OPTIMISING DISEASE CONTROL IN SOUTHERN VICTORIAN MALLEE CEREAL CROPS

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TAKE HOME MESSAGES

- Effective disease management requires tailoring strategies to crop variety, seasonal conditions and disease levels.
- Minimising fungicide use in low-disease years can improve profitability without compromising yield.
- Fungicide timing at key growth stages is essential for maximising yield and profitability in disease-prone seasons.

BACKGROUND

The variable nature of disease, which is driven largely by rainfall, complicates in-crop disease management in the southern Mallee. In disease-prone seasons, poor fungicide management can result in significant yield losses, highlighting the need for effective control strategies. Conversely, in low-disease years, fungicide applications often provide no yield benefit, instead increasing costs and reducing profit. Wheat in the region is commonly affected by Septoria tritici blotch and stripe rust, while barley is impacted by spot form of net blotch (SFNB) and net form of net blotch (NFNB).

This report details the second year of a GRDC project. Results from 2023 emphasised the importance of avoiding highly susceptible cereal varieties to mitigate disease risk and demonstrated premium fungicide treatments do not always yield better economic returns (Jones and Plowman, 2023). Previous research by Agriculture Victoria and BCG in the southern Mallee found SFNB reduced yields of susceptible barley varieties by 17 per cent in 2016 and 10 per cent in 2017 (McLean et al., 2022). Another study in 2022 showed foliar diseases could reduce wheat yields by up to 50 per cent, underscoring the significant threat these diseases pose during a conducive season (Dadu et al., 2022). These yield losses were mitigated by using integrated disease management strategies, including variety selection and timely fungicide application (Dadu et al., 2022).

To support growers facing challenges with disease management amid seasonal variability, field trials focused on variety selection, optimising fungicide timing, and evaluating fungicide options. These trials aim to provide practical recommendations for enhanced disease control and improved profitability for growers in the southern Mallee.

AIM

This study aimed to enhance cereal disease management in the southern Mallee region by:

- Assessing how various wheat and barley varieties with differing disease resistance ratings performed during the 2024 season.
- Identifying the most effective timings for fungicide application to control disease.
- Evaluating the effectiveness and economic viability of different fungicide options for disease control.

PADDOCK DETAILS

Location:	Nullawil
Crop year rainfall (Nov–Oct):	361mm
GSR (Apr–Oct):	178mm
Soil type:	Loamy clay
Paddock history:	Vetch brown manure

TRIAL DETAILS

Crop type/s:	Wheat and barley
Treatments:	Refer to Tables 2, 3 and 4
Target plant density:	130 plants/m^2
Seeding equipment:	Knife points, press wheels, 30cm row spacing
Sowing date:	22–24 May 2024
Replicates:	Three or four
Harvest date:	12 November 2024 (barley), 9 December 2024 (wheat)

TRIAL INPUTS

Nutrition, weeds and insects were managed as per best practice.

METHOD

Six trials were set up at Nullawil, in the Victorian southern Mallee, with three trials each dedicated to wheat and barley. The trials aimed to investigate different varieties, fungicide timings, and fungicide product selection for foliar disease management. Wheat and barley varieties with varying resistance ratings were sown (Table 1) and subjected to either a high (nil control) or low (full control) disease treatment (Table 2, Trials 1 and 4). Additional trials focused on wheat varieties Scepter and LRPB Matador, as well as barley varieties Maximus CL and RGT Planet, to examine various fungicide timing applications (Table 3, Trials 2 and 5) and fungicide product selection (Table 4, Trials 3 and 6).

All trials were set up using randomised complete block designs with three or four replicates. Assessments included disease severity, establishment counts, and yield parameters. Disease severity was visually assessed by estimating the percentage of leaf area affected with disease on eight occasions during the season, from GS15 to GS55. These severity estimates were used to calculate the Area Under the Disease Progression Curve (AUDPC), providing a cumulative measure of disease severity over time (Brown and Keane, 1997).

Table 1. Disease resistance ratings[1] for wheat and barley varieties used in the southern Mallee disease management trials (1 and 4) during 2024.

Disease	Variety					
	Wheat					
	Scepter	**Ballista**	**Vixen**	**Valiant**	**Matador**	**Sunblade**
Septoria tritici blotch	S	SVS	S	MSS	S (P)	S
Stripe rust	MSS	MSS	SVS	S	MS	MRMS
Leaf rust	MSS	S	SVS	S	MSS	MSS
	Barley					
	Combat	**Maximus**	**Commodus**	**Planet**	**Titan**	**Neo**
Spot form of net blotch	RMR	MS	MSS	SVS	MS	MR (P)
Net form of net blotch	MRMS	MRMS	MSS	SVS	MS	MS (P)
Scald	S	SVS	SVS	SVS	VS	S (P)

MR=moderately resistant, MRMS=moderately resistant to moderately susceptible, MS=moderately susceptible, MSS=moderately susceptible to susceptible, S=susceptible, SVS=susceptible to very susceptible, VS=very susceptible, P=provisional.

[1]Disease ratings were sourced from GRDC National Variety Trials.

Table 2. Fungicide treatments, active ingredients, application timings and rates for wheat and barley 'variety' trials (Trials 1 and 4) in the southern Mallee during 2024.

Treatment		Product	Active ingredient	Timing	Rate
Wheat					
i)	High disease	No fungicide	-	-	-
ii)	Low disease	Flutriafol	Flutriafol	Sowing	400mL/100kg fertiliser
		Aviator Xpro	150g/L Prothioconazole, 75g/L Bixafen	GS31	500mL/ha
		Maxentis	133g/L Azoxystrobin, 100g/L Prothioconazole	GS39	600mL/ha
		Prosaro	210g/L Prothioconazole, 210g/L Tebuconazole	GS55	300mL/ha
Barley					
i)	High disease	No fungicide	-	-	-
ii)	Low disease	Systiva	333g/L Fluxapyroxad	Sowing	150mL/100kg seed
		Aviator Xpro	150g/L Prothioconazole, 75g/L Bixafen	GS31	500mL/ha
		Maxentis	133g/L Azoxystrobin, 100g/L Prothioconazole	GS39	400mL/ha
		Prosaro	210g/L Prothioconazole, 210g/L Tebuconazole	GS55	300mL/ha

Growth stage according to Zadoks scale, GS15=seedling growth, GS31=stem elongation, GS39=flag leaf emergence, GS55=head emergence (Zadoks, et al., 1974).

Table 3. Fungicide treatments, active ingredients, application timings and rates for wheat and barley 'fungicide application timing' trials (Trials 2 and 5) in the southern Mallee during 2024.

Treatment/product		Active ingredient	Timing	Rate
Wheat				
i)	Nil control	-	-	-
ii)	Flutriafol	Flutriafol	Sowing	400mL/100kg fertiliser
iii)	Proviso	250g/L Prothioconazole	GS15	190mL/ha
iv)	Aviator Xpro	15g/L Prothioconazole, 75g/L Bixafen	GS31	500mL/ha
v)	Maxentis	133g/L Azoxystrobin, 100g/L Prothioconazole	GS39	600mL/ha
vi)	Flutriafol	Flutriafol	Sowing	400mL/100kg fertiliser
	Maxentis	133g/L Azoxystrobin, 100g/L Prothioconazole	GS39	600mL/ha
vii)	Proviso	250g/L Prothioconazole	GS15	190mL/ha
	Maxentis	133g/L Azoxystrobin, 100g/L Prothioconazole	GS39	600mL/ha
viii)	Aviator Xpro	150g/L Prothioconazole, 75g/L Bixafen	GS31	500mL/ha
	Maxentis	133g/L Azoxystrobin, 100g/L Prothioconazole	GS39	600mL/ha
ix)	Flutriafol	Flutriafol	Sowing	400mL/100kg fertiliser
	Aviator Xpro	150g/L Prothioconazole, 75g/L Bixafen	GS31	500mL/ha
	Maxentis	133g/L Azoxystrobin, 100g/L Prothioconazole	GS39	600mL/ha
Barley				
i)	Nil control	-	-	-
ii)	Systiva	333g/L Fluxapyroxad	Sowing	150mL/100kg seed
iii)	Proviso	250g/L Prothioconazole	GS15	190mL/ha
iv)	Aviator Xpro	150g/L Prothioconazole, 75g/L Bixafen	GS31	500mL/ha
v)	Maxentis	133g/L Azoxystrobin, 100g/L Prothioconazole	GS39	400mL/ha
vi)	Systiva	333m/L Fluxapyroxad	Sowing	150mL/100kg seed
	Maxentis	133g/L Azoxystrobin, 100g/L Prothioconazole	GS39	400mL/ha
vii)	Proviso	250g/L Prothioconazole	GS15	190mL/ha
	Maxentis	133g/L Azoxystrobin, 100g/L Prothioconazole	GS39	400mL/ha
viii)	Aviator Xpro	150g/L Prothioconazole, 75 g/L Bixafen	GS31	500mL/ha
	Maxentis	133g/L Azoxystrobin, 100g/L Prothioconazole	GS39	400mL/ha
ix)	Systiva	333ml/ha Fluxapyroxad	Sowing	150mL/100kg seed
	Aviator Xpro	150g/L Prothioconazole, 75g/L Bixafen	GS31	500mL/ha
	Maxentis	133g/L Azoxystrobin, 100g/L Prothioconazole	GS39	400mL/ha

Table 4. Fungicide treatments, active ingredients, application timings and rates for wheat and barley 'fungicide strategy' trials (Trials 3 and 6) in the southern Mallee during 2024.

Treatment		Product	Active ingredient	Timing	Rate (mL/ha)
Wheat					
i)	Nil control	No fungicide	-	-	-
ii)	Triazole only	Epoxyconazole 125	125g/L Epoxyconazole	GS31	500
		Prosaro	210g/L Prothioconazole, 210g/L Tebuconazole	GS39	300
iii)	Mid-range 1	Epoxyconazole 125	125g/L Epoxyconazole	GS31	500
		Maxentis	210g/L Prothioconazole, 210g/L Tebuconazole	GS39	400
iv)	Mid-range 2	Maxentis	133g/L Azoxystrobin, 100g/L Prothioconazole	GS31	600
		Epoxyconazole 125	125g/L Epoxyconazole	GS39	500
v)	Expensive	Elatus Ace	40g/L Benzovindiflupyr, 250g/L Propiconazole	GS31	500
		Maxentis	133g/L Azoxystrobin, 100g/L Prothioconazole	GS39	400
vi)	Full control	Elatus Ace	40g/L Benzovindiflupyr, 250g/L Propiconazole	GS31	500
		Maxentis	133g/L Azoxystrobin, 100g/L Prothioconazole	GS39	400
		Prosaro	210g/L Prothioconazole, 210g/L Tebuconazole	GS55	300
Barley					
i)	Nil control	No fungicide	-	-	-
ii)	Triazole only	Propiconazole 250	250g/L Propiconazole	GS31	500
		Proviso	133g/L Azoxystrobin, 100g/L Prothioconazole	GS39	250
iii)	Mid-range 1	Propiconazole 250	250g/L Propiconazole	GS31	500
		Maxentis	133g/L Azoxystrobin, 100g/L Prothioconazole	GS39	400
iv)	Mid-range 2	Maxentis	133g/L Azoxystrobin, 100g/L Prothioconazole	GS31	600
		Proviso	133g/L Azoxystrobin, 100g/L Prothioconazole	GS39	250
v)	Expensive	Elatus Ace	40g/L Benzovindiflupyr, 250g/L Propiconazole	GS31	500
		Maxentis	133g/L Azoxystrobin, 100g/L Prothioconazole	GS39	400
vi)	Full control	Elatus Ace	40 g/LBenzovindiflupyr, 250g/L Propiconazole	GS31	500
		Maxentis	133g/L Azoxystrobin, 100g/L Prothioconazole	GS39	400
		Prosaro	210g/L Prothioconazole, 210g/L Tebuconazole	GS55	300

RESULTS AND INTERPRETATION

Seasonal conditions and diseases present

Nullawil received 178mm (Decile 1) of rainfall during the growing season, leading to dry seasonal conditions and low overall disease pressure. Despite the dry conditions, Septoria, rust, and yellow leaf spot (YLS) were observed in wheat, while barley was affected by spot form of net blotch (SFNB), net form of net blotch (NFNB), and scald. Stored soil water resulted in higher yield than would have been expected based solely on in-crop rainfall.

Trial 1: Wheat varieties with and without disease

Disease presence and resistance rating alignment

Disease progression was monitored throughout the season, with Septoria detected in all plots during the early growth stages (GS31 to GS39). By mid-season (GS39), additional diseases, including stripe rust, became evident. Late-season assessments (GS55 and two weeks post-GS55) revealed the presence of stripe rust, Septoria, and YLS across all varieties.

In the high disease treatments, a clear relationship was observed between disease severity and variety susceptibility to stripe rust. The lowest disease severity was recorded in the Sunblade CL Plus low disease treatment (MRMS, AUDPC 111), while the highest was in the Vixen high disease treatment (SVS, AUDPC 435) (Table 5). Even under low disease treatments, susceptible varieties such as Vixen exhibited substantial disease loads (AUDPC 231) (Table 5). Although low disease treatments significantly reduced disease severity ($p<.001$), complete suppression was not achieved (Table 5). Susceptible varieties consistently retained higher residual disease loads compared to those with moderate resistance, underscoring the importance of avoiding highly susceptible varieties as part of an effective disease management strategy.

Disease effects and yield

Despite differences in disease levels between varieties and high and low disease treatments, the disease did not significantly affect grain yield in this trial (Table 5). This indicates that while disease was present, levels were not sufficient to limit yield. Despite the lack of yield impact, high disease levels did affect protein content, with reduced protein in treatments with greater disease severity ($p=0.001$) (Table 5). However, the differences in protein levels were not enough to alter grain quality ratings. Partial gross margin (PGM) analysis suggests small impacts of disease on PGM in all varieties, except for LRPB Matador, which recorded the highest PGM under the high disease treatment ($944). In contrast, the Valiant CL Plus high disease treatment recorded the lowest PGM ($576), reflecting the significant cost of uncontrolled disease for highly susceptible varieties (Table 5).

Table 5. Effect of foliar disease levels (Table 2) on disease severity, grain yield, and partial gross margins of wheat varieties with contrasting resistance/susceptibility to disease (Table 1) at Nullawil during 2024 (Trial 1).

Variety	Treatment	AUDPC^	Grain yield (t/ha)	Protein (%)	PGM ($/ha)*	Cost of disease ($/ha)
Ballista	Low disease	154	3.06	10.10	874	-
	High disease	373	2.90	***10.03***	829	45
LRPB Matador	Low disease	164	3.09	10.93	883	-
	High disease	313	***3.30***	10.07	***944***	-61
Scepter	Low disease	162	2.89	11.10	827	-
	High disease	430	2.56	10.50	733	94
Sunblade CL Plus	Low disease	***111***	2.22	11.63	635	-
	High disease	170	2.11	11.37	603	31
Valiant CL Plus	Low disease	151	2.82	***12.37***	805	-
	High disease	410	***2.01***	11.67	***576***	230
Vixen	Low disease	231	2.94	10.47	840	-
	High disease	***435***	2.49	10.30	712	128
	Sig. diff.					
	Variety	**<.001**	**0.004**	**<.001**		
	Treatment	**<.001**	**NS**	**0.001**		
	Variety x treatment	**NS**	**NS**	**NS**		
	LSD (P=0.05)					
	Variety	**54.9**	**0.475**	**0.430**		
	Treatment	**31.7**	**NS**	**0.248**		
	Variety x treatment	**NS**	**NS**	**NS**		

Values that are bold and italicised represent the lowest and highest values for that trait. ^AUDPC = Area Under Disease Progress Curve, based on 8 observations of foliar disease severity (% leaf area affected) between GS15 and GS55. *PGM = Partial gross margin, calculated using wheat AGP cash prices ($286/t) from *The Weekly Times*, 11 December 2024, Wycheproof. This calculation does not include fungicide and application costs and is based on the yields presented in this table.

Trial 2: Wheat under various fungicide applications and timings

This trial involved two wheat varieties, Scepter and LRPB Matador, treated with various fungicide application timings (Table 3). These varieties were selected for their resistance ratings. Since statistical analysis showed no significant variety effect, the data from both varieties was combined for analysis.

Disease presence across treatments

Septoria was the predominant disease throughout the growing season, with occasional occurrences of stripe rust and dead leaf symptoms (senescence), particularly during the later stages of crop maturity. Treatments incorporating flutriafol, either alone or in combination with additional fungicide applications, significantly reduced disease severity (p=0.047) and AUDPC (p<.001); however, complete suppression was not achieved (Table 6). GS31+GS39 (Treatment viii) and Flutriafol+GS31+GS39 (Treatment ix) exhibited the most effective disease suppression, with AUDPC values of 224 and 228, whilst the Nil control (Treatment i) experienced the highest disease pressure (AUDPC 459) (Table 6). These results highlight the importance of well-timed, dual fungicide applications for achieving optimal disease control.

Yield and fungicide timing

Fungicide treatments significantly affected yield (p=0.003), with the dual application at GS31 and GS39 (Treatment viii) achieving the highest yield (4.93t/ha) and PGM ($1331/ha) compared to other treatments (Table 6). Among single applications, GS39 (Treatment v) was the most effective timing for disease control; however, it did not result in increased yield or PGM (Table 6). These findings underscore the importance of applying fungicides at both GS31 and GS39 to maximise yield and economic returns, aligning with the results of Dadu et al., (2023), who reported similar outcomes in a more disease-conducive year.

Table 6. Effect of fungicide treatments (Table 3) on foliar disease severity, grain yield and partial gross margins of wheat (mean of two wheat varieties) in Nullawil during 2024 (Trial 2).

Treatment		Disease severity (%LAA) 2 weeks post GS55 spray[#]	AUDPC^	Grain yield (t/ha)	PGM ($/ha)*	Profit difference ($/ha)[†]
i)	Nil	48	***459***	***3.61***	***1032***	0
ii)	Flutriafol	43	378	3.72	1044	12
iii)	GS15	***57***	443	3.78	1065	33
iv)	GS31	48	397	3.96	1089	57
v)	GS39	33	267	3.82	1057	25
vi)	Flutriafol+GS39	41	275	4.02	1094	62
vii)	GS15+GS39	25	255	4.15	1136	104
viii)	GS31+GS39	31	***224***	***4.93***	***1331***	299
ix)	Flutriafol+GS31+GS39	***24***	228	4.05	1059	27
	Sig. diff.	**0.047**	**<.001**	**0.003**		
	LSD (P=0.05)	**21.7**	**65.7**	**0.579**		

Growth stage according to Zadoks scale, GS55=head emergence. Values that are bold and italicised represent the lowest and highest values for that trait. [#]Disease severity refers to the percentage of leaf area affected (%LAA) by disease. ^AUDPC = Area Under Disease Progress Curve, based on 8 observations of foliar disease severity (% leaf area affected) between GS15 and GS55. *PGM = Partial gross margin, calculated using wheat AGP cash prices ($286/t) from *The Weekly Times*, 11 December 2024, Wycheproof. This calculation includes fungicide and application costs and is based on the yields presented in this table. [†]Profit difference refers to the difference between the treatment and nil control.

Trial 3: Wheat fungicide strategy

This trial involved two wheat varieties, Scepter and LRPB Matador, treated with various fungicide strategies (Table 4). As statistical analysis showed no significant difference between varieties, data from both was combined for analysis.

Disease severity

Disease severity two weeks after the GS55 spray ranged from 28 per cent for the Mid-range 1 strategy (Treatment iii) to 43 per cent for the Nil control (Treatment i) (Table 7). Fungicide treatments significantly reduced disease severity (p<.001), with all strategies outperforming the Nil control (Treatment i). Similarly, AUDPC values, which indicate disease progression over time, ranged from 276 under the Full control (Treatment v) to 363 for the Nil control (Treatment i), demonstrating a significant reduction in disease progression with fungicide applications (p=0.003) (Table 7).

Grain yield and economic outcomes

Despite reductions in disease severity and AUDPC, fungicide treatments did not result in a significant increase in grain yield, with no strategy delivering a statistically higher yield compared to the Nil treatment (Treatment i) (Table 7). However, PGM analysis highlighted the importance of cost considerations. The Triazole only strategy (Treatment ii) achieved the highest PGM at $970/ha, while the Expensive strategy (Treatment ix) recorded the lowest PGM at $917/ha. Moderate approaches, such as the Mid-range 1 strategy (Treatment iii) and Mid-range 2 strategy (Treatment iv), balanced effective disease control with economic return. In contrast, the Expensive (Treatment ix) and Full Control (Treatment v) strategies incurred higher costs without corresponding yield or financial benefits. These findings suggest that targeted, cost-effective fungicide strategies are optimal under the low to moderate disease pressure conditions observed in 2024.

Table 7. Effect of fungicide treatment (Table 4) on disease severity, grain yield and partial gross margins of wheat (mean of two wheat varieties) at Nullawil during 2024 (Trial 3).

Treatment		Disease severity (%LAA) 2 weeks post GS55 spray#	AUDPC^	Grain yield (t/ha)	PGM ($/ha)*	Profit difference ($/ha)†
i)	Nil	***43***	***363***	***3.22***	921	0
ii)	Triazole only	33	322	3.52	***970***	49
iii)	Mid-range 1	***28***	301	3.48	949	28
iv)	Mid-range 2	34	304	***3.54***	967	46
ix)	Expensive	33	296	3.41	***917***	-4
v)	Full control	33	***276***	3.53	934	13
	Sig. diff.	**<.001**	**0.003**	**NS**		
	LSD (P=0.05)	**5.5**	**38.6**	**NS**		

Growth stage according to Zadoks scale, GS55=head emergence. Values that are bold and italicised represent the lowest and highest values for that variable. #Disease severity refers to the percentage of leaf area affected (%LAA) by disease. ^AUDPC = Area Under Disease Progress Curve, this is based on 8 observations of foliar disease severity (% leaf area affected) between GS15 and GS55. *PGM = Partial gross margin, this was calculated using wheat AGP cash prices ($286/t) from *The Weekly Times*, 11 December 2024, Wycheproof. This calculation includes fungicide and application costs and is based on the yields presented in this table. †Profit difference refers to the difference between the treatment and nil control.

Trial 4: Barley varieties with and without disease

Disease presence

Barley exhibited lower overall disease levels compared to wheat. Disease progression was consistent across trials, with SFNB appearing early in the season (GS31 to GS39). By mid-season (GS39), both SFNB and NFNB were detected in most treatments. Late-season assessments (GS55 and two weeks post-GS55) revealed the presence of SFNB, NFNB, and scald across all plots. Despite the presence of multiple diseases, overall disease pressure remained low throughout the growing period.

Disease effects and yield

Fungicide treatments significantly reduced disease severity ($p<.001$) and AUDPC ($p=0.023$). However, no significant yield differences were observed, due to limited disease development in this experiment (Table 8).

Table 8. Effect of foliar disease level (Table 2) on disease severity, grain yield and partial gross margins of barley varieties with different resistance/susceptibility to disease (Table 1) at Nullawil during 2024 (Trial 4).

Variety	Treatment	Disease severity (%LAA) 2 weeks post GS55 spray#	AUDPC^	Grain yield (t/ha)	PGM ($/ha)*	Disease cost ($/ha)
Combat	Low disease	***2***	***77***	***5.05***	***1506***	-
	High disease	4	96	4.65	1385	121
Commodus CL	Low disease	***2***	101	***4.20***	***1252***	-
	High disease	6	133	4.37	1302	-50
Maximus CL	Low disease	3	134	4.64	1382	-
	High disease	6	132	4.89	1456	-74
Neo CL	Low disease	***2***	131	4.75	1414	-
	High disease	5	147	5.05	1504	-90
RGT Planet	Low disease	9	228	4.65	1385	-
	High disease	***21***	***269***	4.45	1325	60
Titan AX	Low disease	***2***	115	4.40	1312	-
	High disease	4	134	4.52	1346	-34
	Sig. diff.					
	Variety	**<.001**	**<.001**	**0.002**		
	Treatment	**<.001**	**0.023**	**NS**		
	Variety x treatment	**0.009**	**NS**	**NS**		
	LSD (P=0.05)					
	Variety	**2.8**	**30.9**	**0.299**		
	Treatment	**1.6**	**17.8**	**NS**		
	Variety x treatment	**4.0**	**NS**	**NS**		

Growth stage according to Zadoks scale, GS55=head emergence. Values that are bold and italicised represent the lowest and highest values for that variable. #Disease severity refers to the percentage of leaf area affected (%LAA) by disease. ^AUDPC = Area Under Disease Progress Curve, this is based on 8 observations of foliar disease severity (% leaf area affected) between GS15 and GS55. *PGM = Partial gross margin, this was calculated using barley MALT 1 cash prices ($298/t) from *The Weekly Times*, 11 December 2024, Wycheproof. This calculation does not include fungicide and application costs and is based on the yields presented in this table.

Trial 5: Barley under various fungicide applications and timings

This trial involved two barley varieties, Maximus CL and RGT Planet, treated with various fungicide application timings (Table 3). These varieties were selected for their resistance ratings. Since statistical analysis showed no significant variety effect, the data from both varieties was combined for analysis.

Disease presence across treatments

Throughout the trial, SFNB appeared early in the season (GS31–GS39), while NFNB became more prominent by mid-season. Late-season assessments (GS55 and two weeks post-GS55) revealed a combination of SFNB, NFNB, and scald across most plots. Fungicide treatments significantly reduced disease progression (p<.001) (Table 9). The Nil control (Treatment i) recorded the highest AUDPC (273), while dual fungicide combinations, GS15+GS39 (Treatment vii) and GS31+GS39 (Treatment viii), achieved significantly lower AUDPC values of 176 and 170 respectively, indicating enhanced disease control (Table 9). Despite this, complete suppression of disease was not achieved.

Yield and fungicide timing

Due to low rainfall during the growing season, disease pressure was minimal and did not significantly affect yield (Table 9). In years where disease does not limit yield, the cost of production can be increased by unnecessary fungicide applications, as reflected in several negative profit margins shown in Table 9.

Table 9. Effect of fungicide treatment (Table 3) on foliar disease severity, grain yield and partial gross margins of barley (mean of two barley varieties) at Nullawil during 2024 (Trial 5).

Treatments		AUDPC^	Grain yield (t/ha)	PGM ($/ha)*	Profit difference ($/ha)†
i)	Nil control	***273***	4.14	1234	0
ii)	Systiva	243	4.30	1254	20
iii)	GS15	204	***4.11***	1209	-25
iv)	GS31	188	4.24	1220	-14
v)	GS39	229	***4.38***	***1278***	44
vi)	Systiva+GS39	217	4.22	1204	-30
vii)	GS15+GS39	176	4.33	1248	14
viii)	GS31+GS39	***170***	4.21	1184	-50
ix)	Systiva+GS31+GS39	192	4.22	***1160***	-74
	Sig. diff.	**<.001**	**NS**		
	LSD (P=0.05)	**44.8**	**NS**		

Values that are bold and italicised represent the lowest and highest values for that variable. ^AUDPC = Area Under Disease Progress Curve, this is based on 8 observations of foliar disease severity (% leaf area affected) between GS15 and GS55. *PGM = Partial gross margin, this was calculated using barley MALT 1 cash prices ($298/t) from *The Weekly Times*, 11 December 2024, Wycheproof. This calculation includes fungicide and application costs and is based on the yields presented in this table. †Profit difference refers to the difference between the treatment and nil control.

Trial 6: Barley fungicide strategy

This trial involved two barley varieties, Maximus CL and RGT Planet, treated with various fungicide strategies (Table 4). These varieties were selected for their resistance ratings. Since statistical analysis showed no significant variety effect, the data from both varieties was combined for analysis.

Disease severity

Low disease pressure was observed throughout the trial, and no significant differences in disease severity and AUDPC were detected between treatments (Table 10). This outcome reflects the dry seasonal conditions, indicating that in a low-pressure disease environment, disease impacts were minimal across all treatments.

Grain yield and economic outcomes

Grain yield did not vary significantly between treatments (Table 10). The Nil control (Treatment i) achieved the highest PGM at $1424/ha, suggesting the economic benefit of applying fungicides was limited (Table 10) under the dry conditions experienced in 2024. These results indicate that reducing fungicide inputs during seasons with low disease pressure may optimise profitability without compromising yield.

Table 10. Effect of fungicide treatment (Table 4) on disease severity, grain yield and partial gross margins of barley (mean of two barley varieties) at Nullawil during 2024 (Trial 6).

Treatment		Disease severity (%LAA) 2 weeks post GS55 spray#	AUDPC^	Grain yield (t/ha)	PGM ($/ha)*	Profit difference ($/ha)†
i)	Nil	11	191	4.78	***1424***	0
ii)	Triazole only	***21***	179	4.76	1397	-27
iii)	Mid-range 1	10	***159***	4.84	1412	-12
iv)	Mid-range 2	10	***248***	***4.54***	***1314***	-110
ix)	Expensive	***9***	163	4.85	1398	-26
v)	Full control	10	166	***4.89***	1392	-32
	Sig. diff.	**NS**	**NS**	**NS**		
	LSD (P=0.05)	**NS**	**NS**	**NS**		

Growth stage according to Zadoks scale, GS55=head emergence. Values that are bold and italicised represent the lowest and highest values for that variable. #Disease severity refers to the percentage of leaf area affected (%LAA) by disease. ^AUDPC = Area Under Disease Progress Curve, this is based on 8 observations of foliar disease severity (% leaf area affected) between GS15 and GS55. *PGM = Partial gross margin, this was calculated using barley MALT 1 cash prices ($298/t) from *The Weekly Times*, 11 December 2024, Wycheproof. This calculation includes fungicide and application costs and is based on the yields presented in this table. †Profit difference refers to the difference between the treatment and nil control.

COMMERCIAL PRACTICE AND ON-FARM PROFITABILITY

Research into disease management remains critical, even during dry seasons like 2024, as it highlights the economic risks of unnecessary fungicide applications and reinforces the importance of tailoring fungicide decisions to crop variety and seasonal conditions. Consistent with the findings from BCG's 2023 disease trials, variety selection and timely fungicide applications are key to effective disease control, with wheat exhibiting greater sensitivity to fungicide timing than barley (Jones and Plowman, 2023). Protecting the critical money leaves, flag-3, flag-2, flag-1, and the flag leaf, during GS31 to GS39 proved pivotal in wheat. These leaves play a crucial role in grain fill, and fungicide applications at these stages had the most significant impact on yield and partial gross margins.

The dry conditions of 2024 reduced disease pressure, highlighting that fungicide applications may not always be necessary, particularly for less susceptible varieties. In low-disease years, minimising or avoiding fungicide use can enhance profitability. Conversely, during wetter seasons with higher disease risk, such as 2022, well-timed fungicide applications are essential for protecting yield (Dadu et al., 2022). Research by Agriculture Victoria and BCG in the southern Mallee demonstrated that foliar diseases could reduce wheat yields by up to 50 per cent under conducive conditions. However, these losses were mitigated through varietal selection and timely fungicide applications (Dadu et al., 2022). Similarly, Agriculture Victoria and BCG studies from 2016 and 2017 revealed barley yield losses due to SFNB of 17 per cent and 10 per cent, respectively, emphasising the importance of effective disease management during conducive seasons (McLean et al., 2022).

Avoiding unnecessary fungicide use during dry seasons also helps preserve the longevity of available fungicide options. Fungicide resistance is an increasing concern nationally, and the Australian Fungicide Resistance Extension Network (AFREN) emphasises the importance of reducing fungicide use when possible. For more information on fungicide resistance, go to the website <www.afren.com.au>.

Overall, strategic and adaptable disease management is essential for optimising profitability. While intensive fungicide regimes offered little economic benefit in 2024, continued research across diverse seasonal conditions will further refine best-practice guidelines for wheat and barley growers in the southern Mallee.

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OPTIMISING DISEASE CONTROL IN NORTH CENTRAL CEREAL CROPS

Meg Conlan, Dr Yolanda Plowman, Casey Sim (BCG), and Grant Hollaway (Astute Ag)

TAKE HOME MESSAGES

- Avoiding highly susceptible varieties is a valuable component of an integrated disease management strategy.
- Making in-crop fungicide decisions that factor in seasonal conditions, variety susceptibility and disease levels in a paddock can reduce fungicide inputs in low-risk situations.
- In low disease pressure seasons, minimal fungicide use, combined with resistant varieties, can reduce costs without compromising profitability and reduce risks associated with fungicide resistance.

BACKGROUND

In the North Central region, the need for in-crop disease management in cereal crops is influenced by seasonal conditions, crop variety, and paddock history. Effective disease management strategies are essential for minimising yield losses during seasons with high disease pressure, while avoiding unnecessary fungicide applications in low-pressure years to reduce costs, without compromising profitability. Poorly timed or excessive fungicide applications can lead to significant yield penalties in high-risk seasons or unnecessary expenses when disease pressure is low.

Cereal crops in the North Central region are commonly affected by multiple foliar diseases. Septoria tritici blotch and stripe rust are prevalent in wheat, while barley is frequently impacted by spot form of net blotch (SFNB) and net form of net blotch (NFNB).

Trials conducted during 2023, the first year of this two-year GRDC project, were disrupted by kangaroo grazing. Incorporating feedback from local growers, the 2024 trials aimed to assess disease impacts and yield losses in cereal varieties with different resistance levels. These trials also evaluated various fungicide timings and product options, offering practical insights to enhance disease management strategies for growers in the North Central.

AIM

This study aimed to enhance cereal disease management in the North Central region by:

- Assessing how various wheat and barley varieties with differing disease resistance ratings performed during the 2024 season.
- Identifying the most effective timings for fungicide application to control disease.
- Evaluating the effectiveness and economic viability of different fungicide options for disease control.

PADDOCK DETAILS

Location:	Mitiamo
Crop year rainfall (Nov–Oct):	467mm
GSR (Apr–Oct):	202mm
Soil type:	0–70cm clay, 70–100cm silty clay loam
Paddock history:	Oats

TRIAL DETAILS

Crop type/s:	Wheat and barley
Treatments:	Refer to Tables 2, 3, and 4
Target plant density:	130 plants/m^2
Seeding equipment:	Knife points, press wheels, 30cm row spacing
Sowing date:	23 May 2024
Replicates:	Four
Harvest date:	5 December 2024

TRIAL INPUTS

Nutrition, weeds and insects were managed as per best practice.

METHOD

Six trials were set up at Mitiamo, in the North Central region, with three each dedicated to wheat and barley. The trials investigated different varieties, fungicide timings, and fungicide options. Varieties of wheat and barley with varying resistance ratings were sown (Table 1, Trials 1 and 4) and treated with either a high (nil control) or low (full control) disease treatment (Table 2). Trials with wheat varieties Scepter and LRPB Matador (Trials 2 and 3) and barley varieties Maximus CL and RGT Planet (Trials 5 and 6), examined different fungicide timing applications (Table 3) and fungicide options (Table 4).

All trials were set up using randomised complete block designs with four replicates. Assessments included disease severity, establishment counts, and yield parameters. Disease severity was visually assessed by estimating the percentage of leaf area affected by disease on eight occasions during the season, from GS15 to GS55. These severity estimates were then used to calculate the Area Under the Disease Progression Curve (AUDPC), providing a cumulative measure of disease severity over time (Brown and Keane, 1997).

Table 1. Disease resistance ratings[1] for wheat and barley varieties used in the North Central region disease management trials (1 and 4) during 2024.

Disease	Variety					
	Wheat					
	Scepter	Ballista	Vixen	Valiant	Matador	Sunblade
Septoria tritici blotch	S	SVS	S	MSS	S (P)	S
Leaf rust	MSS	S	SVS	S	MSS	MSS
Stripe rust	MSS	MSS	SVS	S	MS	MRMS
	Barley					
	Combat	Maximus	Commodus	Planet	Titan	Neo
Spot form of net blotch	RMR	MS	MSS	SVS	MS	MR (P)
Net form of net blotch	MRMS	MRMS	MSS	SVS	MS	MS (P)
Leaf scald	S	SVS	SVS	SVS	VS	S (P)

MR=moderately resistant, MRMS=moderately resistant to moderately susceptible, MS=moderately susceptible, MSS=moderately susceptible to susceptible, S=susceptible, SVS=susceptible to very susceptible, VS=very susceptible, P=provisional. [1]Disease ratings were sourced from the GRDC's National Variety Trials.

Table 2. Fungicide treatments, active ingredients, application timings and rates for wheat and barley 'variety' trials (Trials 1 and 4) in the North Central region during 2024.

Treatment		Product	Active ingredient	Timing	Rate
Wheat					
i)	High disease	No fungicide	-	-	-
ii)	Low disease	Flutriafol	Flutriafol	Sowing	400mL/100kg fertiliser
		Aviator Xpro	150g/L Prothioconazole, 75g/L Bixafen	GS31	500mL/ha
		Maxentis	133g/L Azoxystrobin, 100g/L Prothioconazole	GS39	600mL/ha
		Prosaro	210g/L Prothioconazole, 210g/L Tebuconazole	GS55	300mL/ha
Barley					
i)	High disease	No fungicide	-	-	-
ii)	Low disease	Systiva	333g/L Fluxapyroxad	Sowing	150mL/100kg seed
		Aviator Xpro	150g/L Prothioconazole, 75g/L Bixafen	GS31	500mL/ha
		Maxentis	133g/L Azoxystrobin, 100g/L Prothioconazole	GS39	400mL/ha
		Prosaro	210g/L Prothioconazole, 210g/L Tebuconazole	GS55	300mL/ha

Growth stage according to Zadoks scale, GS15=seedling growth, GS31=stem elongation, GS39=flag leaf emergence, GS55=head emergence (Zadoks, et al. 1974).

Table 3. Fungicide treatments, active ingredients, application timings and rates for wheat and barley 'fungicide application timing' trials (Trials 2 and 5) in the North Central region, during 2024.

Treatment/product		Active ingredient	Timing	Rate
Wheat				
i)	Nil control	-	-	-
ii)	Flutriafol	Flutriafol	Sowing	400mL/100kg fertiliser
iii)	Proviso	250g/L Prothioconazole	GS15	190mL/ha
iv)	Aviator Xpro	150g/L Prothioconazole, 75g/L Bixafen	GS31	500mL/ha
v)	Maxentis	133g/L Azoxystrobin, 100g/L Prothioconazole	GS39	400mL/ha
vi)	Flutriafol	Flutriafol	Sowing	400mL/100kg fertiliser
	Maxentis	133g/L Azoxystrobin, 100g/L Prothioconazole	GS39	400mL/ha
vii)	Proviso	250g/L Prothioconazole	GS15	190mL/ha
	Maxentis	133g/L Azoxystrobin, 100g/L Prothioconazole	GS39	400mL/ha
viii)	Aviator Xpro	150g/L Prothioconazole, 75g/L Bixafen	GS31	500mL/ha
	Maxentis	133g/L Azoxystrobin, 100g/L Prothioconazole	GS39	400mL/ha
ix)	Flutriafol	Flutriafol	Sowing	400mL/100kg fertiliser
	Aviator Xpro	150g/L Prothioconazole, 75g/L Bixafen	GS31	500mL/ha
	Maxentis	133g/L Azoxystrobin, 100g/L Prothioconazole	GS39	600mL/ha
Barley				
i)	Nil control	-	-	-
ii)	Systiva	333m/L Fluxapyroxad	Sowing	150mL/100kg seed
iii)	Proviso	250g/L Prothioconazole	GS15	190mL/ha
iv)	Aviator Xpro	150g/L Prothioconazole, 75g/L Bixafen	GS31	500mL/ha
v)	Maxentis	133g/L Azoxystrobin, 100g/L Prothioconazole	GS39	400mL/ha
vi)	Systiva	333m/L Fluxapyroxad	Sowing	150mL/100kg seed
	Maxentis	133g/L Azoxystrobin, 100g/L Prothioconazole	GS39	400mL/ha
vii)	Proviso	250g/L Prothioconazole	GS15	190mL/ha
	Maxentis	133g/L Azoxystrobin, 100g/L Prothioconazole	GS39	400mL/ha
viii)	Aviator Xpro	150g/L Prothioconazole, 75g/L Bixafen	GS31	500mL/ha
	Maxentis	133g/L Azoxystrobin, 100g/L Prothioconazole	GS39	400mL/ha
ix)	Systiva	333m/L Fluxapyroxad	Sowing	150mL/100kg seed
	Aviator Xpro	150g/L Prothioconazole, 75g/L Bixafen	GS31	500mL/ha
	Maxentis	133g/L Azoxystrobin, 100g/L Prothioconazole	GS39	400mL/ha

Growth stage according to Zadoks scale, GS15=seedling growth, GS31=stem elongation, GS39=flag leaf emergence, GS55=head emergence.

Table 4. Fungicide treatments, active ingredients, application timings and rates for wheat and barley 'fungicide strategy' trials (Trials 3 and 6) in the North Central region during 2024.

Treatment		Product	Active ingredient	Timing	Rate (mL/ha)
Wheat					
i)	Nil control	No fungicide	-	-	-
ii)	Triazole only	Epoxyconazole 125	125g/L Epoxyconazole	GS31	500
		Prosaro	210g/L Prothioconazole, 210g/L Tebuconazole	GS39	300
iii)	Mid-range 1	Epoxyconazole 125	125g/L Epoxyconazole	GS31	500
		Maxentis	210g/L Prothioconazole, 210g/L Tebuconazole	GS39	400
iv)	Mid-range 2	Maxentis	133g/L Azoxystrobin, 100g/L Prothioconazole	GS31	600
		Epoxyconazole 125	125g/L Epoxyconazole	GS39	500
v)	Expensive	Elatus Ace	40g/L Benzovindiflupyr, 250g/L Propiconazole	GS31	500
		Maxentis	133g/L Azoxystrobin, 100g/L Prothioconazole	GS39	400
vi)	Full control	Elatus Ace	40g/L Benzovindiflupyr, 250g/L Propiconazole	GS31	500
		Maxentis	133g/L Azoxystrobin, 100g/L Prothioconazole	GS39	400
		Prosaro	210g/L Prothioconazole, 210g/L Tebuconazole	GS55	300
Barley					
i)	Nil control	No fungicide	-	-	-
ii)	Triazole only	Propiconazole 250	250g/L Propiconazole	GS31	500
		Proviso	133g/L Azoxystrobin, 100g/L Prothioconazole	GS39	250
iii)	Mid-range 1	Propiconazole 250	250g/L Propiconazole	GS31	500
		Maxentis	133g/L Azoxystrobin, 100g/L Prothioconazole	GS39	400
iv)	Mid-range 2	Maxentis	133g/L Azoxystrobin, 100g/L Prothioconazole	GS31	600
		Proviso	133g/L Azoxystrobin, 100g/L Prothioconazole	GS39	250
v)	Expensive	Elatus Ace	40g/L Benzovindiflupyr, 250g/L Propiconazole	GS31	500
		Maxentis	133g/L Azoxystrobin, 100g/L Prothioconazole	GS39	400
vi)	Full control	Elatus Ace	40g/L Benzovindiflupyr, 250g/L Propiconazole	GS31	500
		Maxentis	133g/L Azoxystrobin, 100g/L Prothioconazole	GS39	400
		Prosaro	210g/L Prothioconazole, 210g/L Tebuconazole	GS55	300

Growth stage according to Zadoks scale, GS15=seedling growth, GS31=stem elongation, GS39=flag leaf emergence, GS55=head emergence.

RESULTS AND INTERPRETATION

Seasonal conditions and diseases present

Mitiamo received 202mm (Decile 4) of rainfall during the growing season, leading to dry seasonal conditions and overall low disease pressure. Despite the dry conditions, Septoria and stripe rust were observed in wheat, while barley was mostly affected by spot form of net blotch (SFNB) and some net form of net blotch (NFNB).

Trial 1: Wheat varieties with and without disease

Disease presence and resistance rating alignment

Significant variation was observed in disease severity (both post GS55 and AUDPC) between varieties and treatments (Table 5). Low disease treatments consistently had lower disease (p<.001) and AUDPC (p<.001) compared to high disease treatments, with the largest differences observed in highly susceptible varieties such as Valiant CL Plus and Vixen. Valiant CL Plus exhibited a high AUDPC (86) and disease severity (25 per cent) under high disease treatments, resulting in a substantial cost of disease ($104/ha) (Table 5). In contrast, Sunblade CL Plus, which is less commonly grown in this region and has a moderate resistance rating (MRMS), showed low AUDPC and minimal cost of disease, indicating strong alignment with its resistance profile. These findings reinforce the importance of variety choice in building strategies for disease suppression, even in dry seasons.

Disease effects and yield

Statistically significant differences in yield were observed between low and high disease treatments across varieties (p<.001), indicating that disease negatively impacted grain yield (Table 5). The extent of yield loss varied by variety, with the highest losses recorded in Valiant CL Plus (18 per cent) and Ballista (16 per cent), with the lowest in Sunblade CL Plus (2 per cent) and LRPB Matador (6 per cent) (Table 5). A clear relationship emerged between the disease ratings of varieties and their yield response to disease, with more resistant varieties, such as Sunblade CL Plus and LRPB Matador, showing smaller yield losses. In contrast, highly susceptible varieties like Valiant CL Plus experienced the greatest yield penalties due to disease.

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Table 5. Effect of foliar disease level (Table 2) on disease severity, grain yield, and partial gross margins of wheat varieties with contrasting resistance/susceptibility to disease (Table 1) at Mitiamo during 2024 (Trial 1).

Variety	Treatment	Disease severity (%LAA) 2 weeks post GS55 spray#	AUDPC^	Grain yield (t/ha)	PGM ($/ha)*	Cost of disease ($/ha)
Ballista	Low disease	3	19	2.11	634	-
	High disease	9	42	1.78	537	97
LRPB Matador	Low disease	***2***	***18***	***2.44***	***736***	-
	High disease	6	36	2.30	691	45
Scepter	Low disease	3	21	2.19	658	-
	High disease	11	57	2.01	604	54
Sunblade CL Plus	Low disease	***2***	18	1.85	556	-
	High disease	6	28	1.82	547	9
Valiant CL Plus	Low disease	5	29	1.91	576	-
	High disease	***25***	86	***1.57***	***472***	104
Vixen	Low disease	3	27	2.28	686	-
	High disease	11	***111***	2.02	609	77
	Sig. diff.					
	Variety	**<.001**	**<.001**	**<.001**		
	Treatment	**<.001**	**<.001**	**<.001**		
	Variety x treatment	**0.007**	**0.005**	**0.025**		
	LSD (P=0.05)					
	Variety	**4.5**	**19.7**	**0.097**		
	Treatment	**2.6**	**11.4**	**0.057**		
	Variety x treatment	**6.4**	**27.8**	**0.139**		

Growth stage according to Zadoks scale, GS55=head emergence. Values that are bold and italicised represent the lowest and highest values for that trait. #Disease severity refers to the percentage of leaf area affected (%LAA) by disease. ^AUDPC = Area Under Disease Progress Curve, based on 8 observations of foliar disease severity (% leaf area affected) between GS15 and GS55. *PGM = Partial Gross Margin, calculated using wheat AGP cash prices ($301/t) from *The Weekly Times*, 11 December 2024, Elmore. This calculation does not include fungicide and application costs and is based on the yields presented in this table.

Trial 2: Wheat under various fungicide applications and timings

This trial involved two wheat varieties, Scepter and LRPB Matador, treated with various fungicide application timings (Table 3). These varieties were selected for their resistance ratings. Since statistical analysis showed no significant variety effect, the data from both varieties was combined for analysis.

Disease presence across treatments

Fungicide application treatments significantly reduced disease severity, with the most intensive treatment, Flutriafol+GS31+GS39 (Treatment ix), achieving the lowest disease severity at 4 per cent (p=0.004) and an AUDPC of 28 (p=0.013) (Table 6). Both stripe rust and Septoria were observed across all treatments. Early signs of Septoria appeared two weeks after the GS31 spray, with both stripe rust and Septoria becoming more prominent two weeks post-GS39. By GS55 and beyond, stripe rust was present in all plots, underscoring its widespread nature. Treatments involving multiple fungicide applications, particularly those including GS39, demonstrated greater efficacy in suppressing disease compared to single-application treatments or the Nil control (Treatment i).

Yield and fungicide timing

Fungicide treatments significantly impacted grain yield (*p*=0.001) (Table 6). The highest yield, 2.38t/ha, was achieved with Flutriafol+GS31+GS39 (Treatment ix), representing an 11 per cent yield increase compared to the Nil control (Treatment i) (2.15t/ha). Other multiple-application treatments, such as GS15+GS39 (Treatment vii) at 2.34t/ha and GS31+GS39 (Treatment viii) at 2.27t/ha, also resulted in notable yield improvements. However, despite these yield gains, many fungicide treatments led to reduced PGMs due to higher input costs. For instance, while Flutriafol+GS31+GS39 (Treatment ix) produced the highest yield, its PGM was $617/ha, $30/ha lower than the Nil control (Treatment i) ($647/ha) (Table 6). These findings highlight that in years of low disease pressure, intensive fungicide strategies may not deliver positive economic returns, emphasising the importance of balancing yield gains with the associated costs of fungicide applications.

Table 6. Effect of fungicide treatments (Table 3) on foliar disease severity, grain yield and partial gross margins of wheat (mean of two wheat varieties) at Mitiamo during 2024 (Trial 2).

Treatment		Disease severity (%LAA) 2 weeks post GS55 spray[#]	AUDPC^	Grain yield (t/ha)	PGM ($/ha)*	Profit difference ($/ha)[†]
i)	Nil	***11***	***62***	***2.15***	647	0
ii)	Flutriafol	6	39	2.24	654	7
iii)	GS15	10	59	2.26	***665***	18
iv)	GS31	6	38	2.18	613	-34
v)	GS39	6	38	2.18	621	-26
vi)	Flutriafol+GS39	5	33	2.23	616	-31
vii)	GS15+GS39	8	42	2.34	654	7
viii)	GS31+GS39	6	36	2.27	***605***	-42
ix)	Flutriafol+GS31+GS39	***4***	***28***	***2.38***	617	-30
	Sig. diff. **LSD (P=0.05)**	**0.004** **3.6**	**0.013** **19.7**	**0.001** **0.108**		

Growth stage according to Zadoks scale, GS55=head emergence. Values that are bold and italicised represent the lowest and highest values for that trait. [#]Disease severity refers to the percentage of leaf area affected (%LAA) by disease. ^AUDPC = Area Under Disease Progress Curve, based on 8 observations of foliar disease severity (% leaf area affected) between GS15 and GS55. *PGM = Partial Gross Margin, calculated using wheat AGP cash prices ($301/t) from *The Weekly Times*, 11 December 2024, Elmore. This calculation includes fungicide and application costs and is based on the yields presented in this table. [†]Profit difference refers to the difference between the treatment and nil control.

Trial 3: Wheat fungicide strategy

This trial involved two wheat varieties, Scepter and LRPB Matador, treated with various fungicide strategies (Table 4). These varieties were selected for their resistance ratings. Since statistical analysis showed no significant variety effect, the data from both varieties was combined for analysis.

Disease severity

Fungicide treatments significantly reduced disease severity (*p*<.001), with all fungicide strategies outperforming the Nil control (Treatment i) (Table 7). The Nil control also had the highest AUDPC value, however this was not significant.

Grain yield and economic outcomes

Fungicide treatments significantly impacted yield (p=0.013), with the highest yield observed in the Triazole-only (Treatment ii) and Mid-range 1 (Treatment iii) strategies, both producing 2.33t/ha, compared to the Nil (Treatment i), which yielded 2.13t/ha (Table 7). Regarding economic performance, Triazole-only (Treatment ii) provided the highest PGM of $665/ha, followed by Mid-range 1 (Treatment iii) ($656/ha). Conversely, the Expensive (Treatment ix) and Full-control (Treatment v) strategies had the lowest PGMs, at $607/ha and $614/ha (Table 7). These findings emphasise that in seasons with low disease pressure, expensive fungicide regimens do not necessarily result in positive economic outcomes. Targeted and cost-effective fungicide applications, such as Triazole only (Treatment ii) and Mid-range (Treatments iii and iv) strategies, may be more beneficial under such conditions.

Table 7. Effect of fungicide treatment (Table 4) on disease severity, grain yield and partial gross margins of wheat (mean of two wheat varieties) at Mitiamo during 2024 (Trial 3).

Treatment		Disease severity (%LAA) 2 weeks post GS55 spray[#]	AUDPC^	Grain yield (t/ha)	PGM ($/ha)*	Profit difference ($/ha)[†]
i)	Nil	***11***	***85***	***2.13***	641	0
ii)	Triazole only	7	67	***2.33***	***665***	24
iii)	Mid-range 1	6	62	***2.33***	656	14
iv)	Mid-range 2	5	***52***	2.32	644	3
ix)	Expensive	***4***	55	2.21	***607***	-34
v)	Full control	***4***	66	2.29	614	-27
	Sig. diff.	**<.001**	**NS**	**0.013**		
	LSD (P=0.05)	**3.2**	**NS**	**0.124**		

Growth stage according to Zadoks scale, GS55=head emergence. Values that are bold and italicised represent the lowest and highest values for that trait. [#]Disease severity refers to the percentage of leaf area affected (%LAA) by disease. ^AUDPC = Area Under Disease Progress Curve, based on 8 observations of foliar disease severity (% leaf area affected) between GS15 and GS55. *PGM = Partial Gross Margin, calculated using wheat AGP cash prices ($301/t) from *The Weekly Times*, 11 December 2024, Elmore. This calculation includes fungicide and application costs and is based on the yields presented in this table. [†]Profit difference refers to the difference between the treatment and nil control.

Trial 4: Barley varieties with and without disease

Disease presence

SFNB was the predominant disease observed in the trial, however, disease severity and AUDPC values remained low across treatments due to the dry conditions, which restricted disease progression. For instance, Titan AX recorded an AUDPC of 90 under the low disease treatment, compared to 108 under the high disease treatment, with similarly minor differences observed for other varieties (Table 8). These findings indicate limited rainfall had a greater influence on disease progression than varietal resistance.

Disease effects and yield

Barley exhibited lower overall disease severity than wheat, and there were no significant disease impacts on yield in any variety (Table 8). As a result, disease control measures were not warranted in a season like 2024. Although significant treatment effects were observed for disease severity (p=0.002) in all varieties except Combat, these differences did not affect yield, indicating the low disease levels were not yield-limiting. While resistance ratings generally aligned with observed disease levels, their influence was less pronounced under the dry conditions of 2024. These findings reinforce the idea that in low-pressure seasons, growers can prioritise variety selection and reduce fungicide applications, thereby minimising costs without compromising yields.

Table 8. Effect of foliar disease level (Table 2) on disease severity, grain yield and partial gross margins of barley varieties with different resistance/susceptibility to disease (Table 1) at Mitiamo during 2024 (Trial 4).

Variety	Treatment	Disease severity (%LAA) 2 weeks post GS55 spray#	AUDPC^	Grain yield (t/ha)	PGM ($/ha)*	Cost of disease ($/ha)
Combat	Low disease	***1***	112	***4.23***	***1274***	-
	High disease	***1***	101	3.89	1170	104
Commodus CL	Low disease	2	92	***3.49***	***1051***	-
	High disease	3	115	3.52	1059	-8
Maximus CL	Low disease	2	117	3.59	1081	-
	High disease	3	137	3.57	1074	7
Neo CL	Low disease	***1***	115	4.00	1205	-
	High disease	4	121	3.85	1157	48
RGT Planet	Low disease	3	159	3.79	1142	-
	High disease	***6***	***169***	3.77	1135	7
Titan AX	Low disease	***1***	***90***	3.91	1176	-
	High disease	3	108	3.84	1157	19
	Sig. diff.					
	Variety	**0.005**	**0.005**	**0.036**		
	Treatment	**0.002**	**NS**	**NS**		
	Variety x treatment	**NS**	**NS**	**NS**		
	LSD (P=0.05)					
	Variety	**1.6**	**33.8**	**0.369**		
	Treatment	**0.9**	**NS**	**NS**		
	Variety x treatment	**NS**	**NS**	**NS**		

Growth stage according to Zadoks scale, GS55=head emergence. Values that are bold and italicised represent the lowest and highest values for that trait. #Disease severity refers to the percentage of leaf area affected (%LAA) by disease. ^AUDPC = Area Under Disease Progress Curve, based on 8 observations of foliar disease severity (% leaf area affected) between GS15 and GS55. *PGM = Partial Gross Margin, calculated using barley BAR2 cash prices ($301/t) from *The Weekly Times*, 11 December 2024, Elmore. This calculation does not include fungicide and applications costs and is based on the yields presented in this table.

Trial 5: Barley under various fungicide application timings

This trial involved two barley varieties, Maximus CL and RGT Planet, treated with various fungicide application timings (Table 3). These varieties were selected for their resistance ratings. Since statistical analysis showed no significant variety effect, the data from both varieties was combined for analysis.

Yield and fungicide timing

Disease development in this trial was limited, with no significant treatment effects observed on disease severity (AUDPC) or grain yield (Table 9). These findings suggest that during dry seasons with low disease pressure, in-crop fungicide applications are not warranted.

Table 9. Effect of fungicide treatment (Table 3) on foliar disease severity and grain yield of barley (mean of two barley varieties) at Mitiamo during 2024 (Trial 5).

Treatments		AUDPC^	Grain yield (t/ha)
i)	Nil Control	***122***	***3.43***
ii)	Systiva	143	3.51
iii)	GS15	130	3.51
iv)	GS31	134	***3.84***
v)	GS39	141	3.74
vi)	Systiva+GS39	126	3.50
vii)	GS15+GS39	124	3.45
viii)	GS31+GS39	135	3.56
ix)	Systiva+GS31+GS39	***154***	3.56
	Sig. diff.	**NS**	**NS**
	LSD (P=0.05)	**NS**	**NS**

Values that are bold and italicised represent the lowest and highest values for that trait. ^AUDPC = Area Under Disease Progress Curve, based on 8 observations of foliar disease severity (% leaf area affected) between GS15 and GS55.

Trial 6: Barley fungicide strategy

This trial involved two barley varieties, Maximus CL and RGT Planet, treated with various fungicide strategies (Table 4). These varieties were chosen for their resistance ratings. Since statistical analysis showed no significant variety effect, the data from both varieties was combined for analysis.

Disease severity

No significant differences were observed in disease severity and AUDPC in the fungicide treatments, with all strategies maintaining a consistently low disease severity of 2 per cent at two weeks post-GS55 spray (Table 10).

Grain yield and economic outcomes

Grain yield differences were also not significant, ranging from 3.42t/ha in the Nil control (Treatment i) to 3.64t/ha in the Triazole-only (Treatment ii) strategy (Table 10). These results suggest that in a low disease pressure season, intensive fungicide regimes offer limited economic benefit. Instead, minimal fungicide strategies, such as Triazole-only (Treatment ii), were more cost-effective, highlighting the importance of tailoring fungicide use to seasonal conditions.

Table 10. Effect of fungicide treatment (Table 4) on disease severity, grain yield and partial gross margins of barley (mean of two barley varieties) at Mitiamo during 2024 (Trial 6).

Treatment		Disease severity (%LAA) 2 weeks post GS55 spray#	AUDPC^	Grain yield (t/ha)	PGM ($/ha)*	Profit difference ($/ha)†
i)	Nil	2	116	***3.42***	1029	0
ii)	Triazole only	2	***129***	***3.64***	1099	***70***
iii)	Mid-range 1	2	118	3.62	1059	30
iv)	Mid-range 2	2	***114***	3.49	1012	-17
v)	Expensive	2	115	3.54	1018	-11
vi)	Full control	2	120	3.60	1018	-11
	Sig. diff.	**NS**	**NS**	**NS**		
	LSD (P=0.05)	**NS**	**NS**	**NS**		

Growth stage according to Zadoks scale, GS55=head emergence. Values that are bold and italicised represent the lowest and highest values for that trait. #Disease severity refers to the percentage of leaf area affected (%LAA) by disease. ^AUDPC = Area Under Disease Progress Curve, based on 8 observations of foliar disease severity (% leaf area affected) between GS15 and GS55. *PGM = Partial Gross Margin, calculated using barley BAR2 cash prices ($301/t) from *The Weekly Times*, 11 December 2024, Elmore. This calculation includes fungicide and application costs and is based on the yields presented in this table. †Profit difference refers to the difference between the treatment and nil control.

COMMERCIAL PRACTICE AND ON-FARM PROFITABILITY

Effective disease management remains crucial, even in dry seasons like 2024, as it highlights the economic risks of unnecessary fungicide applications. These trials demonstrated that under low disease pressure, intensive fungicide strategies are often unwarranted as they add to production costs without improving profitability. A strategic, minimal fungicide approach, tailored to disease levels as determined through crop monitoring, can effectively maintain yields while reducing input costs. Avoiding highly susceptible varieties also emerged as a key strategy, significantly reducing disease risk even under dry conditions.

Fungicide applications improved wheat yields, however the additional input costs often outweighed the financial benefits, emphasising the need to balance fungicide expenditure against potential gains. Barley trials showed even less justification for intensive fungicide use, with negligible disease and yield differences across treatments.

Variety selection was shown to play a pivotal role in disease suppression and economic performance. Resistant varieties consistently exhibited lower disease severity and smaller yield losses, reinforcing the value of selecting less susceptible cultivars as part of an integrated disease management strategy. Studies on disease management have consistently demonstrated the advantages of avoiding highly susceptible cultivars to reduce disease severity and prevent yield losses (McLean and Hollaway, 2018; Cook et al., 2024).

Reducing fungicide reliance is also vital for managing resistance in key diseases, such as Septoria and net blotches. Overuse of fungicides accelerates resistance development, threatening the long-term effectiveness of these tools. The Australian Fungicide Resistance Extension Network (AFREN) emphasises the importance of reducing fungicide use where possible. For more information, go to the website <www.afren.com.au>.

Overall, strategic and adaptable disease management is essential for optimising profitability. While intensive fungicide regimes provided little economic benefit in 2024, ongoing research across varying seasonal conditions will help further refine best-practice guidelines for wheat and barley growers in the North Central region.

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