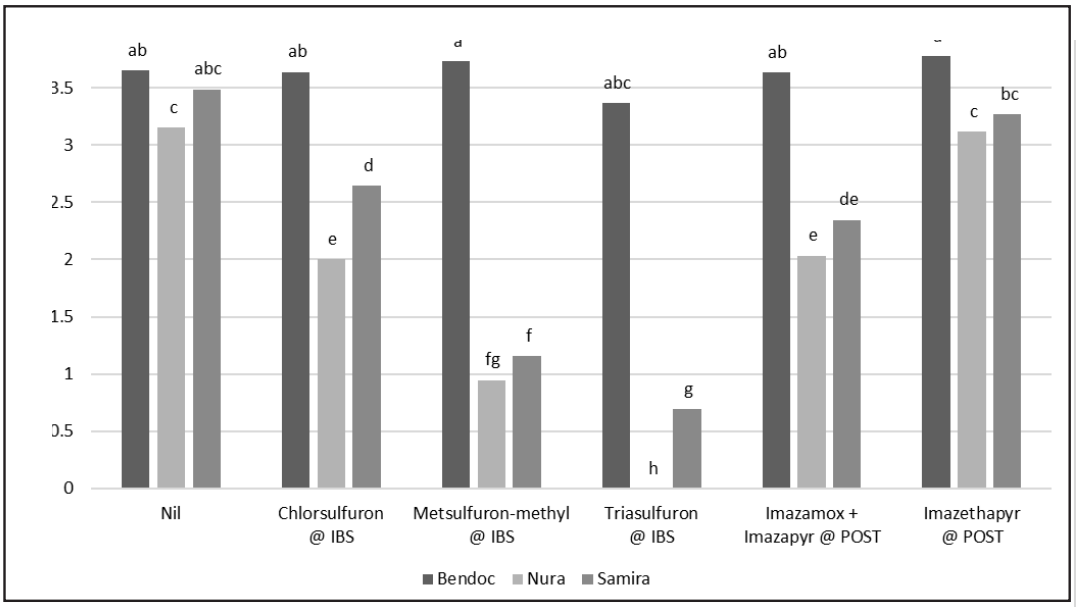

Figure 4. Grain yield response of faba bean varieties to Group B herbicides at Tooligie, 2019. Bars labelled with the same letter are not significantly different (P≤0.05).

An intolerance to these herbicide chemistries, many of which have a long plant back period, can have a profound negative impact on plant developmental structures contributing to overall grain yield components.

In terms of pulse crop sensitivities, lentil and chickpea are the most severely affected by Group B SU herbicide residues (e.g. chlorsulfuron and triasulfuron), with faba bean and field pea the least affected. Chickpea, faba bean and field pea are least sensitive to group B IMI herbicides (e.g. imazamox and imazethapyr), with lentil being extremely sensitive. A lentil rotation using a conventional variety should not immediately follow after faba bean or field pea if some group B herbicides have been used (e.g. flumetsulam, imazamox and imazethapyr), and minimum cropping intervals should be adhered to.

Access to HT traits will provide growers with an increased opportunity to diversify their cropping rotations, and increase in-crop control options, specifically for broadleaf weed control in areas with high weed burdens. With the increased interest and adoption of HT varieties, preventing the evolution of herbicide resistant weeds through integrated weed management strategies will be essential in the present and future. Therefore, it is crucial that permits, product label rates, plant back periods and all label directions for herbicide use are adhered to.

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