

Variety selection key to reduce the losses from *Septoria tritici* blotch (STB) in wheat during a high-pressure season

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Background

Septoria tritici blotch (*Zymoseptoria tritici*, STB), a stubble borne fungal disease of wheat, is widespread and damaging in the Victorian and South Australian HRZ where susceptible cultivars are grown. In recent years, it has also become widespread across Victoria's medium (MRZ) and low (LRZ) rainfall zones. During 2021, AgVic and BCG trials demonstrated less than 10% yield loss in the MRZ and no yield loss in the LRZ in susceptible cultivars.

Disease pressure was extreme during 2022 due to a combination of the amount and frequency of rainfall from August to November which provided ideal conditions for disease development. This resulted in a damaging outbreak of STB in all regions of Victoria and caused yield losses where control was insufficient.

To determine the impact of STB and identify best management practices in the MRZ and LRZ, GRDC is has invested in research led by Agriculture Victoria in partnership with the South Australia Research and Development Institute (SARDI). This report discusses the benefits of variety selection and proactive management strategies during a high-pressure year. This article reports on four experiments conducted in different regions of Vic and SA during 2022.

Aim

To evaluate the impact of *Septoria tritici* blotch on wheat of different resistant ratings and determine yield loss in the MRZ and LRZ of the Southern Australia

Methods

Four field experiments were conducted during 2022 to evaluate yield and quality loss in wheat cultivars with contrasting resistance/susceptibility to STB. One experiment each was conducted in the MRZ and LRZ regions of both Victoria and South Australia (4 experiments total). Each experiment had six commercial wheat varieties with different resistance/susceptibility to STB. Two treatments: 1) Maximum disease and 2) Minimum disease were applied to each wheat variety with six replications and arranged in split plot designs with treatment considered as the main plot and varieties as subplots.

Plots were visually assessed for STB severity on multiple occasions during the growing season. Grain was harvested at the end of season using a plot harvester. A sub-sample from each plot was used for grain

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quality testings such as protein percentage, screenings (percentage of grain less than 2.2 mm in width), retentions (percentage of grain greater than 2.5 mm width) and grain weight. All data was analysed by ANOVA using Genstat.

Trial details

Locations:

Location	Rainfall zone	Soil type	Growing season rainfall (mm)
Longerenong (VIC)	MRZ	Clay	547
Hart (SA)	MRZ	Clay loam	417
Nullawil (VIC)	LRZ	Clay	427
Booleroo (SA)	LRZ	Red loam	381

Treatments:

1. Minimum disease – No stubble, Seed + foliar applied fungicides at Z31 and Z39
2. Maximum disease - No disease control with 1 Kg STB infected wheat stubble or inoculated with spore inoculum at a concentration of > 10,000 spores/mL

Varieties:

Variety	Rating ^A
LRPB Lancer	MS
Hammer CL Plus	MSS
Scepter	S
Calibre	S
Razor CL Plus	SVS
LRPB Impala	SVS

^AHollaway and McLean (2022) Cereal Disease Guide 2022

Trial design: Split plot design

Replicates: 6

Sowing and harvest details:

Location	Rainfall zone	Sowing date	Sowing rate (plants/m ²)	Harvest date	Trial average yield (t/ha)
Longerenong (VIC)	MRZ	28 th April 2022	150	17 th December 2022	3.3
Hart (SA)	MRZ	5 th May 2022	150	25 th November 2022	3.4
Nullawil (VIC)	LRZ	4 th May 2022	150	15 th December 2022	2.9
Booleroo (SA)	LRZ	21 st June 2022	150	18 th December 2022	5.2

Trial inputs: UREA and MAP applied and managed as per best practice and kept weed and pest free.

Chemical applications:

Fungicide application timing	Product	Active ingredient (gai/L) [#]	Rate
Seed	Jockey Stayer [®]	Fluquinconazole 167g/L	300 mL/100 Kg seed
Foliar at Z31	Elatus Ace [®]	Benzovindiflupyr 40g/L Propiconazole 250 g/L	+ 500 mL/ha
Foliar at Z39	Soprano [®]	Epoconazole 500 g/L	125 mL/ha

[#] gai = grams active ingredient

Results

Severe STB developed at three trial sites which reduced grain yield by 8 – 43% or 0.26-1.73 t/ha (Tables 1, 3 & 5). In addition, STB infection caused significant reductions in grain quality of all the varieties at Longerenong (MRZ) and in susceptible varieties at Hart (MRZ) and Booleroo (LRZ) which increased screenings, reduced retentions and reduced seed weight (Tables 2, 4 & 6). At Nullawil, Vic (LRZ), a heavy infestation of stripe rust at the site compromised the ability to draw conclusions on the yield impact of STB (Appendix 1). However, based on the extent of STB development measured at this site it is unlikely that significant yield losses due to STB would have occurred at the site.

During 2022, disease pressure was extreme, the combination of both amount and frequency of rainfall during August to November favoured disease development and caused yield losses. In comparison, the losses were greater than the <10% measured during 2021, demonstrating the role of rainfall in STB infection and the need for proactive management in susceptible cultivars during favourable seasons. The losses also varied with the location and again are reflective of the amount of rainfall received in each location. However, Booleroo (LRZ) showed greater STB severity and yield loss compared to Hart (MRZ), despite receiving more rainfall and more rainy days during the season. This can be attributed to differences in nutrition history between the two sites, higher yield average (5.2 t/ha) was found at Booleroo than at Hart, which only produced 3.4 t/ha on average. Higher nutrition levels particularly

nitrogen often delay crop maturity and make crops more conducive to disease, therefore growers need appropriate disease management strategies where yield potential is higher.

Disease development and yield loss were related to varietal resistance, demonstrating the benefits of avoiding highly susceptible cultivars in the management of STB (Tables 1, 3 & 5). Susceptible to very susceptible varieties, Calibre (S), Scepter (S), and Razor CL Plus (SVS) were worst hit at all the locations. LRPB Impala (SVS) varied in its response to STB infection between Vic and SA (Tables 1, 3 & 5). Severity and yield losses were greater in Vic compared to SA trials suggesting presence of different pathotypes with varied virulence in both states. Continuous monitoring of pathogen populations is required to detect virulence changes and improve integrated disease management strategies for STB accordingly. The losses in less susceptible varieties (LRPB Lancer (MS) or Hammer CL Plus (MSS)) were 21% or less (Tables 1, 3 & 5), but demonstrated that STB needs to be proactively managed during favourable seasons.



Figure 1: Images displaying the symptoms of *Septoria tritici* blotch in Wheat at Hamilton (HRZ), Victoria during 2022. The infection on top three leaves can result in yield reductions.

Table 1: *Septoria tritici* blotch severity (% leaf area affected) and associated grain yield loss of six wheat varieties treated with minimum and maximum disease levels at Longerenong (MRZ), VIC during 2022.

Variety	Rating	Severity (%LAA) ^A in Max. treatment			Grain yield (t/ha)		Yield loss (%) ^D
		07-Aug ^B	05-Sep	18-Oct			
		Z37-39	Z45-59	Z75-77	Min. ^C	Max.	
LRPB Lancer	MS	3 ^a	8 ^a	75 ^a	4.93	4.09**	17
Hammer CL Plus	MSS	10 ^b	21 ^b	88 ^b	4.88	3.87**	21
Calibre	S	14 ^d	34 ^c	98 ^c	5.11	3.33**	35
LRPB Impala	SVS	12 ^c	34 ^c	100 ^c	4.83	3.13**	35

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Sceptre	S	14 ^d	37 ^d	99 ^c	4.8	3.07**	36
Razor CL Plus	SVS	12 ^c	40 ^e	100 ^c	3.98	2.25**	43
P		<0.001	<0.001	<0.001	-	-	-
LSD (0.05)		1.2	1.7	8.9			

^AWithin column means with one letter in common are not significantly different. ** = statistically significant at 5% LSD. ^BDate of assessment made and Zadoks growth stages Z37, flag leaf emergence; Z51, Ear emergence; Z75, Milk development according to Zadoks et al. (1974). First two assessments were average of single plot assessments while the third assessment was average of the top three leaves of ten tillers per plot. ^CMax. = Maximum disease treatment; Min. = Minimum disease treatment. ^DYield loss % for each variety was presented as percentage yield decrease vs the minimum disease treatment.

Table 2: Grain quality of six wheat varieties treated with minimum and maximum levels of STB at Longerenong (MRZ), VIC during 2022.

Variety	Rating	Protein (%)		Screenings (%)		Retention(%)		1000GW	
		Min.	Max. ^A	Min.	Max.	Min.	Max.	Min.	Max.
LRPB Lancer	MS	12	13 ^{ns}	3.6	5.5**	87.8	75.5**	38.5	33.9**
Hammer CL Plus	MSS	12	12 ^{ns}	5.0	10.7**	78.1	59.3**	33.3	29.1 ^{ns}
Scepter	S	11	13**	5.5	15.8**	74.4	45.1**	35.3	27.0**
Calibre	S	11	13**	4.3	7.2**	84.7	70.8**	40.3	32.2**
Razor CL Plus	SVS	12	13**	6.6	11.8*	71.8	55.9**	29.8	27.1 ^{ns}
LRPB Impala	SVS	10	11**	10.1	32.8**	58.0	25.9**	26.8	20.2**

Between minimum and maximum treatments, ** = statistically significant at 5% LSD; * = statistically significant at 1% LSD, ^{ns} = not significant at 5% LSD.

^AMax. = Maximum disease; Min. = Minimum disease

Table 3: Septoria tritici blotch severity (% leaf area affected) and associated grain yield loss of six wheat varieties treated with minimum and maximum disease levels at Hart (MRZ), SA during 2022.

Variety	Rating	Severity (% LAA) in Max. treatment ^A		Grain yield (t/ha)		Yield loss (%) ^D
		19 Sept Z55-71 ^B		Min.	Max. ^C	
LRPB Lancer	MS	10 ^a		3.56	3.41 ^{ns}	-
LRPB Impala	SVS	20 ^{bc}		3.53	3.30 ^{ns}	-
Hammer CL Plus	MSS	12 ^{ab}		3.55	3.24*	8
Calibre	S	20 ^{bc}		3.84	3.50*	9
Razor CL Plus	SVS	26 ^{cd}		3.63	3.25**	11
Scepter	S	30 ^d		3.88	3.41**	12
P		<0.001				
LSD (0.05)		8.9				

^AWithin column means with one letter in common are not significantly different. ^BAverage of ten tillers per plot;

^CMax. = Maximum disease; Min. = Minimum disease; ** = statistically significant at 5% LSD; * = statistically

significant at 1% LSD, ^{ns} = not significant at 5% LSD. ^D Yield loss % for each variety was presented as percentage yield decrease vs the minimum disease treatment.

Table 4: Grain quality of six wheat varieties treated with minimum and maximum levels of STB at Hart (MRZ), SA during 2022.

Variety	Rating	Protein %		Screenings (%)		Test weight (Kg/hL)	
		Min.	Max. ^A	Min.	Max.	Min.	Max.
Hammer CL Plus	MSS	10	10 ^{ns}	2.5	2.7 ^{ns}	82.5 ^{ns}	82.1 ^{ns}
Razor CL Plus	SVS	9	9 ^{ns}	3	3.1 ^{ns}	82.0 ^{ns}	81.9 ^{ns}
Scepter	S	9	10 ^{**}	2.9	3.3 ^{ns}	83.0 ^{ns}	82.8 ^{ns}
LRPB Lancer	MS	9	9 ^{ns}	1.8	2.0 ^{**}	83.2 ^{ns}	82.6 ^{ns}
LRPB Impala	SVS	8	8 ^{ns}	2	2.6 ^{**}	83.3 ^{ns}	82.6 ^{ns}
Calibre	S	10	9 ^{ns}	3.6	3.9 ^{ns}	81.2 ^{**}	79.3 ^{**}

Between minimum and maximum treatments, ** = statistically significant at 5% LSD; * = statistically significant at 1% LSD, ^{ns} = not significant at 5% LSD.

^AMax. = Maximum disease; Min. = Minimum disease

Table 5: Septoria tritici blotch severity (% leaf area affected) and associated grain yield loss of six wheat varieties treated with minimum and maximum disease levels at Booleroo (LRZ), SA during 2022.

Variety	Rating	Severity (% LAA) in Max. treatment ^A	Grain yield (t/ha)		Yield loss (%) ^D
		4 Nov Z55-71 ^B	Min.	Max. ^C	
LRPB Lancer	MS	29 ^a	5.65	5.48 ^{ns}	-
Hammer CL Plus	MSS	63 ^{bc}	6.11	5.42 ^{**}	11
LRPB Impala	SVS	54 ^b	5.92	5.10 ^{**}	14
Razor CL Plus	SVS	83 ^e	6.12	4.89 ^{**}	20
Scepter	S	72 ^{cd}	6.50	5.17 ^{**}	21
Calibre	S	74 ^{de}	6.59	5.09 ^{**}	23
P		<0.001	-	-	-
LSD (0.05)		10.3	-	-	-

^AWithin column means with one letter in common are not significantly different. ^BAverage of ten tillers per plot;

^CMax. = Maximum disease; Min. = Minimum disease; ** = statistically significant at 5% LSD; * = statistically significant at 1% LSD, ^{ns} = not significant at 5% LSD. ^D Yield loss % for each variety was presented as percentage yield decrease vs the minimum disease treatment.

Table 6: Grain quality of six wheat varieties treated with minimum and maximum levels of STB at Booleroo (LRZ), SA during 2022.

Variety	Rating	Protein (%)		Screenings (%)		Test weight (Kg/hL)	
		Min.	Max. ^	Min.	Max.	Min.	Max.
LRPB Lancer	MS	10	10 ^{ns}	1.7	1.9 ^{ns}	80.5	78.4 ^{ns}
Scepter	S	10	10 ^{ns}	1.6	2.0 ^{ns}	80.6	77.4 ^{ns}
Calibre	S	10	10 ^{ns}	2.7	2.6 ^{ns}	75.9	73.6 ^{ns}
LRPB Impala	SVS	10	9 ^{ns}	1.6	1.9 ^{ns}	80.8	79.3 ^{ns}
Razor CL Plus	SVS	10	10 ^{ns}	2.9	4.3*	77.1	74.0*
Hammer CL Plus	MSS	10	10 ^{ns}	1.6	3.4**	80.0	74.6**

Between minimum and maximum treatments, ** = statistically significant at 5% LSD; * = statistically significant at 1% LSD, ^{ns} = not significant at 5% LSD.

^Max. = Maximum disease; Min. = Minimum disease

Conclusion

STB is a common foliar disease of wheat in both the medium and low rainfall zones of Southern Australia. Historically, losses due to STB were most common in susceptible cultivars in the high rainfall zone. However, AgVic and SARDI trials demonstrated that large losses (i.e ~23- 43%) in the susceptible varieties in both the MRZ and LRZ are possible when there are exceptionally wet conditions. In both the states and sites where trials were conducted, 2022 was the wettest August to November period in more than 100 years which created highly favorable conditions for STB development. However, in these experiments the disease development and yield losses were relatively low when susceptible varieties were avoided. Therefore, growing resistant cultivars can greatly reduce the potential impact of this disease even during a high-pressure season.

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Appendix 1:

Summary tables showing yield and quality loss to stripe rust infection in variety selection trial at Nullawil, Vic, 2022

Table A1: Stripe rust severity (% Leaf area affected), head infection and associated yield loss of six wheat varieties with and without disease at Nullawil (BCG), Victoria during 2022

Variety	Stripe rust rating ^A	Stripe rust severity (% leaf area infected) in		Head infection (%)	Grain yield loss (t/ha)		Yield loss (%) ^D
		Max. disease treatment [#]			Max. disease ^C	Min. disease	
		14-Sep Z50-62 ^B	27-Oct Z77	27-Oct Z77			
LRPB Lancer	RMR	1 ^a	7 ^a	3 ^a	3.95	4.37**	10
LRPB Impala	MRMS	5 ^a	7 ^a	7 ^a	3.57	4.24**	16
Razor CL Plus	MS	4 ^a	10 ^c	19 ^{bc}	3.17	3.93**	19
Hammer CL Plus	MS	16 ^b	31 ^b	10 ^{ab}	2.88	3.74**	23
Scepter	MSS	50 ^d	89 ^d	23 ^c	2.02	3.33**	39
Calibre	S	32 ^c	89 ^d	72 ^d	1.81	3.62**	50
P		<0.001	<0.001	<0.001			
LSD (0.05)		8.0	8.4	11.1			
CV%		35.5	15.7	42.3			

[#]Within column, means with one letter in common are not significant: ** = statistically significant at 5% LSD.

^AHollaway and McLean (2022) Cereal Disease Guide 2022. Agriculture Victoria. ^BDate of assessment made and Zadoks growth stages Z51, Ear emergence; Z75, Milk development according to Zadoks et al. (1974). ^CMax. disease = Maximum disease treatment; Min. disease = Minimum disease treatment. ^DYield loss % for each variety was presented as percentage yield decrease vs the minimum disease treatment.

Table A2: Grain quality of six wheat varieties with and without stripe rust at Nullawil (BCG), Victoria during 2022

Variety	Stripe rust rating ^A	Protein (%)		Screenings (%)		Test weight (Kg/hL)	
		Max. ^B	Min.	Max.	Min.	Max.	Min.
LRPB Lancer	RMR	12	12 ^{ns}	1.1	0.8**	74.8	76.0 ^{ns}
LRPB Impala	MRMS	11	10*	3.5	1.6**	74.7	77.1**
Razor CL Plus	MS	12	12*	2.3	1.3**	72.7	76.1**
Hammer CL Plus	MS	12	12 ^{ns}	2.3	1.3**	73.6	76.4**
Scepter	MSS	13	12**	3.3	1.6**	65.0	73.0**
Calibre	S	13	12**	4.3	1.6**	61.1	72.4**

** = statistically significant at 5% LSD, * = statistically significant at 10% LSD, ^{ns} = not significant at 5% LSD. ^AHollaway and McLean (2022) Cereal Disease Guide 2022. Agriculture Victoria. ^BMax. disease = Maximum disease treatment; Min. disease = Minimum disease treatment.