Fungicide on canola in the low and medium rainfall zones of NSW – Great investment, safe insurance or a waste of money?

Rohan Brill [1], Maurie Street[2] and Ben O'Brien[2]

[1] Brill Ag
[2] GOA

Key words
canola, fungicide, sclerotinia, upper canopy blackleg, Alternaria black spot, powdery mildew

GRDC code
GOA2006-001RTX

Take home messages

- Despite being a high yielding year with a favourable spring, there were few instances of consecutive wet days during the flowering period of canola at trial sites in 2021. This resulted in sclerotinia stem rot (main stem) infection averaging only 4% of plants across sites
- Fungicide treatments were effective at reducing disease in canola, but rarely provided complete control
- A reduction in disease did not guarantee an increase in grain yield and an increase in yield did not guarantee an increase in profit
- In low to medium rainfall environments, spring foliar fungicide use on canola may best be viewed as insurance but with a low probability of a pay out, rather than a reliable investment
- Decision support tools are available to help predict the likelihood of a sclerotinia outbreak and therefore when the use of fungicides is more likely to be justified.

Background information
Five trials were conducted by GOA and Brill Ag across southern and central NSW low and medium rainfall zones in 2020 to determine the response of canola to the application of fungicide during the flowering stage, in what was an above average year for canola grain yield.

Multiple diseases were present at most sites including sclerotinia stem rot, upper canopy blackleg, powdery mildew and Alternaria. Various fungicide products and timings were able to reduce the level of these diseases but there was only a positive return on investment (ROI) (compared to untreated) in two of the five sites and only to a small number of specific treatments. Where there was a positive ROI, it was difficult to attribute the yield response to the reduction in any one disease. This trial series was repeated in 2021 with four sites across low to medium rainfall environments of southern and central NSW.

Methodology
Trial sites were geographically located to represent a range of climates and farming systems (Table 1). Each trial was sprayed with a ute-mounted boomspray onto existing commercial crops to ensure that the canopy remained intact, minimising open space for air to circulate. The plots were usually 40-50 m² in size with an area of approximately 15-20 m² harvested with a small plot harvester when the crop was ripe (direct head, not desiccated). All other crop inputs were completed by the grower.

Table 1. Site description for four canola fungicide response trials conducted in NSW, 2021.

Location	Region	Average annual rainfall	Average growing season rainfall	Variety
Ganmain	Eastern Riverina	475 mm	280 mm	44Y94 CL
Rankins Springs	Northern Riverina	420 mm	250 mm	44Y90 CL
Trangie	Central-west plains	495 mm	240 mm	44T02 TT
Wongarbon	Central-west slopes	580 mm	300 mm	44Y94 CL

Two products (Table 2) were used with multiple combinations of timings and rates. The trial used a randomised complete block design, with five replicates and the results were analysed by ANOVA at a 95% confidence level.

Table 2. Description of fungicide products used in four canola fungicide response trials conducted in NSW, 2021.

Trade name	Active ingredient 1	Group	Active ingredient 2	Group
Aviator® Xpro®	Prothioconazole	3	Bixafen	7
Prosaro®	Prothioconazole	3	Tebuconazole	3

There were three product application timings, 10, 30 and 50% bloom at Ganmain and Trangie, and two timings at Rankins Springs and Wongarbon, 30 and 50% bloom. These spray timings are overlaid on daily rainfall, recorded at the site in Figure 1. There were few instances of consecutive days of rainfall >10 mm at any site until late September and into October, when crops were either at late flowering or had completed flowering.

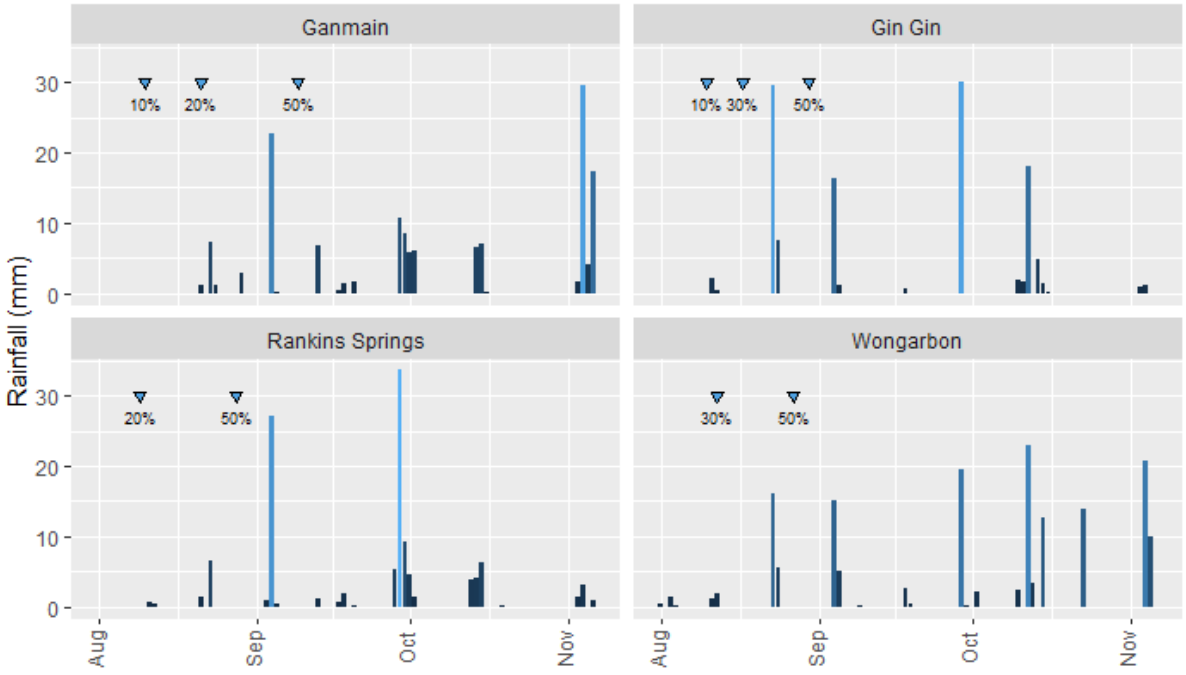

Figure 1. Daily rainfall received (vertical lines) and spray timings (inverted triangles) for four canola fungicide response trials conducted in NSW, 2021. Timings are bloom stage timing, e.g. 10% is 10% bloom stage. Measurements are from a tipping bucket rain gauge installed at the site. There was approximately 7.5 and 5 mm of rain recorded at Ganmain and Rankins Springs in the first week of August before the rain gauges were installed.

Disease assessment

Sclerotinia – two areas of 1 m^2 were assessed in each plot, with the number of plants with sclerotinia (basal, main stem and branch) counted along with the total number of plants in the assessment area to determine infection rates.

Upper canopy blackleg – A 0-4 score was allocated for the same two locations that were assessed for sclerotinia:

- 0 = no infection observed
- 0.5 = at least one lesion found
- 1 = lesion present
- 2 = lesions common
- 3 = lesions common causing damage
- 4 = lesions common causing branch death

Alternaria black spot – The upper canopy blackleg scoring system was adapted for Alternaria with some minor adaptions:

- 0 = no infection observed
- 0.5 = at least one lesion found
- 1 = lesion present
- 2 = lesions common with 1-5% of pod/stem area infected
- 3 = lesions common with 5-15% of pod/stem area infected and low-level early pod senescence.
- 4 = lesions common with >15% of pod/stem area infected and high level of early pod senescence.

Powdery mildew – An assessment was made of the proportion of stem area infected with powdery mildew (two locations per plot as per sclerotinia).

Results

Geographic disease distribution

Sclerotinia infection levels increased to the south and east of the trial's region as illustrated in Figure 2, but only to a maximum of ~8% of plants with main stem infection at Ganmain. Further west, Rankins Springs had a very low 0.4 % of plants with main stem sclerotinia infection. Upper canopy blackleg (branch) infection was generally less severe than 2020, with very low infection levels at the Trangie site and low-moderate levels at other sites. Alternaria and powdery mildew infection levels were generally lower than 2020 observations but were highest at the western sites, Rankins Springs and Trangie with no powdery mildew observed at Ganmain.

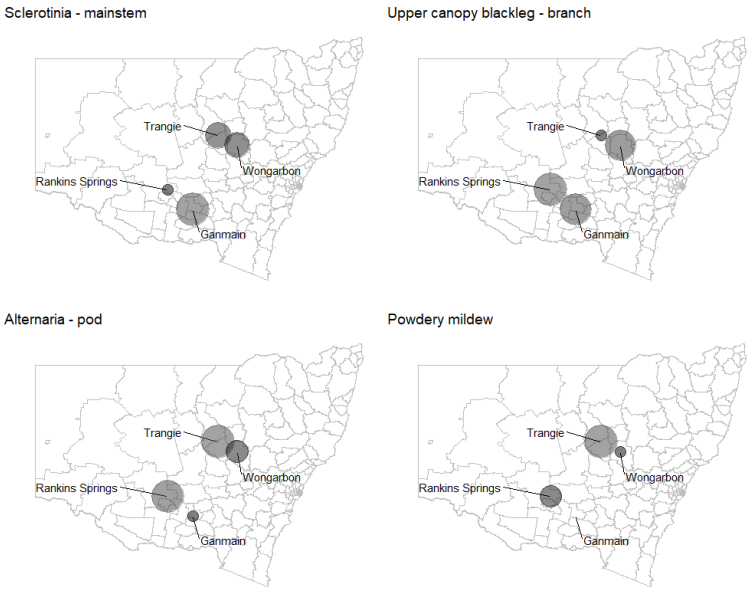

Figure 2. Severity of the diseases Sclerotinia stem rot (main stem), upper canopy blackleg (branch), Alternaria (pod) and powdery mildew across five canola fungicide response trials in NSW in 2021. Larger circles represent greater infection levels (data presented from untreated control). Data presented is dimensionless and no comparison can be made between diseases.

Ganmain

Ganmain had the highest level of sclerotinia infection of the four sites with 7.8% and 2.6% of main stems and branches infected respectively. All fungicide treatments reduced sclerotinia infection but the very early fungicide (5-10% bloom) was less effective than later applications. Several fungicide treatments reduced upper canopy blackleg, but infection levels were only low-moderate in the untreated control. No treatment tested reduced Alternaria at this site although the disease incidence was quite low.

Both two-spray strategies of Aviator Xpro followed by Prosaro resulted in yield higher than the untreated control, with Aviator Xpro at 5-10% bloom followed by Prosaro at 50% bloom yielding 0.3 t/ha (8.5%) above the untreated control. Single applications of any fungicide as well as Prosaro followed by Aviator Xpro did not increase grain yield.

It is difficult to ascertain the main drivers of the yield response at this site. The two-spray Aviator Xpro followed by Prosaro treatments did control sclerotinia, but so too did single sprays of Aviator Xpro or Prosaro at 20-30% bloom but without the yield response. The two-spray Aviator Xpro followed by Prosaro treatments also reduced upper canopy blackleg infection levels, suggesting that the yield response was from reducing the level of multiple diseases.

Table 4: Canola grain yield, oil% and disease response to fungicide in a crop of 44Y94 CL at Ganmain in 2021

	Yield (t/ha)	**Oil (%)**	**Sclero MS (%)**	**Sclero Br. (%)**	**UC BL Br.**	**Alt. pod**	**PM (%)**
Aviator Xpro @ 800mL/ha @ 5-10% bloom	3.59	47.2	4.0	0.3	0.5	0.7	
Prosaro @ 450mL/ha @ 20-30% bloom	3.57	47.3	0.7	0.7	1.2	0.8	
Aviator Xpro @ 800mL/ha @ 20-30% bloom	3.50	47.4	0.0	0.0	1.1	0.7	
Aviator Xpro @ 800mL/ha @ 5-10% bloom f/b Prosaro @ 450mL/ha @ 50% bloom	3.84	46.8	0.3	0.0	0.6	0.6	
Aviator Xpro @ 800mL/ha @ 20-30% bloom f/b Prosaro @ 450mL/ha @ 50% bloom	3.78	47.8	0.0	0.0	0.5	0.6	
Prosaro @ 450mL/ha @ 20-30% bloom f/b Aviator Xpro @ 800mL/ha @ 50% bloom	3.70	47.4	0.0	0.0	1.0	0.6	*Nil*
Prosaro @ 450mL/ha @ 50% bloom	3.55	47.4	1.2	0.0	1.4	0.7	
Aviator Xpro @ 800mL/ha @ 50% bloom	3.64	47.8	1.4	0.4	1.1	0.5	
Untreated control (UTC)	*3.54*	*47.8*	*7.8*	*2.6*	*1.5*	*0.7*	
l.s.d. (*p<0.05)*	0.22	0.5	1.7	1.1	0.5	0.3	

Sclero MS = Proportion of plants with sclerotinia infection on the main stem. Sclero Br. = proportion of plants with sclerotinia infection on a branch. UC BL Br = Upper Canopy Blackleg Branch infection with protocol outlined in methodology. Alt. pod = Alternaria pod infection score with protocol outlined in methodology. PM (%) is proportion of stem are infected with powdery mildew. Shaded cells indicate result is significantly different to the untreated control.

Rankins Springs

No fungicide treatments increased yield compared to the untreated control at Rankins Springs. There was a yield reduction from Aviator at 50% bloom. Sclerotinia levels at maturity were negligible and there were low-moderate levels of upper canopy blackleg (branch), Alternaria (pods) and powdery mildew. No fungicide treatment reduced the incidence of sclerotinia, albeit at a very low level of infection. All treatments reduced the incidence of upper canopy blackleg (Br.) and Alternaria except Prosaro at 50% on upper canopy blackleg. All treatments except Aviator at 50% bloom reduced the incidence of powdery mildew. Various fungicide treatments reduced (but did not completely control) these diseases.

Table 5: Canola grain yield, oil % and disease response to fungicide in a crop of 44Y90 CL at Rankins Springs in 2021.

	Yield (t/ha)	**Oil (%)**	**Sclero MS (%)**	**Sclero Br. (%)**	**UC BL Br.**	**Alt. pod**	**PM (%)**
Prosaro @ 450mL/ha @ 20-30% bloom	2.80	44.0	0.0	0.0	0.4	0.9	4
Aviator Xpro @ 800mL/ha @ 20-30% bloom	2.77	43.7	0.0	0.0	0.7	1.2	7
Aviator Xpro @ 800mL/ha @ 20-30% bloom f/b Prosaro @ 450mL/ha @ 50% bloom	2.64	44.1	0.5	0.0	0.5	0.8	2
Prosaro @ 450mL//ha @ 20-30% bloom f/b Aviator Xpro @ 800mL/ha @ 50% bloom	2.78	43.2	0.0	0.0	1.3	0.6	5
Prosaro @ 450mL/ha@ 50% bloom	2.75	43.9	0.8	0.8	1.4	0.9	5
Aviator Xpro @ 800mL/ha @ 50% bloom	2.49	43.7	0.7	0.0	1.2	0.6	11
Untreated control (UTC)	*2.82*	*43.6*	*0.4*	*0.9*	*1.7*	*2.0*	*13*
l.s.d. (*p<0.05)*	0.32	n.s.	n.s.	n.s.	0.4	0.3	5

Sclero MS = Proportion of plants with sclerotinia infection on the main stem. Sclero Br. = proportion of plants with sclerotinia infection on a branch. UC BL Br = Upper Canopy Blackleg Branch infection with protocol outlined in methodology. Alt. pod = Alternaria pod infection score with protocol outlined in methodology. PM (%) is proportion of stem are infected with powdery mildew. Shaded cells indicate result is significantly different to the untreated control.

Trangie

There were slightly higher disease levels at Trangie compared with Rankins Springs but similarly to Rankins Springs, fungicide did not increase grain yield. Sclerotinia infection levels were low (4% of main stems infected) in the untreated and all fungicide treatments reduced this to negligible levels. Minimal blackleg was observed even in the untreated control. Alternaria and powdery mildew levels were moderate. Several fungicide treatments reduced (but did not eliminate) Alternaria infection. Similarly, several fungicide treatments reduced powdery mildew levels, but only two-spray strategies reduced infection to less than 10% of stem area infected (from 32% in the untreated control).

Table 6: Canola grain yield, oil% and disease response to fungicide in a crop of 44T02 TT at Trangie 2021.

	Yield (t/ha)	**Oil (%)**	**Sclero MS (%)**	**Sclero Br. (%)**	**UC BL Br.**	**Alt. pod**	**PM (%)**
Aviator Xpro @ 800mL/ha @ 5-10% bloom	3.53	45.5	0.4	0.0	0.1	1.8	20
Prosaro @ 450mL/ha @ 20-30% bloom	3.39	45.5	0.0	0.0	0.1	2.3	22
Aviator Xpro @ 800mL/ha @ 20-30% bloom	3.36	45.3	0.3	0.0	0.0	1.4	21
Aviator Xpro @ 800mL/ha @ 5-10% bloom f/b Prosaro @ 450mL/ha @ 50% bloom	3.43	45.8	0.0	0.0	0.0	1.1	5
Aviator Xpro @ 800mL/ha @ 20-30% bloom f/b Prosaro @ 450mL/ha @ 50% bloom	3.47	46.1	0.5	0.0	0.1	1.3	7
Prosaro @ 450mL/ha @ 20-30% bloom f/b Aviator Xpro @ 800mL/ha @ 50% bloom	3.33	45.6	0.0	0.0	0.0	0.8	5
Prosaro @ 450mL/ha @ 50% bloom	3.60	45.7	0.7	0.0	0.1	1.4	15
Aviator Xpro @ 800mL/ha @ 50% bloom	3.44	45.5	0.7	0.0	0.1	1.3	21
Untreated control (UTC)	3.43	45.4	4.0	1.1	0.2	2.1	32
l.s.d. (*p<0.05)*	0.27	0.7	1.6	0.7	0.2	0.6	9

Sclero MS = Proportion of plants with sclerotinia infection on the main stem. Sclero Br. = proportion of plants with sclerotinia infection on a branch. UC BL Br = Upper Canopy Blackleg Branch infection with protocol outlined in methodology. Alt. pod = Alternaria pod infection score with protocol outlined in methodology. PM (%) is proportion of stem are infected with powdery mildew. Shaded cells indicate result is significantly different to the untreated control.

Wongarbon

All treatments reduced sclerotinia and powdery mildew levels compared to the untreated control, while some treatments reduced upper canopy blackleg infection and Alternaria. Like the Ganmain site, a reduction in sclerotinia to negligible levels did not guarantee a yield response from fungicide as only the two-spray treatments and Aviator Xpro at 20-30% bloom increased grain yield compared to the untreated control.

Table 7. Canola grain yield, oil%, and disease response to fungicide in a crop of 44Y94 CL at Wongarbon in 2021.

	Yield (t/ha)	Oil (%)	Sclero MS (%)	Sclero Br. (%)	UC BL Br.	Alt. pod	PM (%)
Prosaro @ 450mL/ha @ 20-30% bloom	4.15	47.2	0.0	0.0	0.8	1.0	0.9
Aviator Xpro @ 800mL/ha @ 20-30% bloom	4.30	47.1	0.2	0.0	0.7	0.8	0.5
Aviator Xpro @ 800mL/ha @ 20-30% bloom f/b Prosaro @ 450mL/ha @ 50% bloom	4.42	47.5	0.0	0.0	0.5	0.8	1.4
Prosaro @ 450mL @ 20-30% bloom f/b Aviator Xpro @ 800mL/ha @ 50% bloom	4.27	46.8	0.0	0.0	0.7	0.5	0.9
Prosaro @ 450mL/ha @ 50% bloom	4.06	47.4	0.3	0.3	1.1	1.1	2.6
Aviator Xpro @ 800mL/ha @ 50% bloom	4.17	47.0	0.6	0.3	0.9	0.6	0.4
Untreated control (UTC)	4.01	47.2	3.6	1.2	1.5	1.1	6.8
l.s.d. (*p<0.05)*	0.26	n.s.	1.1	1.1	0.6	0.3	1.8

Sclero MS = Proportion of plants with sclerotinia infection on the main stem. Sclero Br. = proportion of plants with sclerotinia infection on a branch. UC BL Br = Upper Canopy Blackleg Branch infection with protocol outlined in methodology. Alt. pod = Alternaria pod infection score with protocol outlined in methodology. PM (%) is proportion of stem are infected with powdery mildew. Shaded cells indicate result is significantly different to the untreated control.

Gross margin analysis

A partial gross margin analysis was completed in 2020 and 2021 where the total income (incorporating yield and oil) was calculated then costs deducted from each treatment. Fungicide costs were assumed to be the same across seasons, but the assumed canola price reflected each season, with $550 and $850/tonne in 2020 and 2021 respectively. Application cost was assumed as $13/ha per fungicide application in both seasons, which may vary from grower to grower. Wheel tracking damage from spray applications was not considered.

There was only one treatment out of 28 site* treatment combinations with an economic benefit compared to the untreated control in 2021, despite the yield response and very high canola price of $850/t. Where a price of $550/tonne was used in the analysis of the 2021 results, no treatments were profitable at any site. Two of the 28 site* treatment combinations lost money in 2021 with $850/tonne canola price. Using a canola price of $550/tonne on the 2021 yield responses, four of 28 site* treatment combinations would lose money, all of these at the western sites of Rankins Springs and Trangie.

Table 8. Summary of yield and economic response to fungicide application over that of the UTC over two years of trials

Year	Site	Maximum yield response (t/ha) compared to UTC (% increase over UTC)	Treatments with yield > UTC/no. of treatments	Treatments with GM > UTC*	Assumed Price $/t	$/ha net economic benefit of best treatment over UTC
2020	*Ganmain*	Nil	0/10	0/8	$550	Nil
	Kamarah	0.4 (16%)	8/9	2/7		$190
	Temora	0.66 (21%)	6/11	4/9		$320
	Warren	Nil	0/9	0/8		Nil
	Wellington	0.26 (7%)	2/10	0/10		Nil
2021	*Ganmain*	0.3 (8%)	2/8	0/8	$850	Nil
	Rankins Springs	Nil	0/6	0/6		Nil
	Trangie	Nil	0/8	0/8		Nil
	Wongarbon	0.41 (10%)	3/6	1/6		$289

*Some treatments were not included in the gross margin analysis as the products had not been priced at the time. Gross margin calculated with assumed price of $850/tonne in 2021 and $550/tonne in 2020. GM = Gross Margin. UTC = Untreated Control.

Discussion and conclusion

Canola is susceptible to several diseases including sclerotinia, blackleg, Alternaria and powdery mildew, and fungicides can be used to reduce the incidence of each of these diseases. However, a yield benefit from reducing disease is not guaranteed and two years of trials conducted by GOA and Brill Ag in low-medium rainfall regions of NSW have shown that across a range of products and timings, a yield response was less likely than no yield response, with only 23 of 77 sites* treatment combinations resulting in higher grain yield. As reduced disease does not guarantee increased yield, increased yield does not guarantee increased profit. In 2021 only one site * treatment combinations resulted in a higher gross margin compared to the untreated control.

Growers considering fungicide applications on canola in similar environments to where these trials were conducted, maybe could view it more as insurance than an investment. In considering fungicide as insurance, growers should question how often do weather conditions justify fungicide application in these environments and where yield is reduced, what is the overall penalty on income from the disease versus the costs of spraying? And simply observing sclerotinia in a crop at harvest does not mean that it would have been worth spraying with fungicide. As shown in the trial outcomes over the last two years, which were some of the wettest on record, coupled with high grain prices and very high yields, the insurance was only economically justified in a small number of cases.

Although these trials were conducted in two ‘wet’ years, there were few instances of consecutive wet days through the critical crop flowering period which is essential for the sclerotinia to infect the crop. This is common for low to medium rainfall environments and likely the primary reason why sclerotinia is a sporadic and infrequent disease in these environments.

Another factor for consideration of applying fungicides is that crop yield potential and price received can have a significant bearing on the resulting economic benefit. As detailed above, the combination of high yields and high prices in 2021 did result in one case returning a healthy return on the money

invested of around $289/ha. However, had the price for canola been $550/t, there was no treatment that returned enough yield benefit to result in a return greater than not spraying at all. It could be surmised that if yield potential was lower, the potential for any application to be profitable could be lower again.

Tools are available to assist in the prediction of sclerotinia outbreaks and the likelihood of fungicides reducing yield loss from disease and the economic case for their use (see https://www.agric.wa.gov.au/apps/sclerotiniacm-sclerotinia-management-app). The use of these may give growers the confidence to make more informed fungicide application decisions.

Although diseases such as Alternaria and powdery mildew seem more prevalent in the lower rainfall, warmer environment from this trial work, their control by fungicides appears to be variable and there is little evidence of increased yield where these diseases were reduced.

Acknowledgements
Thanks to the farmer co-operators for allowing us to complete this work on their crops.

- Freeth family – co-operators at the Trangie site.
- Pfitzner family - co-operators at the Rankins Springs site.

Contact details
Rohan Brill
Brill Ag
Ph: 0488 250 489
Email: rohan@brillag.com.au

Maurie Street
Grain Orana Alliance P
Ph: 02 6887 8258
Email: maurie.street@grainorana.com.au

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