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NEWSLETTER

Welcome to the April issue of the Crop Science Society of SA newsletter

In this month's newsletter we explore:

- Liquid trace elements at sowing reducing nodulation and yield in chickpeas
- Data available from March 17 meeting on new product forums and panel session
- An evening with Dr Steve Jefferies presented by Ag Institute Australia

We hope you are keeping well. Please contact us if you have any requests for content or information.

Many thanks
Craig Davis
President, Crop Science Society of South Australia

Liquid trace elements at sowing reduced nodulation and yield in chickpea

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Funded By: GRDC 9176500

Project Title: Increasing N fixation in pulse crops through the development of improved rhizobial strains, inoculation and crop management practices

Key Words: *Nodulation, fertiliser, chickpea, trace elements, inoculation*

Key Messages

- Trace elements applied as a liquid is toxic to inoculant both when combined in solution and applied separately on the seed
- Chickpea plants with trace elements applied in-furrow had lower nodulation and yield than plants sown without trace elements
- Liquid trace elements were applied in-furrow either with inoculated seed, or as a combined peat inoculant plus trace elements mixture

Background

The aim of this trial was to determine the compatibility of rhizobia with liquid trace element fertiliser. In some cases farmers would like to apply amendments at sowing (fertilisers, fungicides, pesticides) but with little knowledge as to the effect of these chemicals on the inoculant. Pulses such as chickpeas have a high nutritional requirement especially for trace elements which have known toxicity to rhizobia *in vitro*. Inoculation of chickpeas is vital to ensure adequate nodulation for growth and yield, yet little is known about the effect of fertiliser applications on rhizobial survival both on the seed and in-furrow at sowing

Prior laboratory research showed that common commercial trace element solutions are highly toxic to rhizobia. The toxicity can be related to either low pH, as well as direct toxicity of the trace, or both (Ballard et al 2017). There has been some evidence that farmers mix trace element solutions with inoculant at sowing time to reduce double handling, which can have catastrophic consequences to the survival of the rhizobia (Ballard et al 2017). To determine the toxic effect of the trace element liquid fertiliser, we applied the liquid separately alongside the inoculated seed and together with the inoculant infused in the trace element solution.

About the trial

The trial was designed to follow farmer practice of applying liquid trace elements in the furrow at seeding. We tested the effect of a trace element solution based on commercial rates (Cu, Zn, Mn, Mo) with the peat inoculant applied on the seed and in the liquid fertiliser (tea-bag method). The trace element solution was devised from a commercial formulation (Table 1).

The trial was conducted at Angas Valley in the SA mallee in 2020 on a sandy loam soil (Table 1). Chickpeas were sown in late May with peat-based seed inoculant, with or without trace elements sprayed into the furrow, or with the inoculant supplied as a liquid sprayed into the furrow. The liquid inoculant was applied in water or as a trace element solution, infused with peat inoculant. This was achieved by placing the peat inoculant into a nylon bag in the water/trace element solution to allow the rhizobia to diffuse but not the fibrous component ('teabag' method). Nil inoculant and nil fertiliser plots were included as controls. Each treatment was replicated three times. Plants were sampled (12 plants/plot) in August to rate nodulation (Corbin et al 1977), with biomass (shoot dry weight) and yield also measured.

Table 1. Summary of chickpea inoculant and liquid trace element trial conducted at Angas Valley 2020

Inoculant	Trace elements	Trace Element Solution / ha
Nil	-	$CuSO_4$ 1 kg
Peat liquid only in furrow	-	$ZnSO_4$ 2.5 kg
Peat on seed only	-	$MnSO_4$ 3.5 kg
Peat on seed	+	Na_2MoO_4 0.06 kg
Peat liquid + TE in furrow	+	

Results & Discussion

The 2020 season at Angas Valley was slightly below average with a dry period May to July but receiving a much needed rainfall in early August. In general, the dry period after sowing was also colder than average, which provided difficult conditions for the establishment and early nodulation of the chickpeas. Although average nodule rating was lower than desirable, the shoot biomass and yield were higher than expected despite the slow early growth.

Figure 1 shows the average nodule rating (12 plants per plot) in late August. The average rating was low with 2.5 considered adequate nodulation for chickpea (Corbin et al 1977), which may have been due to the cold conditions after sowing and the time when the plants initiate nodulation. Although there was no significant difference between the nil and peat only inoculated plants, there was a significant decrease in nodule rating in the plants which inoculated with peat infused into a trace element solution. There was also a decrease in nodule rating, although non-significant, with the plants inoculated with peat on the seed and trace elements applied into the furrow.

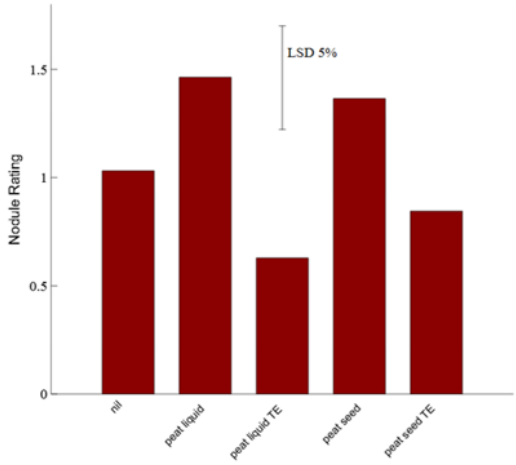


Figure 1. *Average nodule rating (0-5 scale) of plants with different inoculation and trace element treatments (nil = no inoculation and trace elements, peat liquid = peat inoculant infused into water and sprayed in-furrow, peat liquid TE = peat inoculant infused into trace element solution and sprayed in-furrow, peat seed TE = peat inoculated onto seed and trace elements sprayed in-furrow).*

Table 2 shows the biomass and yield data, which is also displayed in Figure 2. There were no significant differences in biomass between treatments, but there was a significant decrease in the yield in the liquid trace element treatment, even though the inoculant was separated from the trace elements by coating onto the seed.

Table 1. *Yield and shoot biomass of chickpeas grown at Angas Valley in 2020.*

Inoculant	Trace Elements	Grain yield (t/ha)	Shoot biomass (g plant/plot)
Nil	-	0.9ab	64.6
Peat liquid only	-	1.1a	106
Peat on seed only	-	1.1a	92
Peat on seed	+	0.6bc	84
Peat liquid	+	0.8ab	82.6
LSD 5%		0.3	NS

Figure 2 shows the similarity between the nodulation and yield data. The nodule rating score closely followed yield, where treatments with peat and trace elements sprayed into the furrow had a lower yield (and nodule rating) than when the peat was coated onto the seed only. Yield was reduced, although not significantly, when the peat inoculant was infused into the trace element solution. This was surprising because the population of rhizobia recovered from the peat plus trace element solution was 30% lower than the viable population of rhizobia recovered from the peat liquid without trace elements (data not shown). Although there was no history of chickpea grown at this site, there was some nodulation in the nil inoculant treatment. The fixation of N due to background rhizobia may have contributed to the yield being comparable with the inoculated treatments (Figure 2). N fixation data is currently being processed to address this possibility.

The background rhizobia may also be an explanation for the higher than expected nodule rating in the peat plus trace element treatment (Figure 1).

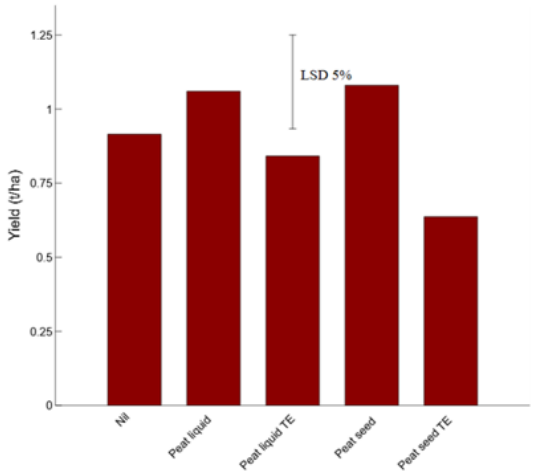


Figure 2. *Average yield of chickpeas with different inoculation and trace element treatments (nil = no inoculation and trace elements, peat liquid = peat inoculant infused into water and sprayed in-furrow, peat liquid TE = peat inoculant infused into trace element solution and sprayed in-furrow, peat seed TE = peat inoculated onto seed and trace elements sprayed in-furrow).*

Implications for commercial practice

Liquid trace elements applied at sowing of chickpeas can have a detrimental effect on the inoculant, nodulation and even yield. It is advisable to separate the inoculant from toxic amendments such as trace elements at sowing. These results show that separation of liquid trace elements does not necessarily prevent reductions in nodulation and yield. Rhizobia are highly sensitive to both low pH (< pH 5) and trace elements (such as Zn and Cu), and to improve inoculation and nodulation, we suggest that liquid trace element fertilisers are not applied in furrow at sowing of chickpeas, and could be applied as a foliar spray instead.

Further work in this area investigating other pulse crops and different fertilisers and trace elements combined with inoculants may be undertaken in the future.

Acknowledgements

We acknowledge GRDC (9176500) for funding this project, as well as support from farmers Paul and Alex McGorman We would also like to thank Michael Moodie and Chris for seeding and Peter Telfer for harvesting this trial.

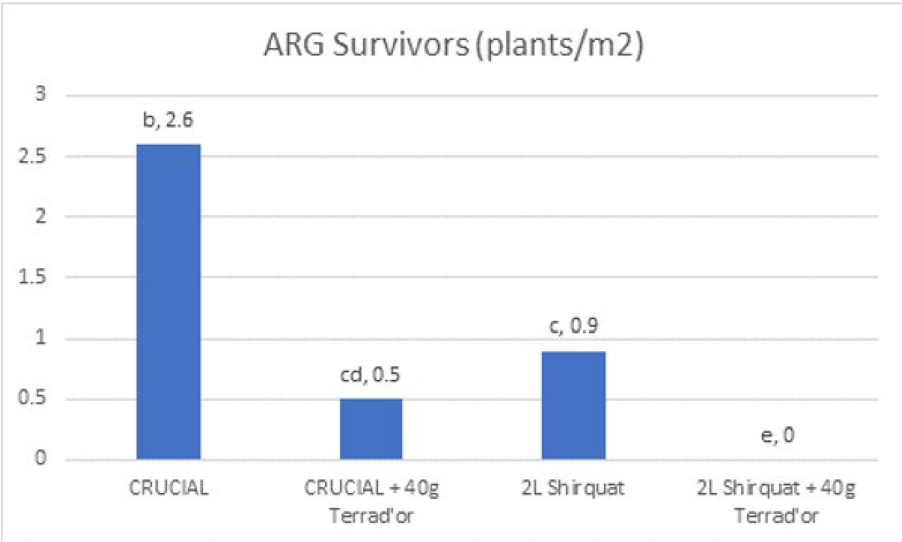
Acknowledgements

Ballard R, Farquharson E, Ryder M, Rathjen R and Denton M 2017. Maximising the fixed nitrogen benefits of pulses, GRDC Grains Research Updates, Adelaide. https://grdc.com.au/resources-and-publications/grdc-update-papers/tab-content/grdc-update-papers/2017/02/maximising-the-fixed-nitrogen-benefits-of-pulses

Corbin EJ, Brockwell J and Gault RR 1977. Nodulation studies on chickpea (*Cicer arietinum*). *Australian Journal of Experimental Agriculture and Animal Husbandry.* 17: 126-134

Data available from March 17 meeting on new product forums

Terrad'or™ from NuFarm – providing a Group 14 (G) alternative on Group M resistant Annual ryegrass (Lolium rigidum). Craig Davis, data provided by David Keetch, Nufarm Ltd.



2020 NuFarm Ltd trial, Boort, Vic.

Terrad'or (active ingredient Tiafenacil) belongs to a new generation of Group 14 (formerly group G) herbicides that have true grass activity

This trial result highlights the statistically significant improvement of annual ryegrass (ARG) control when Terrad'or™ is tank mixed with either glyphosate or paraquat compared to glyphosate or paraquat applied alone.

Luximax™ - an old active with new uses under wheat. Craig Davis, data and information provided by Damien Hooper, BASF.

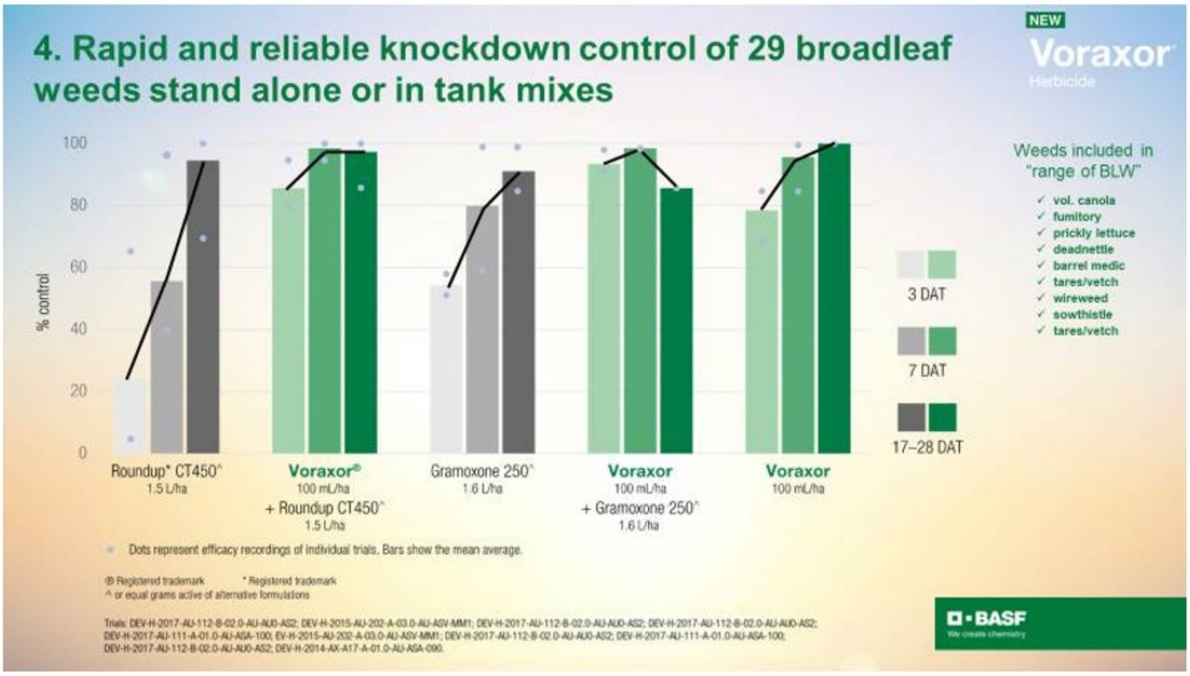
Luximax (active ingredient Cinmethylin) is a new grass pre-emergent herbicide from BASF Crop Solutions, registered for use IBS in wheat, for the control of ARG, barley grass, silver grass and toad rush. Luximax herbicide also offers growers suppression of wild oats and brome grass. Luximax herbicide is a brand new Mode of Action (MOA), group 30 (formerly group T), which gives growers the ability to improve their integrated weed management by reducing the selection pressure on other modes of action. Not only is Luximax a resistance management tool, Luximax herbicide provides up to 12 weeks of residual control on its labelled weeds and its efficacy matches that of the industry standards.

Luximax herbicide provides growers the flexibility to sow winter cereals and legumes the following season, with a 9 month plant back period to oats and other winter rotational crops. Luximax has been widely adopted with very positive results across the nation.

Voraxor™ - broad sprectrum residual group 14 (G) for use under cereals. Craig Davis, data and information provided by Damien Hooper, BASF.

Voraxor (active ingredients Saflufenacil plus Trifludimoxazin) is a new broad leaf weed pre-emergent herbicide from BASF Crop Solutions, for wheat, durum and barley. Voraxor herbicide gives growers the ability to enhance early season control of 16 BLW, for an average of 12 weeks into their cereal crop. Voraxor's group 14 (formerly group G) MoA will not only delay the need for a post emergent herbicide, but also compliments grass herbicides by adding to the management of annual ryegrass (Lolium rigidum) through Voraxor's ability to suppress ARG.

Additional to its residual capability, Voraxor will also knock down emerged BLW and small ARG, when used in conjunction with Glyphosate or Paraquat. This knock down capability extends to ARG populations which are resistant to group M herbicides. Voraxor has a short plant back period to rotational crops and was used with success in BASF's innovation / trial sites across the country in 2019 and 2020.



Reflex® a new residual group 14 (G) for use in pulses. (Registration pending). Craig Davis. Data & information provided by Guerian Schnippenkoetter. Syngenta.

Reflex (active ingredient Fomesafen) is pending registration for the control of a range of broadleaf weeds when applied prior to sowing or post-sowing, pre emergence in Chickpeas, Narrow leaf Lupins, Lentils, Field Peas, Faba Beans and Vetch.

Reflex

- **Market:** Pre-emergent broadleaf herbicide in pulses
- **Active:** 240g/L fomesafen
- **Use:** 500mL-1500mL (IBS) & 500mL- 1250mL (PSPE)
- **Mode of action:** GROUP 14 HERBICIDE formerly GROUP G HERBICIDE
- **Crop:** Chickpeas, Narrow Leaf Lupins, Lentils, Field Peas, Faba Beans and Vetch
- **Pest:** Controls 10 key broadleaf weeds & suppresses 7 others
- **Residual:** 8-10 weeks
- **Plant-back:** 9 months
- **WHP:** Grazing 12 weeks
- **Incorporate:** 7 days
- **Cost:** $16.00/ha (1L/ha)

Reflex® syngenta

It offers a novel mode of action pre-emergent herbicide in pulses controlling group 2 (B), 5&6 (C), 3 (D), 12 (F) and 4 (I) resistant weeds. It can complement grass or broadleaf preemergent herbicides, for robust weed control enabling maximum yield. The active provides long in-season residual pre-emergent herbicide removes weed competition early, whilst providing length of protection.

Application guidelines

	Chickpeas	Narrow leaf Lupins	Field Peas	Faba Beans	Vetch	Lentils
IBS Rates	500 to 1500 mL/ha					500 to 1000 mL/ha
IBS Timing	Incorporate by sowing within 7 days of application					
IBS Seeding	Knife point press wheel					
PSPE Rates	500 to 1250 mL/ha				500 to 900 mL/ha	NA
PSPE Timing	Apply as soon as possible after sowing					NA
PSPE Seeding	Knife point press wheel or Disc Seeder*					NA
Water Rate	> 50L/ha water rate					

* Refer to label prior to use

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Reflex® syngenta

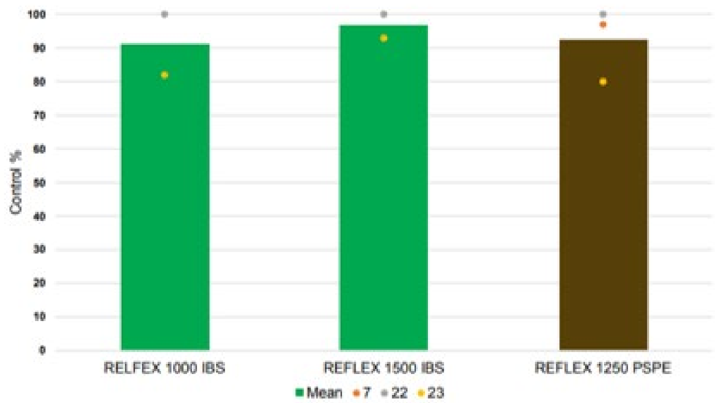
Reflex shows good crop safety to pulses, whilst dispatching troublesome broadleaf weeds like Sowthistle, Wild Radish and Fumitory.

REFLEX – labelled weeds by use pattern

Incorporated by sowing (IBS)		Post sowing pre-emergent (PSPE)	
Control	Suppression	Control	Suppression
Indian Hedge Mustard	Slender Celery	**Indian Hedge Mustard**	Slender Celery
Wild Radish	Fleabane	**Wild Radish**	Fleabane
Wild Turnip	Toad Rush	**Wild Turnip**	Toad Rush
Prickly Lettuce	Crassula	**Fumitory**	Crassula
Sow Thistle	Jersey Cudweed	**Prickly Lettuce**	Capeweed
Bifora	Capeweed	**Sow Thistle**	Double Gee
Wireweed	Double Gee	Wireweed	Bifora
Deadnettle	Fumitory	Deadnettle	
Black Mustard		Black Mustard	

BOLD = Confirmed resistance to other modes of action in AU   Highlighted = Control level changes between IBS & PSPE

Bifora



Assessments 53 – 130 DAS
AgXtra, Sunnyvale SA 2018, Lentils, AgXtra, Roseworthy SA 2019, Lentils, AgXtra, Roseworthy SA 2019, Lentils

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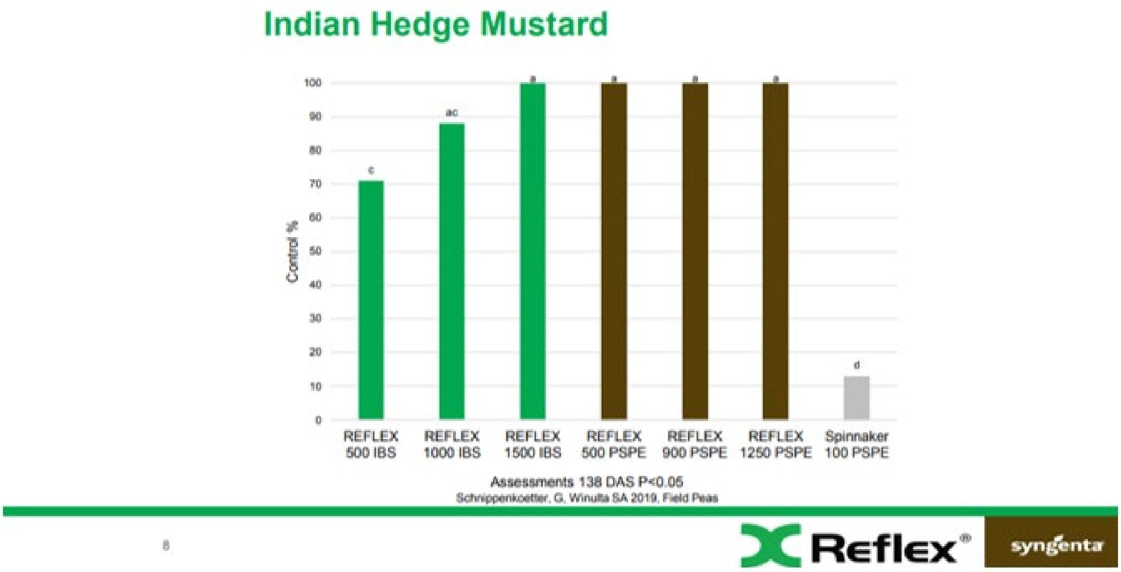
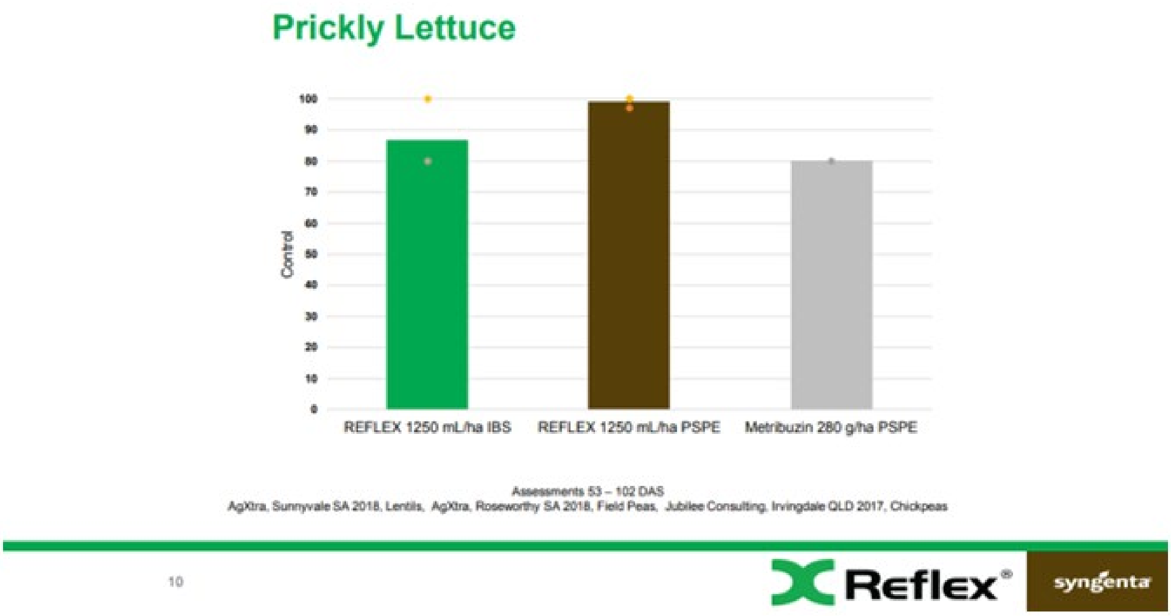

Indian Hedge Mustard
Control %
100
90
80
70
60
50
40
30
20
10
0
c
ac
a
a
a
a
d
REFLEX 500 IBS
REFLEX 1000 IBS
REFLEX 1500 IBS
REFLEX 500 PSPE
REFLEX 900 PSPE
REFLEX 1250 PSPE
Spinnaker 100 PSPE
Assessments 138 DAS P<0.05
Schnippenkoetter, G. Winulta SA 2019, Field Peas
8
Reflex®
syngenta


Prickly Lettuce
Control
100
90
80
70
60
50
40
30
20
10
0
REFLEX 1250 mL/ha IBS
REFLEX 1250 mL/ha PSPE
Metribuzin 280 g/ha PSPE
Assessments 53 – 102 DAS
AgXtra, Sunnyvale SA 2018, Lentils, AgXtra, Roseworthy SA 2018, Field Peas, Jubilee Consulting, Irvingdale QLD 2017, Chickpeas
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Reflex®
syngenta

Crop safety for Reflex is related to the spatial separation of seed and roots from active ingredient, and is paramount. The application of Reflex PSPE can show slightly reduced crop tolerance.

Fomesafen has limited movement in the soil, but crop safety when applied PSPE can be reduced by significant rainfall after sowing. With crop tolerance, there is significant variation by crop with sensitivity greatest in Lentils then Vetch. Therefore, rates and use patterns for Lentils and Vetch are developed to mitigate risk.

Recropping limitations are relatively minimal with 9 months and 250mm for most crops (see table below).

Re-cropping intervals

Crops	Re-cropping Interval	Required Rainfall
Wheat, Oats, Durum Wheat, Chickpeas, Field Peas, Faba Beans, Lupins, Vetch Lentils	9 months	250 mm
Sub Clover, Medic, Canola, Barley*	9 months	250 mm
Cotton, Mung Beans	3 months	75 mm
Sorghum, Maize	> 18 months	

*In some instances, reduced biomass or vigour may be noted in Barley, Canola, Sub Clover and Medics. However, the effect will resolve under good growing conditions and will be unlikely to translate to yield loss.

The above re-cropping intervals should be observed between the application of REFLEX at 1500 mL/ha and the planting of a following crop. Lower use rates will reduce any following crop responses noted, though the same re-cropping interval and rainfall thresholds apply.

Reflex® syngenta

An evening with Dr Steve Jefferies presented by AG Institute Australia

WHAT'S ON

SA Division
Mar 2021

AG INSTITUTE AUSTRALIA

Ag Institute Australia (AIA) is the peak industry body for agricultural and natural resource management professionals.

April Early Evening Event with Dr Steve Jefferies

The SA Division invites members and guests to their April light supper event.

There will be an update from Ag Institute members on SA Division progress with Craig Davis (SA working group lead), AIA/AUASA student activities (with AUASA President Brianna Shaefer) and a member in focus session with (SA division committee member and editor Kimi Pellosis).

Also, hear from **Dr Steve Jefferies**, AM, Director, Jefferies Ag Solutions.

Steve is a well-known Ag industry leader and he will provide personal insights as a former oat, barley & wheat breeder, undergraduate & postgraduate teacher (The University of Adelaide), past CEO of the Australian Grain Technology, immediate past Managing Director of Grains Research Development Corporation and director and interim CEO of Grain Producers SA.

When: 28th April, 5:00-8:00pm

Where: **The Arkaba Hotel, Osmond Room, 150 Glen Osmond Rd, Fullarton 5063**

Cost: $30 for members and non-members

$10 for students

Save the date! Ag Institute Ethics Masterclass 6th May 2021

Thurs 06 May 2021 @ 2:30-4.00pm ACST (3.00-5.30pm AEST)

The SA division of AIA are excited to announce the first hybrid (face-to-face + online) AIA Ethics Masterclass for 2021. These masterclasses attracted a wide variety of AIA members in 2020 and were a great opportunity to network and share ideas.

In this masterclass participants will be introduced to ethical dilemmas in various agricultural industries. The AIA's code of ethics will then be explored for ways the impacts of these ethical dilemmas can be reduced or mitigated. This class will be suitable for both experienced and emerging Australian agriculturalists to come together and discuss experiences and ideas.

Join us at 2:30-4.00pm ACST – Thursday 6th May 2021 via Webinar or face to face with SA Livestock Consultants meeting at Murray Bridge.

Contact admin@aginstitute.com.au or visit www.aginstitute.com.au for more details.

Registration Cost:
AIA Member: $60
Non-AIA Member: $90
Student AIA Member: Free
Student Non-Member: $30

RSVP: By Friday 30th April 2021