YIELD LOSSES FROM NET BLOTCHES IN THE SOUTHERN MALLEE: SERIOUS PROBLEM OR SALES PITCH?

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TAKE HOME MESSAGES

- NFNB (net form of net blotch) and SFNB (spot form of net blotch) developed at low levels due to the dry winter but did not cause yield losses in this trial.
- Applying Systiva® increased yields in RGT Planet but not Spartacus CL however the return on investrment from applying Systiva® on RGT Planet was only $1/ha.
- Applying propiconazole at either GS39 or GS31 and GS39 did not have an effect on yields in this trial.
- Growers should carefully consider the influence of seasonal conditions, variety and crop rotations on disease risk and understand the yield losses needed for an economic return when deciding on fungicide strategies.

BACKGROUND

Coming into a growing season with a full soil moisture profile, an ANZAC day autumn break and an expected La Nina forecast; farmer's expectations for the 2020 season were for well above average yield potentials. A forecast for wetter than average conditions also increased the likelihood of spot form of net blotch (SFNB) and net form of net blotch (NFNB) becoming a problem during the season in susceptible varieties. It was this train of thought that made applying a premium fungicide seed treatment at sowing easy to justify.

The wet winter didn't eventuate – with May, June and July recording Decile 1-2 rainfall, at early tillering to flag emergence – growers were probably more worried about the moisture stress their barley was beginning to show, than the low levels of SFNB that were present. However, a La Nina was still expected to bring a wetter than average spring and the boom was going over the paddock with a broad leaf spray. At this point, growers needed to decide whether a relatively cheap foliar fungicide should be part of the tank mix.

The wet spring did eventuate, with August to October averaging Decile 6 rainfall. While the dry winter had taken the cream off the top of the barley yield potential, yields were well above average at harvest.

So, what was the right disease management strategy for barley in 2020? Did it still pay to use premium products despite the drier than average winter? Or was is better to cut back spending on seed treatments and fungicide applications?

AIM

To investigate the effects of seed treatment and foliar fungicides in controlling foliar barley diseases on yield, quality and returns to provide growers with information to make decisions in a highly variable environment.

PADDOCK DETAILS

Location:	Whirily
Crop year rainfall (Nov-Oct):	386mm
GSR (Apr-Oct):	240mm
Soil type:	Clay
Paddock history:	2019 – Wheat

TRIAL DETAILS

Crop type/s:	RGT Planet and Spartacus CL barley
Treatments:	Refer to Table 1
Target plant density:	130 plants/m^2
Seeding equipment:	Knife points, press wheels, 30cm row spacing
Sowing date:	15 May 2020
Replicates:	Four
Harvest date:	16 November 2020
Trial average yield:	4.3t/ha

TRIAL INPUTS

Fungicide:	Refer to Table 1
Seed treatment:	Refer to Table 1

Trial managed as per best practice.

METHOD

A replicated field trial was sown using a complete randomised block trial design. Grain was treated as per best practice prior to sowing, with Raxil® T applied as a control treatment as it only controls smuts and doesn't control any foliar diseases in barley. Assessments included disease scores of percentage of plot effected, grain yield and quality parameters (protein, test weight, retention and screenings).

Table 1. Treatment outline.

Variety	Seed treatment	Foliar fungicide
RGT Planet Spartacus CL	Raxil® T Systiva®	Nil Propiconazole (250g/L) @ 500mL/ha @ GS39 only Propiconazole (250g/L) @ 300mL/ha @ GS31 and GS39

RESULTS AND INTERPRETATION

Disease levels

There were significant differences in disease levels between treatments, with Systiva® applied treatments having the lowest levels of disease (Figure 1). The disease present was predominately SFNB, with very low levels of NFNB.

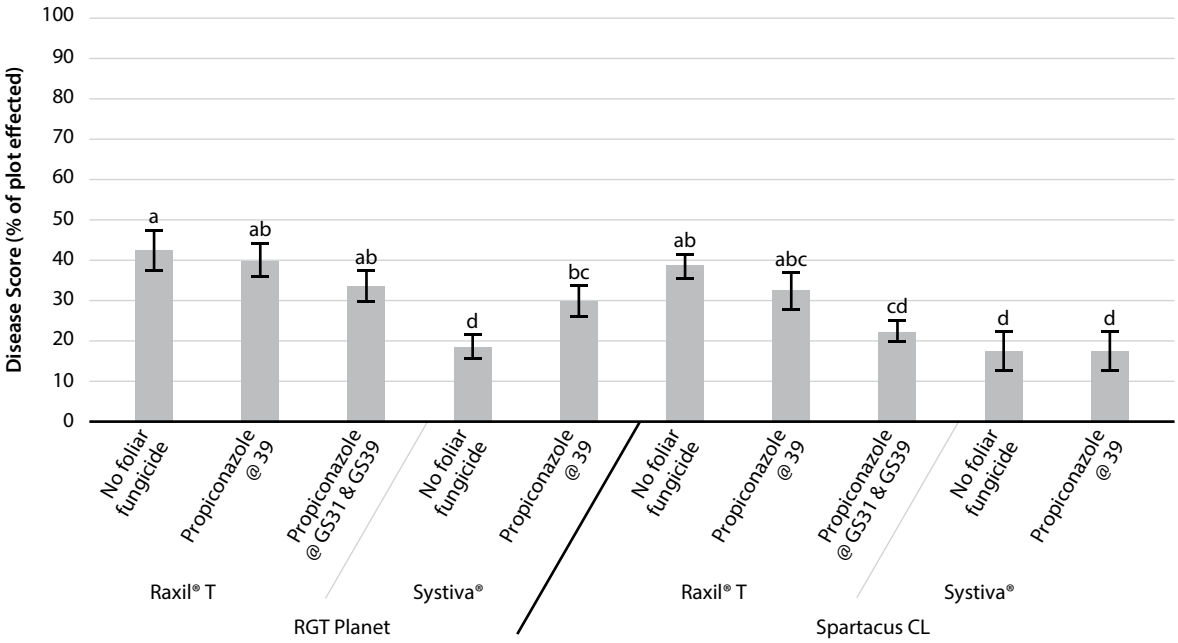

Figure 1. Disease scores conducted using relative visual assessment of percentage of plot effected on 1/10/2020. Variety (p=0.523, LSD=NS, CV=35.5%), Fungicide (p=0.033, LSD=1.00, CV=35.5%). Standard error bars with different letters are significantly different at P=0.05.

While there were significant differences between the disease scores, overall they were quite low with lesions not reaching the flag minus 1 leaf. Although there were early signs of disease, they did not become a problem due to the dry winter conditions.

Yield

There was a significant difference between varieties, with RGT Planet yielding 0.7t/ha more than Spartacus CL across the trial ($p<0.001$, LSD=0.098t/ha, CV=3.5%). This could be due to RGT Planet having a higher genetic yield potential or due to the phenotypic plasticity of RGT Planet reducing the effects of the dry winter compared to Spartacus CL.

Fungicide packages had a significant effect on yield ($p=0.043$, LSD=0.156t/ha,CV=3.5%). In this trial the application of Systiva® increased yields of RGT Planet by 0.2t/ha however application of propiconazole did not. For Spartacus CL, there was no yield benefits from applying either Systiva® or propiconazole.

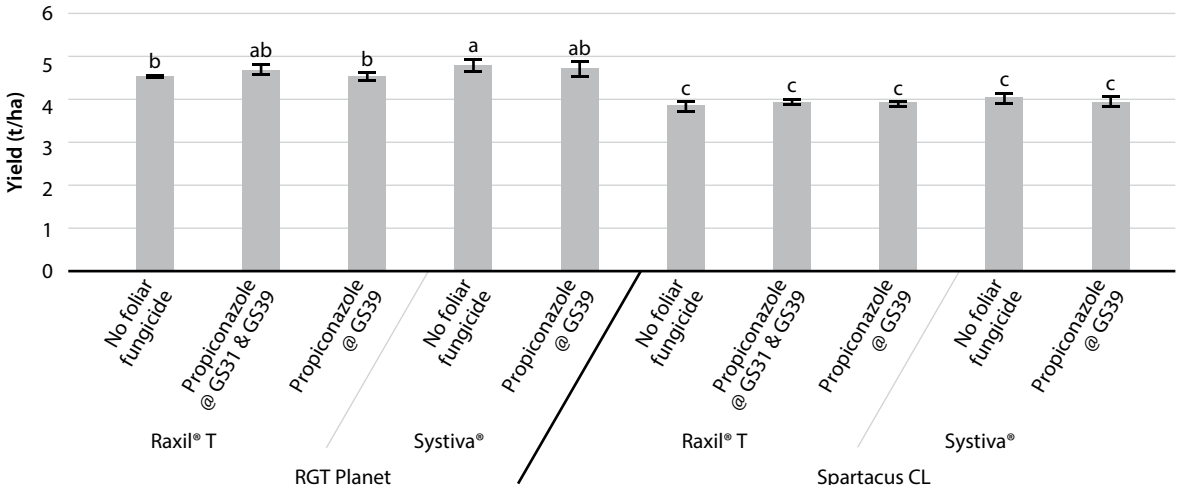

Figure 2. Treatment yields. Variety ($p<0.001$, LSD=0.098t/ha, CV=3.5%), Fungicide ($p=0.043$, LSD=0.16t/ha, CV=3.5%). Standard error bars with different letters are significantly different at P=0.05.

Grain quality

In this trial, Spartacus CL was malt quality, while RGT Planet was BAR1 (FED1), with an average protein of 8.8%. Test weight, retention and screenings for both varieties were well above MALT1 receival standards (70.8kg/hL, 89% retention, 1% screenings). While both variety and fungicide treatment had statistically significant effects on retention and screenings, these were not relevant in a commercial sense.

COMMERCIAL PRACTICE AND ON-FARM PROFITABILITY

The economics of fungicides in this trial

There was little economic return from application of fungicides in this trial. Applying Systiva® to RGT Planet seed provided a return on investment of $1/ha, which covered the cost of the Systiva®($23.86/ha) and made the farmer $1/ha. The return on applying Systiva® on Spartacus CL was lower at 50^{c}/ha. These low returns indicate that farmers could have possibly gained a larger return from spending the same amount on something other than applying Systiva®.

Applying propiconazole did not increase yields and as such it produced a negative return. While propiconazole can be considered a 'cheap insurance' at $5.70/ha, in 2020 a grower paid the premium but did not receive a payout. This demonstrates the value of monitoring for disease during the season and applying fungicides if necessary.

Table 2. Economic return from treatments. Calculated using treatment costs ofPropiconazole= $11.70/L, Contract spraying=$11/ha (SARDI gross margin guide), Systiva®=$36.71/100kg seed, Raxil® T=$2.26/100kg seed (NSW Winter Variety Guide), both varieties sown at 65kg/ha.

	Yield (t/ha)	Income ($/ha)	Treatment Cost ($/ha)[1]	Income after treatment costs ($/ha)	ROI ($/ha)*
RGT Planet Raxil® T (no foliar fungicide)	4.55^{b}	$855.7^{b}	$1.47	$854.2^{ab}	-
RGT Planet Raxil® T + propiconazole @ GS39	4.55^{b}	$855.2^{b}	$18.17	$849^{ab}	-$1.03
RGT Planet Raxil® T + propiconazole @ GS31 + GS39	4.72^{ab}	$887.2^{ab}	$34.87	$842.4^{b}	-$0.1
RGT Planet Systiva® (no foliar fungicide)	4.80^{a}	$903.3^{a}	$23.86	$887.5^{a}	$0.99
RGT Planet Systiva® 2 + propiconazole @ GS39	4.73^{ab}	$888.6^{ab}	$40.56	$848.0^{ab}	-$0.19
Spartacus CL Raxil® T (no foliar fungicide)	3.85^{c}	$724.1^{c}	$1.47	$722.6^{c}	
Spartacus CL Raxil® T + propiconazole @ GS39	3.91^{c}	$735.9^{c}	$18.17	$717.7^{c}	-$0.35
Spartacus CL Raxil® T + propiconazole @ GS31 + GS39	3.96^{c}	$745.3^{c}	$34.87	$710.4^{c}	-$0.39
Spartacus CL Systiva® (no foliar fungicide)	4.04^{c}	$759.7^{c}	$23.86	$735.8^{c}	$0.49
Spartacus CL Systiva® + propiconazole @ GS39	3.97^{c}	$746.6^{c}	$40.56	$706.1^{c}	-$0.44
Sig. diff.					
Variety	**<0.001**	**<0.001**		**<0.001**	
Fungicide	**0.043**	**0.043**		**0.118**	
Variety*Fungicide	**0.937**	**0.937**		**0.937**	
LSD(P=0.05)					
Variety	**0.0988**	**18.57**		**18.57**	
Fungicide	**0.1562**	**29.36**		**NS**	
Variety*Fungicide	**NS**	**NS**		**NS**	
CV%	**3.5%**	**3.5%**		**3.6%**	

*Compared to Raxil® T (no foliar fungicide) treatment of the same variety

Applying Systiva® did not provide a large return to growers in 2020. This was due to the small yield losses from disease due to the dry winter and low barley prices. However, Systiva® can be a valuable tool to maximise returns by preventing yield losses from NFNB and SFNB, especially where yield potentials and disease risk are high. Table 3 shows the breakeven point of applying Systiva® to help growers decide if they are likely to cover the costs of Systiva® in their environment.

Table 3. Break-even point of applying Systiva®. Showing the yield gain (t/ha) from preventing a yield loss from disease (%) of a yield potential (t/ha) by applying Systiva®. Calculated with Systiva® at $36.71/100kg (NSW Winter Crop Variety guide) with the crop being sown at 65kg/ha, resulting in a cost of $23.68/ha. Cost of applying Systiva® not included assuming that growers would apply a seed treatment for smuts and bunts.

		Yield potential (t/ha)											
		1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5
Yield loss prevented by applying Systiva (%)	1	0.01	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.05	0.06	0.06	0.07
	2.5	0.03	0.04	0.05	0.06	0.08	0.09	0.10	0.11	0.13	0.14	0.15	0.16
	5	0.05	0.08	0.10	0.13	0.15	0.18	0.20	0.23	0.25	0.28	0.30	0.33
	7.5	0.08	0.11	0.15	0.19	0.23	0.26	0.30	0.34	0.38	0.41	0.45	0.49
	10	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65
	12.5	0.13	0.19	0.25	0.31	0.38	0.44	0.50	0.56	0.63	0.69	0.75	0.81
	15	0.15	0.23	0.30	0.38	0.45	0.53	0.60	0.68	0.75	0.83	0.90	0.98
	17.5	0.18	0.26	0.35	0.44	0.53	0.61	0.70	0.79	0.88	0.96	1.05	1.14
	20	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00	1.10	1.20	1.30

Doesn't cover costs $100/t $150/t $200/t $250/t

Estimating yield losses from foliar diseases can be difficult, as they vary with seasonal conditions, variety disease reactions, yield potential and inoculum levels. Table 4 is a summary of the yield losses from foliar diseases in the Southern Mallee from trials conducted by Agriculture Victoria, undertaken by Dr Mark McLean and Dr Grant Holloway. It is worth noting these trials were conducted with the disease treatment being a 'worst-case' scenario, similar to a barley-on-barley rotation with no fungicides (either seed treatments or foliar) applied.

Table 4. Yield losses from SFNB and NFNB from trials around Birchip from 2016-2020.

Year	Location	GSR (mm)	Variety	NFNB Rating	SFNB Rating	NFNB LAA% @ GS85	SFNB LAA% @ GS85	Disease yield[1] (t/ha)	Full fungicide yield[2] (t/ha)	Yield Loss (%)
2020[a]	Curyo	240mm	RGT Planet	SVS	S	5.3%	19%	5.2	6.5	20%*
2020[a]	Curyo	240mm	Maximus CL	MS	MRMS	0.3%	0%	5.6	6.2	10%*
2019[b]	Karyrie	197mm	RGT Planet	SVS	S	11%	10%	6.5	6.7	3%
2019[b]	Karyrie	197mm	Spartacus CL	SVS	MSS	1%	10%	6.2	6.4	3%
2018[c]	Sunnyside	137mm	RGT Planet	SVS	S	<5%	-	0.44	0.46	0%
2017[d]	Curyo	215mm	Rosalind	S	MR	-	12%	5.6	6.2[3]	10%
2016[e]	Curyo	354mm	Rosalind	S	MR	-	15%	5.7	4.6[3]	20%

1. Plots spread with barley stubble, Proguard®T treatment (smuts only), no foliar fungicide

2. Plots not spread with stubble, Systiva® applied, Prosaro® applied at GS31 and GS39

3. These plots were spread with barely stubble

*95% Sig. diff.

Reference: a. McLean & Murray 2020; b. McLean & Murray 2019; c. McLean & Murray 2018; d. McLean & Murray 2017; e. McLean & Murray 2016.

PLANNING DISEASE CONTROL IN 2021: KNOW YOUR RISK OF YIELD LOSSES

Rotation

If barley plays a large role in your rotation, it may be worth taking a more proactive approach to disease management. A common source of scald, NFNB and SFNB inoculum is barley stubble and spores can be produced for more than two years from remaining stubble. If barley stubble is present, or if barley is being grown more than once every four years, the chances of yield losses are increased and should be managed as such. Barley-on-barley rotations are a high risk for yield losses from disease and should be avoided.

Variety selection

The variety you are growing will also influence the likelihood of yield losses occurring if conditions for disease eventuate. Varieties with stronger disease packages, such as Scope CL, are less likely to have yield losses from foliar diseases than those with weaker disease packages, such as RGT Planet.

Previous work conducted by Agriculture Victoria has suggested that NFNB should be managed in barley varieties rated S, SVS and VS in all environments where yield potential is greater than 5t/ha (McLean and Murray 2019). Growing varieties with a rating of MSS or better will prevent losses from NFNB in most cases.

When growing varieties with S, SVS and VS ratings in the Southern Mallee, such as RGT Planet, the need for seed treatments and foliar fungicides to control NFNB should be considered when yield potential is greater than 5t/ha, such as when there if a full profile of moisture at sowing.

If growing varieties with disease ratings of R, RMR, MRMS or MSS, such as Scope CL and Compass, the need to manage for NFNB with seed treatments and foliar fungicides is reduced due to the variety's resistance. A new NFNB pathotype that can cause major damage in Spartacus CL was seen around Birchip in 2019, which may mean that Spartacus CL may require fungicide for NFNB despite its MSS rating.

SFNB can commonly cause losses where susceptible (S) or worse rated varieties are grown such as RGT Planet and Spartacus CL, where there is wet weather during late winter to early spring and grain yield potential is greater than 3t/ha (McLean and Murray 2020).

Table 5 indicates the different disease ratings for commonly grown varieties in the Southern Mallee to show which varieties have a greater chance of yield losses.

Table 5. Disease ratings of commonly grown barley varieties in the Southern Mallee, as taken from the Cereal Disease Guide 2020. Resistant (R) < Resistant to moderately resistant (RMR) < Moderately resistant (MR) < Moderately resistant to moderately susceptible (MRMS) < Moderately susceptible (MS) < Moderately susceptible to susceptible (MSS) < Susceptible (S) < Susceptible to very susceptible (SVS) < Very susceptible (VS).

	SFNB	NFNB
Beast	MSS	MS
Compass	MS	MSS
Hindmarsh	SVS	MS
Leabrook	MS	MRMS
Maximus CL	MS	MRMS
RGT Planet	S	SVS
Scope CL	MSS	MR
Spartacus CL	SVS	MSS

Seasonal forecast and weather conditions

As seen in this trial, disease prevalence and consequent yield losses highly depend on the seasonal conditions being conducive to disease and inoculum present. The 5% yield difference in RGT Planet from the highest yielding treatment to the lowest yielding treatment could have been bigger had there been a wetter winter or closer barley rotation.

The conditions that are conducive to SFNB and NFNB are outlined below (Table 6). In 2020 the trial site only experienced one event longer than 6 hours with 95-100% humidity and temperature between 10-25°C. In years when these conditions occur more frequently, yield losses are more likely.

Table 6. Conditions that favour SFNB and NFNB (Hollaway and McLean 2020, Field Crop Diseases Victoria 2020).

	SFNB	NFNB
Lower leaves become infected (primary infection) autumn and early winter	Temperatures between 10-22°C and moist for 6+ hours	Moist conditions with temperatures below 25°C (most rapid between20-25°C)
Conditions needed for movement up plant	Rain splash and wind	Rain splash and wind
Upper leaves become infected (secondary infection) – late winter and spring	High humidity and mild temperatures	8-25°C at 95-100% humidity for 10+ hours

Yield potential

In the southern Mallee, years that are wetter have higher disease risks but also have higher yield potential Meaning: in the years where yields are high, you subsequently have a greater amount to lose.

Previous research conducted by Agriculture Victoria suggests controlling for NFNB when yield potential is greater than 5t/ha, or when yield potential is between 3-5t/ha in wet spring conditions. Yield losses from NFNB are unlikely when a crop yields less than 3t/ha and there are dry spring conditions (McLean and Murray 2019). Agriculture Victoria research also shows that yield losses from SFNB is unlikely when yield is less than 2.5t/ha (McLean, Murray and Browne 2015).

Logistical decisions

When considering your disease management package, it is important to consider what fits best logistically with the rest of your program. Applying Systiva® provides protection against SFNB and NFNB until head emergence, which reduces the need to monitor for disease.

If you decide to use a lesser seed treatment you will need to monitor for disease from late tillering to flag leaf emergence, to decide if disease levels justify a foliar fungicide.

Applying a foliar fungicide could form part of a tank mix for a broadleaf spray when the boom is going over, depending on timing and compatibility, minimising the cost of application. However, in a wet year it might be difficult to get onto paddocks to spray or competing priorities, such as urea applications, may take precedence.

Fungicide stewardship

There have been confirmed cases of NFNB resistance to fluxapyroxad and NFNB and SFNB resistance to triazoles in Australia. It is important that growers demonstrate good chemical stewardship to prevent resistance levels from increasing by ensuring Systiva® is used correctly and applied at label rate with good seed covering.

While propiconazole is quite cheap compared to other foliar fungicides, it is important to ensure that we are good stewards of the chemistry to ensure that we slow the rate of fungicide resistance to preserve modes of action for as long as possible. It is recommended that no Group 3 fungicides should be applied twice in a row. While this was done in this trial, it is not a recommended practice.

BRINGING IT ALL TOGETHER FOR 2021

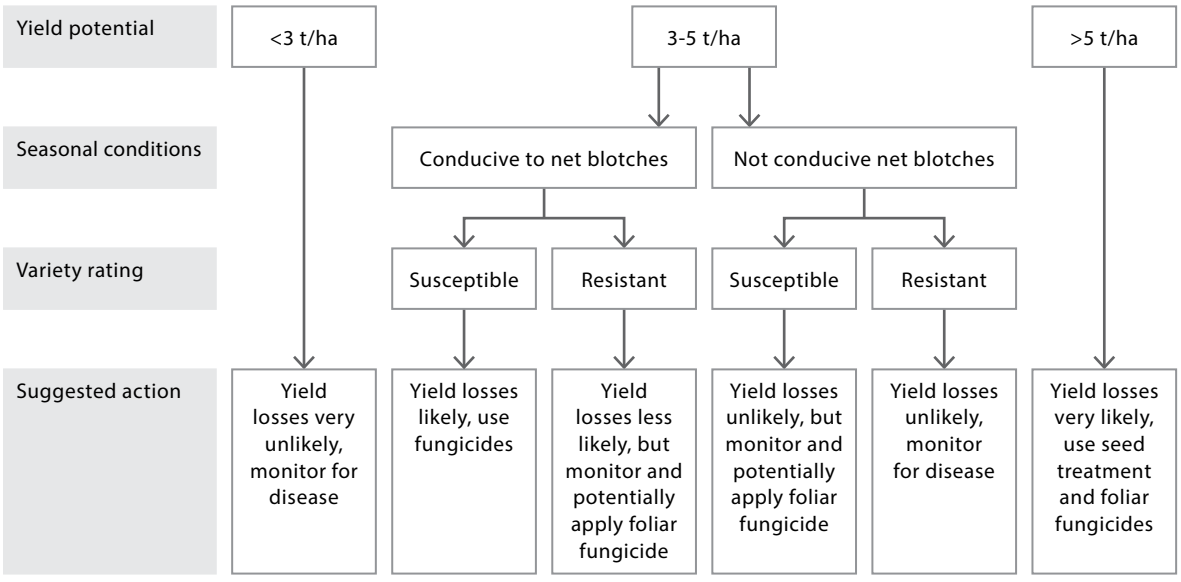

Figure 3. Decision tree for the likelihood of yield losses from SFNB and NFNB (McLean and Murray 2020; McLean and Murray 2019; McLean, Murray and Browne 2015).

Managing SFNB and NFNB in barley in the southern Mallee is difficult, as often yield potentials fall in the 3-5t/ha middle zone. It is important to understand these risk factors, combined with the seasonal conditions, to understand if controlling foliar diseases in barley in the southern Mallee is likely to lead to an economic benefit. If your yield potential is greater than 3t/ha or if a wetter than average season is forecast, controlling for SFNB and NFNB is more likely to provide an economic benefit. If your yield potential is less than 3t/ha, SFNB and NFNB in barley isn't likely to cause economic losses but listening to sales pitches for fungicides could.

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