IS THERE ANYTHING TO BE GAINED IN SPRAYING SCOPE CL FOR SFNB?

Simon Craig (BCG) and Mark McLean (DEPI)

TAKE HOME MESSAGES

- Yield loss of 0.1-0.5t/ha was observed in some SFNB susceptible varieties at Horsham that had two fungicide applications.
- The Quambatook site suffered significant yield loss but this was due to a combination of SFNB and an additional factor (possibly crown rot).
- It is unlikely that a single application of foliar fungicide would have provided effective control of SFNB and prevented yield loss if applied after GS39 or to MS or better rated varieties.

KEY WORDS

Barley, crown rot, disease, fungicides, SFNB, spot form of net blotch, varietal tolerance.

BACKGROUND

During the 2013 season, there was some concern about higher than normal levels of spot form of net blotch (SFNB) in Scope CL barley. Scope, a derivative of Buloke that is tolerant to Clearfield (imidazolinones) herbicides, was widely grown in 2013 due to the previous dry spring/summer and subsequent plantback issues, particularly to the group B herbicides. Scope CL has some susceptibility (MS) to SFNB and, to date, there has been very little evidence to suggest it is worthwhile spraying for SFNB in the Mallee.

Since the 2010 season, stubble retained systems have encountered stubble-borne diseases such as yellow leaf spot (YLS) in wheat and SFNB in barley. These diseases are moving further up the canopy and placing crops under greater pressure than previously observed. This had some growers and advisors concerned that yield was being affected and they wished to know whether these diseases warrant control in some varieties.

Within the GRDC-funded project 'Barley agronomy for Southern Australia', the tolerance of new barley varieties (including Scope) to SFNB, scald and leaf rust has been on-going since 2010. These trials provide a useful screen of newer varieties to identify any serious management problems or implications as they come to market. Last season they found that each variety reacted relative to its disease rating.

Each disease affects the crop to different degrees, with scald and leaf rust previously shown to significantly reduce yields (>20% yield loss, depending on the variety). The effect of SFNB, on the other hand, particularly in the lower yielding environments, has usually been insignificant, provided that other factors such as weeds and root diseases are not present to compromise the validity of the trial.

AIM

To determine the varietal tolerance of new and current barley varieties to foliar diseases (leaf rust, scald and SFNB).

METHOD

Location: Quambatook and Horsham
Replicates: Four
Target plant density: 130 plants/m^2

The trial used a split-plot design in which the fungicide treatments were randomly allocated as main plots, with varieties randomised within each main plot (sub-plots).

Table 1. Main plot treatments applied to the individual varieties.

Treatment	Description
Fungicide	Plots were kept disease free during the season with Prosaro® (150ml/ha) + BS1000 (0.25% v/v). Jockey (4L/t) was applied to the seed prior to sowing.
No fungicide	No fungicides were applied to these plots during the growing season.

Raxil was applied to all plots to control smuts and bunts.

Commander barley straw infected with SFNB, NFNB and scald was spread over the plots after sowing to ensure there was a level of inoculum at the site. Barley stubble infected with SFNB was also present at the site.

Table 2. Trial details.

Site	Quambatook	Horsham
Soil type	clay loam	clay (black)
Previous crop	chemical fallow	wheat
Sowing date	14 May	9 May
Emergence date	2 June	1 June
GSR (mm)	176	341
Varieties	Hindmarsh, Skipper, Fathom, Scope, Wimmera, La Trobe, Navigator, Bass Commander, GrangeR, Gairdner, Compass, SY Rattler	Hindmarsh, Skipper, Fathom, Scope, Wimmera, La Trobe, Navigator, Commander, Bass, GrangeR, Gairdner, Flinders, Fleet, Westminster, Oxford, Fairview, SY Rattler
Fertiliser (per ha)	23/5 Supreme Z @ 55kg 17/7 Urea @ 90kg	9/5 MAP @ 55kg 2/7 Urea @ 90kg 13/8 Urea @ 90kg
Herbicides (per ha)	2/5 Triflur X @ 2L Avadex @ 2L 24/7 Velocity @ 670ml LVE @ 350ml Lontrel @ 200ml Hasten @ 0.5% 1/8 Axial @ 200ml Adigor @ 0.5%	9/5 Triflur X @ 2L Avadex Xtra @ 2L 24/7 Velocity @ 670ml LVE @ 330ml Lontrel @ 170ml Hasten @ 0.5%

Site	Quambatook		Horsham	
Fungicides (per ha)	14/5	Jockey @ 4L/t (seed)*	9/5	Jockey @ 4L/t (seed)*
	24/7	Prosaro @ 150ml*	15/8	Prosaro @ 150ml*
		BS1000 @ 0.25% v/v		BS1000 @ 0.25% v/v
	27/8	Prosaro @ 150ml*	2/9	Prosaro @ 150ml*
		BS1000 @ 0.25 %v/v		BS1000 @ 0.25 % v/v
	19/9	Prosaro @ 150ml*		
		BS1000 @ 0.25% v/v		

* Fungicide applications only were applied to 'Fungicide' plots only.

Note: The number of Prosaro applications used in this trial exceeds the maximum label rate of only two applications. The third application was applied to prevent any late infection and to keep the fungicide product constant.

Disease ratings for the barley varieties in this trial can be referred to pp. 49.

Both trials were assessed by DEPI disease pathologists (Drs Mark McLean and Grant Hollaway) during the season. Disease incidence and severity were visually assessed for per cent leaf area affected (%LAA) by disease at GS31-33 (stem elongation, Quambatook only), GS55-65 (head emergence to flowering) and GS75-85 (grain filling). These assessments were used to quantify the differences in the levels of disease observed between the varieties.

Plots were harvested with a Kingaroy plot harvester and protein was measured using a Foss Infratec NIR whole grain analyser. Yields were corrected to 11% moisture. All other quality parameters (test weight and screenings) were also measured with standard procedures.

RESULTS AND INTERPRETATION

Mallee (Quambatook)

Fungicide application was found to reduce the level of SFNB severity across the trial and within varieties, to increase grain yield and to reduce screenings (Table 4).

Table 3. Average difference between disease severity and grain yield and quality of fungicide and no fungicide treatments at Quambatook.

Treatment	SFNB severity (% LAA)	Grain yield (t/ha)	Grain protein (%)	Retention (%)	Screenings (%)	Test weight (kg/hl)
Fungicides	5	4.37	14.2	76	4.4	67
No fungicides	15	3.72	13.4	62	10.1	65
Sig. diff.	P<0.001	P<0.001	P<0.001	P<0.001	P<0.001	P<0.001
LSD (P=0.05)	1	0.53	0.8	4	1.3	1
CV%	26.3	9.2	5.8	13.5	46.8	2.9

It could easily be thought that the level of SFNB severity in the unsprayed plots led to the difference in grain yield and quality (Table 3). Based on the severity scores taken during the season, it was clear that SFNB susceptible varieties had a higher level of infection (Figure 1). While the differences were not evident earlier in the season (August), they became more apparent at head emergence/grain filling (September-October).

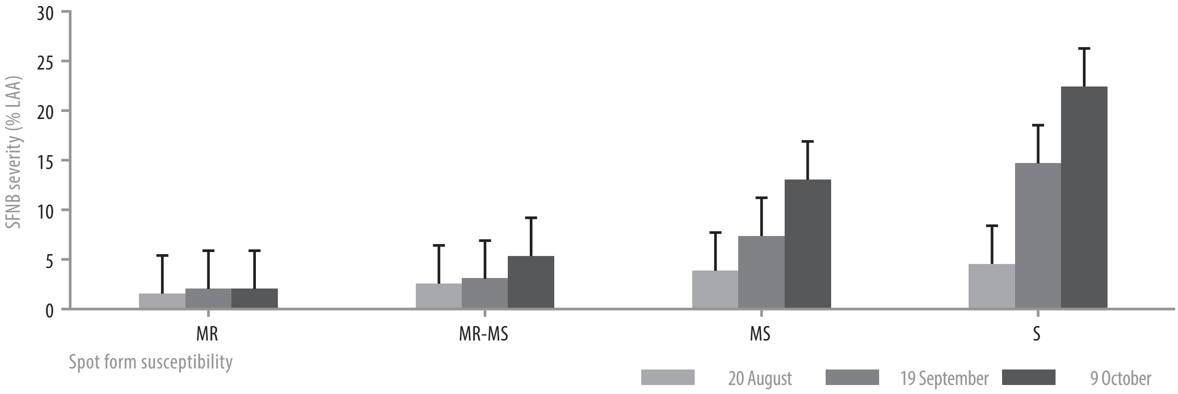

Figure 1. SFNB severity on percent leaf area affected (% LAA) at three timings during the season (rating P<0.001, timing P<0.001; timing x rating P<0.001, LSD=3.9%, CV40%).

As expected, differences between individual varieties for SFNB were also found. Susceptible varieties (SY Rattler, Hindmarsh, La Trobe and GrangeR) had significantly higher levels than the rest of the varieties, which all behaved as their official disease rating would suggest. Scope CL had the lowest SFNB infection of the MS rated varieties and was unlikely to have achieved yield improvements from SFNB control.

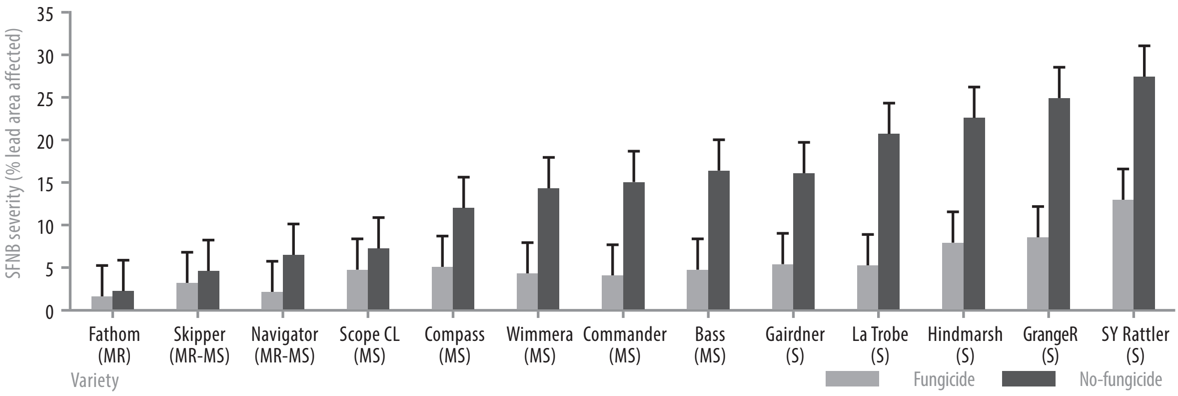

Figure 2. SFNB severity (expressed as a % of leaf area affected) for each of the varieties in October. Brackets denote the variety's current SFNB ratings.

In terms of grain yield, SFNB accounted for 60% of the variation according to multiple regression analysis (data not shown). However, Fathom (MR), which had the least amount of SFNB, suffered a 0.66t/ha yield loss (Figure 3). The heavily infected Hindmarsh (S) suffered only a 0.48t/ha loss. This suggests that another unknown factor had a significant effect (0.4-0.7t/ha) across all the varieties yield loss. This makes it difficult to accurately determine the yield loss as a result of SFNB.

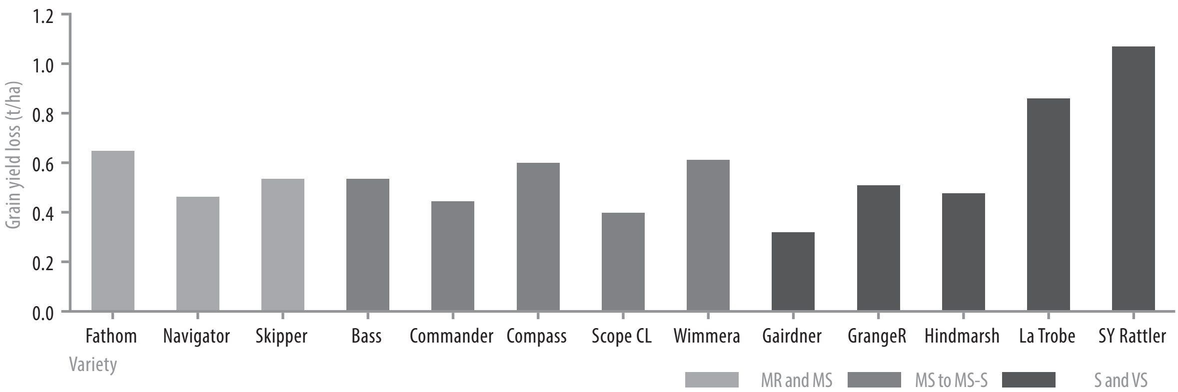

Figure 3. Grain yield loss (difference between sprayed and unsprayed) of individual varieties. Bars of different colour indicate different levels of resistance to SFNB (Not significant, CV68%).

Table 4. Difference between unsprayed and sprayed in grain yield at Quambatook.

Variety	Yield (t/ha)			Yield loss (%)
	Fungicide	No fungicide	Difference	
SY Rattler (S)	4.45	3.38	1.08	24
La Trobe (S)	4.93	4.07	0.86	17
Wimmera (MS-S)	3.59	2.96	0.63	17
GrangeR (S)	3.86	3.35	0.51	13
Fathom (MR)	5.1	4.44	0.66	13
Bass (MS-S)	4.14	3.61	0.53	13
Navigator (MR-MS)	4.06	3.59	0.47	12
Compass (MS)	5.24	4.63	0.6	12
Skipper (MR-MS)	4.87	4.32	0.55	11
Commander (MS)	4.32	3.84	0.47	11
Scope CL (MS)	4.07	3.67	0.4	10
Hindmarsh (S)	4.9	4.42	0.48	10
Gairdner (S)	3.43	3.1	0.33	10
Sig. diff.				
Variety	P<0.001		NS	NS
Fungicide	P<0.001			
Variety x fungicide	NS			
LSD (P=0.05)				
Variety	0.37			
Fungicide	0.15			
Variety x fungicide	-			
CV%	9.3			

The addition of fungicide did improve the lodging of the crop slightly. Lodging, unsurprisingly, was most evident in those varieties that were prone to it (Scope CL and Skipper). The amount of lodging was nevertheless insignificant (5-10% leaning, not properly lodged) and unlikely to have any impact on yield. SFNB infects the leaf sheaths, (the parts of the leaves that wrap around the stem below that specific leaf). SFNB infections on the leaf sheath weaken the straw strength of the plant and increase its likelihood to lodge. If harvest were delayed, the degree of lodging may have been higher, which would have resulted in some yield loss.

Though not measured in this trial, the adjacent 'wheat variety x disease' trial (data not presented) had a high level of crown rot (CR) infection (20-25% dead heads). Differences were observed between varieties, with earlier varieties (Emu Rock, Corack and Mace) less affected than later maturing varieties (Phantom, Scout, and Yitpi). Barley has always been thought to have escaped significant yield losses from CR compared to wheat because it reaches its physical maturity much earlier. Unlike wheat, in which the symptoms of CR are typically identifiable in the form of 'dead heads', the effects in barley may be seen more in the reduction in grain weight and size, as was found in this trial (Table 4). The reduction in test weight, retention and elevated screenings suggests that grain size was affected. CR is a disease that specifically affects cereals. It blocks the translocation of moisture and nutrients to the head during grain filling; typically tillers are affected more so than the main stem.

Controlling CR is typically achieved through crop rotations: growing crops that do not host or increase levels of the disease in the next season (e.g. canola or vetch). There have been trials that have found the fungicide product used in this trial (Prosaro®) has some activity on crown rot, and results such as these have been seen before. It appears that when Prosaro® is regularly applied (>3 applications), levels of CR can be reduced. However, results can be inconsistent across seasons. Applying more than two applications of Prosaro is not registered and may result in Maximum Residue Limit (MRL) levels being exceeded. It is plausible that the fungicide did reduce the level of CR infection across all the varieties, which would explain the results of this trial. However, confirmation and further investigation is required. There was no other foliar disease present at the site throughout the season.

A proportion of crop residue (stubble and roots) was collected from individual plots for further analysis to determine whether CR levels were higher in some plots than others. This would go some way towards explaining some of the yield differences which were not consistent with the SFNB severity. These results were not available at the time of writing and will be presented at a later date.

Horsham

A moderate level of SFNB infection was observed across the trial. The addition of the fungicide significantly reduced the average level of infection from 12% to 3%. However, there was no statistical difference as a result in grain yield or any of the grain quality parameters.

Table 5. SFNB severity and grain yield and quality (mean of varieties) at Horsham.

Treatment	SFNB severity (% LAA)	Grain yield (t/ha)	Grain protein (%)	Retention (%)	Screenings (%)	Test weight (kg/hl)
Fungicide	3	5.29	9.0	92	2.4	67
No fungicide	12	5.10	9.1	89	2.8	67
Sig. diff.	**P<0.001**	**NS**	**NS**	**NS**	**NS**	**NS**
LSD (P=0.05)	**3**	**–**	**–**	**–**	**–**	**–**
CV%	**25.7**	**6.8**	**8.6**	**3.7**	**38.5**	**1.5**

The level of infection within each of the varieties corresponded well to their disease rating (Figure 4). Notably, Gairdner at both sites had the lowest infection rate among the susceptible varieties, almost to the point that its levels were significantly lower than all varieties. This indicates that the pathogen population of SFNB is changing in response to the dominant varieties being grown; that virulence in Hindmarsh is now more common; and that Gairdner has better resistance than its rating suggests. Consistent with the Quambatook findings, resistant varieties (Fathom and Fleet) were the least infected. Although not presented in Figure 4, the addition of the fungicide reduced the level of infection in that all varieties had less than 5% infection.

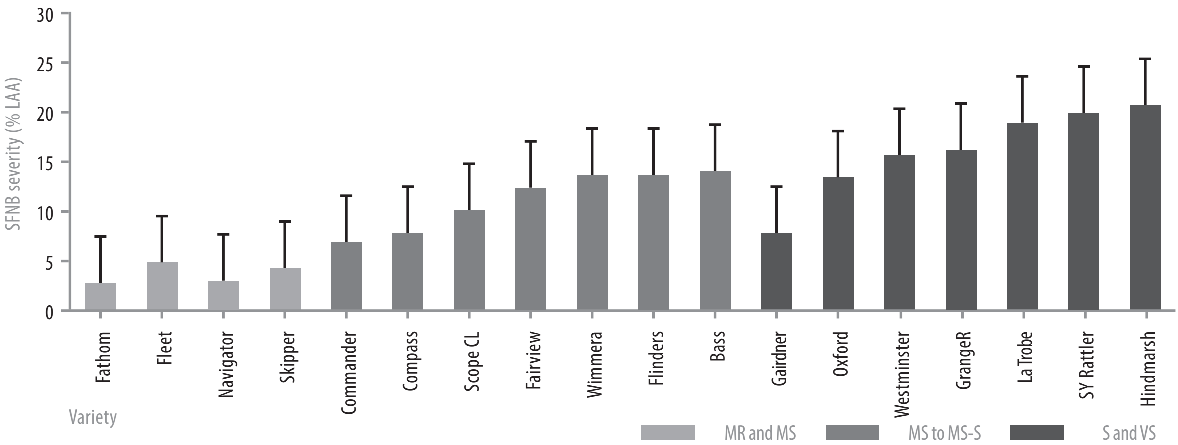

Figure 4. SFNB severity on percent leaf area affected (% LAA) at Horsham (var P<0.001, fungicide P<0.001, var x fung P<0.001, LSD=4.7%, CV39%). LSD used in graph is located on the two way interaction - LSD=4.7%.

Figure 5 shows the yields of the different varieties with and without fungicide. The only significant difference found was between the yields of the varieties (mean of treatments). Though there was no significant treatment found in this analysis, further analysis (linear regression) significantly attributed yield loss of 0.1-0.5t/ha in susceptible varieties (DEPI analysis) which is consistent with other studies over 10 years in medium to high rainfall environments. Controlling SFNB with regular foliar fungicide application, particularly Prosaro, is generally economical only in high disease pressure situations in very susceptible varieties, and only when applied during the stem elongation to flag emergence period. Fungicides applied later than flag emergence are unlikely to improve either in grain yield or quality. It should be noted that there was very little scald or other disease found in this trial. The presence of those diseases can lead to significant yield losses and would definitely warrant application of fungicide for control.

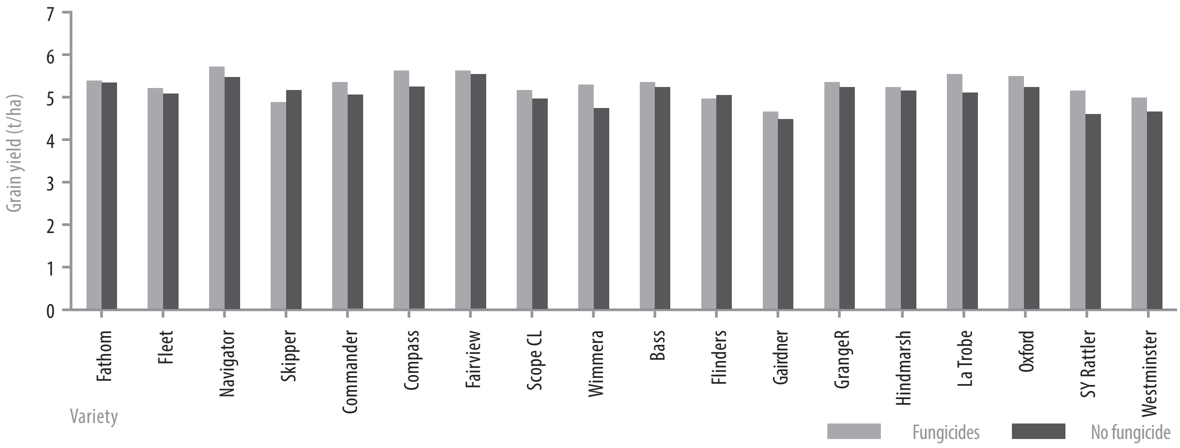

Figure 5: Grain yields for each of the varieties in fungicides and no fungicides plots (yields not significantly different between treatments : variety $P<0.001$, treatment NS; var x treatment NS).

Lodging was again worse in those varieties prone to lodging (Scope, Skipper, Fathom and Compass), though there was not a clear difference between the plots that were sprayed with fungicide and those that weren't. Very low levels of NFNB and scald were found in some varieties at the site during the season, however it is unlikely that yield was affected at those levels.

COMMERCIAL PRACTICE

The grain yield and quality benefits from spraying fungicide at Quambatook were unlikely to be due to SFNB control alone. A potential confounding effect of another disease, believed to be crown rot, may explain some of the losses found in resistant varieties, but confirmation is still pending. The SFNB levels at the Horsham site correlated well with the varieties' disease ratings and in the absence of other confounding diseases, the effect on yield was judged to be more attributable to SFNB. Benefits for controlling SFNB are most likely observed in wetter environments where the disease progression through the canopy would be greater. In the Mallee, losses to SFNB are expected to be much lower and generally not economic to control.

All diseases can affect crops to different degrees, and can in some seasons be worse than others. This trial supports previous studies, particularly in the Mallee, which found that applying a fungicide to control SFNB is more cosmetic than profitable, unless there is another disease present. The trial also confirms that Scope CL is not any worse than its rating would suggest. There was also, no reason for concern about changes in behaviour or tolerance to SFNB, with the exception that Gairdner's resistance may be improving as the area sown is reducing.

To minimise the potential impact of SFNB, choose varieties based on their level of resistance and avoid sowing barley on barley stubble.

ACKNOWLEDGMENTS

This trial was funded by GRDC through the 'Barley agronomy in the southern Australia 2013-2018' (Project code: DAN00173).

The trial was conducted in collaboration with Department of Environment and Primary Industries.